



## **Oral History of Herb Schorr**

Interviewed by:  
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**Burton Grad:** Today is May 16, 2018. My name is Burton Grad. I am with the Software Industry Special Interest Group. I'm conducting an oral history interview of Herb Schorr. This is part of the ongoing Oral History program of the Software Industry Special Interest Group, which is part of the Computer History Museum in Mountain View, California. We are here at the Computer History Museum in Mountain View, California. This interview is being videotaped and recorded. It will be transcribed, edited and posted on the Computer History Museum website. Herb, let's get started. We usually start these with when you were born. Where and when were you born?

### **High School Education**

**Herb Schorr:** I was born in the Bronx of New York City, the borough thereof, on January 20, 1936.

**Grad:** Did you grow up there in the Bronx, or did you move?

**Schorr:** No. I grew up in the Bronx. I went to the Bronx High School of Science.

**Grad:** That's a magnificent place to be. Did you have a particular area of specialty or something you were focused on when you were there at your high school?

**Schorr:** Not really. I was actually an excellent economist or economics student, and I might well have gone into that except the professor of economics wasn't able to get a job during the Depression, so he advised me to stay away from the economics profession.

**Grad:** Oh, is this at college, or was this high school?

**Schorr:** High school.

**Grad:** Really? So, you had people of that caliber teaching there at Bronx High School of Science?

**Schorr:** Oh, yes. The head of the Math Department had been a professor, head of the Math Department in Budapest, one of the major universities. He was a Second World War refugee. There's a lot of people available because of the war and the Depression, so Bronx High School of Science was able to recruit the best out of the public-school system.

**Grad:** That was one of I think three or four of these special high schools in New York, and everything I've heard about the quality of the education was pretty good. Did you feel that when you were taking it, going there?

**Schorr:** Pretty much. It still is very good, by the way.

**Grad:** I'm sure it is. Did you have any special hobbies or things that you did while you were in high school, things that really took your time and interest?

**Schorr:** Hobbies were stamp collecting and electronics.

**Grad:** What were you doing in electronics that early?

**Schorr:** Making radios. It was radio technology. I used to go down to Canal Street, which had all sorts of electronics stores. You can buy all sorts of parts there. I took the subway for five cents. That's all it cost for a ride, and we didn't even think about safety.

**Grad:** Were you building your own radio sets?

**Schorr:** Yes.

**Grad:** Were they for just local stuff, or were you trying to pick up distant stations? What were you doing?

**Schorr:** No, just local stuff. Just trying, learning about it, building my own.

**Grad:** Was there a particular person, other than your economics professor, who said, "Don't go into economics." Were there other professors, teachers at that time, that you were particularly impressed with or subjects that turned you on?

**Schorr:** Well, I was an excellent math student. I was an excellent math, science, economics student and a lousy English major and language major. I had a very spotted high school record of A's and C's.

**Grad:** I see. Nice mixture of those things. Any other special experiences? What did your father, what did your mother do?

**Schorr:** My mother eventually was a homemaker, and then she went to work in a candy store as a sales clerk because we needed the income. My father was in the garment industry, hats, and that was a very spotty job. He would work for a bunch of months, and then they would lay him off and so on.

**Grad:** Was he one of those people affected by the chemicals that were used in making the hats, or was it not an issue then?

**Schorr:** I don't think so. He lived until almost 90.

**Grad:** Because the Mad Hatter was in the *Alice in Wonderland*...

**Schorr:** No. I think that was gone by then.

**Grad:** Okay, great. Anything else from high school? Any particular clubs or other outside activities? Sports? Any of those kinds of things?

**Schorr:** Oh, we did sports, yes. I did sports as well as school orchestra.

**Grad:** What? What did you like particularly?

**Schorr:** We did what was seasonal. In the fall, we played basketball. In the winter, we stayed indoors. In the spring we played baseball, we played football in the fall, and it was mostly just kids from the neighborhood. We just self-organized.

**Grad:** It wasn't a serious kind of thing where you were on the high school teams or anything like that?

**Schorr:** No. I wasn't good enough.

**Grad:** Neither was I.

### **Undergraduate Years**

**Grad:** So, you then go to college. What year? Do you remember what year you started college? How old were you when you started college?

**Schorr:** 1953 I started college.

**Grad:** You were 17 years old.

**Schorr:** Yes.

**Grad:** Where did you go?

**Schorr:** City College of New York.

**Grad:** Okay. What did you major in?

**Schorr:** Electrical engineering.

**Grad:** Why?

**Schorr:** Why? Because I was good in mathematics. I also was interested in earning a living. This was the beginning of the Sputnik era, and there were plentiful jobs in the electronics industry.

**Grad:** It was the electronics connection to your radio thing that may have led you that direction?

**Schorr:** Yes.

**Grad:** You were there four years?

**Schorr:** Yes.

**Grad:** Anything special, particular that you remember enjoying, not enjoying?

**Schorr:** No. It was a good experience.

**Grad:** You were probably a pretty good student.

**Schorr:** Yes. Are you talking about college or high school?

**Grad:** College now.

**Schorr:** Well, in college I was the first in the electrical engineering class. Len Kleinrock was number two.

**Grad:** Quite an experience. Anything special outside of the classes that you did at CCNY? Any clubs, any other organizations, any outside activities?

**Schorr:** Nothing really important. This was a tough game. I used to have sometimes a physics course starting at eight o'clock in the morning at City College, and I had a good 45-minute commute on the subway and walking to get there.

**Grad:** Was CCNY tuition free at that point?

**Schorr:** Yes.

**Grad:** Did you work summers?

**Schorr:** Yes. But I also had a New York State scholarship.

**Grad:** That helped considerably.

**Schorr:** Yes.

**Grad:** Even though you were at CCNY with no tuition, you did get the scholarship money in addition.

**Schorr:** Yes.

**Grad:** How did you get the scholarship? Was it something you had to qualify or take a test for?

**Schorr:** Test. Yes.

**Grad:** Was it a local test there that New York State provided? You graduated then in 1957?

**Schorr:** Yes.

### **Graduate School**

**Grad:** Had you decided at that point what you wanted to do?

**Schorr:** Well, I had decided I would do graduate studies in engineering.

**Grad:** Why? Did you want to teach? There must've been some motivation to do graduate work.

**Schorr:** Motivation. I guess I liked being a student of something. I don't know...

**Grad:** Well, I'm thinking about it from a money standpoint. You had a free ride, and that's at CCNY.

**Schorr:** Had a free ride at Princeton.

**Grad:** Oh. How come?

**Schorr:** They gave me a fellowship the first year, and they kept giving me other money. Some of it was for assistantships in teaching, but it was all free.

**Grad:** Did you intend to teach? Was that why you were going in that direction? I mean, most electrical engineers went out and became engineers.

**Schorr:** I guess I didn't intend to teach, but I wound up seeing what these guys' lives were like, the professors, and decided it was not so bad. I did try my hand at teaching. After I graduated, I first went to Cambridge University in England on an NSF [National Science Foundation] postdoctoral fellowship.

### **First Technical Work Experience**

**Grad:** I can't get a picture of you as a student. Were you strictly just taking your courses? You don't mention any summer work. You don't mention these kinds of things, which many people do.

**Schorr:** Some of the summer work was lifting soda bottles and delivering soda. I worked in a drugstore at a magnificent rate of 40 cents an hour, and that continued in the school year. I worked, but I cut back the hours. Did I do anything technically? I don't think I had a technical job until my senior year.

**Grad:** What was that job?



**Schorr:** I went to work for IT&T Research Labs in Nutley, New Jersey.0

**Grad:** This is your senior year at CCNY?

**Schorr:** Yes. I had graduated, and they gave me a job. It was interesting. I must've had a management gene somewhere. By the end of the summer, I had 10 people working for me at IT&T, including several full-time employees.

**Grad:** You were 21 or 22 at that point in time?

**Schorr:** Yes.

**Grad:** Ah, interesting. None of the jobs you had were really things other than just things that kids get to do. Nothing special because of your electronics or your radio skills or any of that kind of thing.

**Schorr:** No. It was a different environment. You were lucky to make a buck, much less get something good. I didn't get something really interesting, as I said, until senior year.

**Grad:** Did that work at IT&T motivate you in any particular direction?

**Schorr:** Ah, yes. IT&T had me building a digital pulse generator, because you couldn't buy it off the shelf. I did that and supervised it, so when I got to Princeton, they decided that I should take a course on digital circuits and technology and switching theory, as it was called.

**Grad:** Yes.

**Schorr:** The guy there was a fellow by the name of Professor E.J. McCluskey, who left actually before I finished my thesis and went to Stanford. They shoehorned me into that. The guy who advised the students said, "Well, I see you have these digital circuits in your background at IT&T. You ought to take this course," and I said, "Well, I'm really interested in control theory." He said, "You ought to take this course." I got the message. He's filling up this class, and I was going to take that course. It was a small department at Princeton then. You know, it's not big now but was then even smaller. I wound up taking the course with McCluskey, and he eventually became my advisor. I liked what was going on. He was giving a lecture on some material, and I found a hole in what he was doing. So, we figured out how to fix that hole, and we wrote a paper.

**Grad:** Was that your first published paper?

**Schorr:** Yes.

**Grad:** Why did you pick Princeton, or did they pick you?

**Schorr:** Strange, strange coincidence. I got admitted to a few schools: Carnegie Mellon University, MIT [Massachusetts Institute of Technology], and Princeton, I remember. There's probably more since I wasn't sure. Well, Princeton gave me a fellowship. That was nice. MIT gave me an assistantship, but my boyhood friend's sister went to Wellesley, and she said, "You don't want any part of MIT and all those nerds." So, I said, "Okay. Princeton sounds like a good place," so I went there.

**Grad:** You never took a master's degree? You went directly into a PhD program?

**Schorr:** That's right, but I have two master's degrees from Princeton.

**Grad:** In the process of getting your PhD you got some master's degrees?

**Schorr:** Well, one master's was after you passed the general exam. You got a Master of Arts. One summer I worked for RCA, Sarnoff Laboratories, and I wound up doing some work, which we published a paper on, and Princeton was giving the students who came from Sarnoff an MSEE [Master of Science in Electrical Engineering]. So McCluskey, who I guess was always a troublemaker, said, "You should apply to get an MSEE. You've written a paper just like these guys have and got published." Again, I didn't want to argue with him. Particularly since he controlled my life, so I applied and they gave me the MSEE.

### **PhD Research and Dissertation**

**Grad:** To follow that a bit more, McCluskey became your advisor. When did you decide what your thesis was going to be on? Early on? You were at Princeton for a few years, four years altogether maybe?

**Schorr:** Yes, four or five.

**Grad:** You graduated probably around 1961, 1962?

**Schorr:** 1962. But Princeton only gave degrees at the end of the year, so I missed the 1962 graduation.

**Grad:** You actually picked it up in 1963. I guess what I'm trying to get is two things. Did you start to specialize in an area of particular interest besides your switching theory stuff, and when did you decide, with McCluskey's help, what your thesis would be on?

**Schorr:** First, I had to make an enemy.

**Grad:** Who was that?

**Schorr:** One professor there had said, "Come join my group and do some research, and no strings attached." However, he gave me a problem, which I found the solution of in a textbook, so I said,

“What kind of research is this?” I decided I didn’t like the area, signal processing information theory, so I went to McCluskey and got a thesis topic from him.

**Grad:** What was your thesis topic?

**Schorr:** Well, we were trying to automate the synthesis of digital computers, and my particular job was to define a register transfer language in which to describe the computer. A lot of the design automation programs picked up from that, and then I had to produce, from the register transfers, a Boolean logic description. Then somebody else was going to take that and do the actual synthesis of the machine. Well, I succeeded but the guy in the project who was supposed to do the second part didn’t. We were financed by AT&T Bell Labs.

**Grad:** Oh, this was a financed project?

**Schorr:** Yes. McCluskey had come from Bell Labs, so he had connections there. We did that, and I had to write a compiler. I found a guy by the name of Ned Irons, who was at Princeton, and he had invented a syntax directive compiler. In his case he was dealing with trying to compile Algol programs. You gave the syntax of Algol into his compiler and out came Algol code, a code which implemented Algol. I replaced his syntax rules with a register transfer language description, and you had to write the description. The front part was a description of what you were looking for and the back part was the translation. I did that, and Boolean was the second part. It was very much like expert systems.

**Grad:** You mentioned that earlier, when we were talking before. In what way was it like an expert system?

**Schorr:** We had a mechanism which was like the Inference engine. You wrote rules, and that’s how you described the problem, with rules.

**Grad:** What do you mean by a rule?

**Schorr:** What do I mean by a rule? If you had A and B and that added up to C, that could be a rule.

**Grad:** So, was it an if-then, was it a mathematical statement, or was it a combination?

**Schorr:** Register transfer description of a circuit.

**Grad:** It was not a conditional transfer? Then what makes it a decision rule if it’s simply a statement of some specific action to be taken?

**Schorr:** It was essentially a rule-based compiler, that’s all.

**Grad:** What do you mean then by rule-based compiler? Because this will come up later in our discussions.

**Schorr:** Well, you had a bunch of rules. If you fed a description of what you were trying to describe into the computer, then the computer had a bunch of rules on how to translate that into Boolean logic.

**Grad:** How were those rules expressed? Did you write them in English?

**Schorr:** No, in a register transfer language.

**Grad:** Can you give me an example of some statement in a register transfer language I could recognize?

**Schorr:** Oh, you could say shift the register right by two places.

**Grad:** But it wasn't under a certain condition you would shift it right?

**Schorr:** Yes. You can say, "If this and that, then..."

**Grad:** That's what I was getting at. That a rule seemed to me to have some condition, under this circumstance you take this particular defined action.

**Schorr:** Yes.

**Grad:** Was that a mathematical formulation? How did the rules look?

**Schorr:** No. I defined a register transfer language, and then I wrote the rules.

**Grad:** But you wrote the language. Was the language in English? Was the language in symbolic form? What was the language?

**Schorr:** It was symbolic form. Something that could be input to a computer. Since I looked at APL [A Programming Language] and you could describe a computer in APL, I went to Harvard to talk to Ken Iverson about that, but his symbols were not in—what was it? —an 086 key punch.

**Grad:** He had created his own set of symbols for APL.

**Schorr:** Yes. So, I said, "This is no good. Maybe okay to do the job, but I can't get it into a computer." Had to be computable was part of the thing. [The Register Transfer Language was adopted widely in the design automation community.]

### Cambridge University

**Grad:** Right. When did you leave Princeton? I know you got your degree in 1963 officially, but you were done in 1962. Is that correct?

**Schorr:** I went from Princeton to Cambridge.

**Grad:** Why did you go to Cambridge?

**Schorr:** Well, I got married. I told my wife we'd spend a year in Europe. I thought, "I'm going to have the rest of my life to work anyway," and Cambridge had some wonderful people there at the time. Morris Wilkes was in charge. but there were two Barrons: one who went to a company, another one who ran computers at Oxford.

**Grad:** You were married in 1962?

**Schorr:** Yes.

**Grad:** And the name of your wife?

**Schorr:** Lenore.

**Grad:** Had she also come from the Bronx, or was this from a different experience there?

**Schorr:** Yes, she lived but a few miles away.

**Grad:** Is this someone you had known during high school?

**Schorr:** No.

**Grad:** In college?

**Schorr:** No. We were an arranged marriage, if you really want to know. Her parents and my parents had a mutual friend. The mutual friend was saving Lenore, my wife, for her son, but her son went off to Michigan and married some woman, so she was now foot loose and fancy free. The mutual friend introduced us.

**Grad:** Arranged is not in the old sense of having a matchmaker.

**Schorr:** The friend was the matchmaker.

**Grad:** I see. Okay. Now, Cambridge. Did you have people you knew there so that was why you wanted to go there? Was it on some kind of a scholarship or something?

**Schorr:** Well, I got an NSF postdoctoral fellowship, and Wilkes was the guy who did microprogramming. This was very much akin to what I had done in the register transfer language. I thought this would be a good place to go, or at least it was a good thing to bullshit the NSF people who were awarding these things. I could make a plausible story as to why my work related to what Cambridge was doing.

**Grad:** You could make a reasonable living on these scholarships and grants and things like that?

**Schorr:** Yes. You could live. As you make more money, your needs go up.

**Grad:** As you get married, your needs go up little bit too.

**Schorr:** That's true. But Lenore was never a money hungry woman in that sense. She liked money but not it wasn't necessary.

**Grad:** How long did you stay there in Cambridge? Just a year or did you go longer?

**Schorr:** Yes, just a year.

**Grad:** So, you went over in 1962, after you were married.

**Schorr:** Yes.

### **Teaching at Columbia**

**Grad:** You came back to the States in 1963?

**Schorr:** Yes.

**Grad:** I guess it was an important thing. Why did you decide not to teach?

**Schorr:** I taught. I went to teach.

**Grad:** Oh, did you? Where did you go to teach?

**Schorr:** Columbia.

**Grad:** Okay. So, you started in 1963. What were you teaching?

**Schorr:** Electrical engineering.

**Grad:** Any particular subjects within EE?

**Schorr:** Well, the only one that sticks in my head was that the guy who taught information theory, strict information theory, decided late in the year, maybe even in the summer, to go to the University of Illinois. So, they had a course in information theory that needed to be taught. They said, "You are the candidate for doing that." They made me another offer I couldn't refuse. They gave me his notes. He was on the way to publishing a book and they said, "Here." So I wound up teaching that. I don't remember anything else; that was a salient thing.

**Grad:** Let me come back to this. You've graduated. Did you look at a variety of schools?

**Schorr:** Yes.

**Grad:** Did a variety of schools come to you? How did that happen?

**Schorr:** I interviewed at a few schools.

**Grad:** Did you stay in the New York area on purpose?

**Schorr:** Well, I wanted to be on the East Coast. Though later, eventually, to get ahead of the story, I nearly went to Berkeley. After finding out that Columbia was essentially not in good shape. They had two faculty factions. Candidates for tenure, if they were in block A, block B would vote against them and vice versa. Some very good guys who went on to get tenure elsewhere, were denied tenure at Columbia. I said, "This is not a winning place."

**Grad:** How long did you stay at Columbia?

**Schorr:** One year.

### **Joining the T.J. Watson Research Center**

**Grad:** By 1964, you decided you wanted to continue to teach, or did you decide you wanted to work for a company? What was your decision then?

**Schorr:** Well, nothing so straightforward as that. In January of that year I figured there's no point staying at Columbia, so I applied for jobs at Berkeley and a few other places. It was late, too late in the academic year for them to give me a position. Lotfi Zadeh, who was a well-known professor, interviewed me and he said, "Okay. If I get one rejection, you'll get a job offer."

**Grad:** From?

**Schorr:** From Berkeley? But he didn't. So, they agreed he would get me a position at T.J. Watson Research Center with one of his students, Jack Bertram. Zadeh was his thesis advisor. Another thing was that at that point in time if you quit IBM you could never get reemployed by IBM, and there were very few opportunities for a PhD in computers, an electrical PhD. There were very few respectable places that you

could work outside of academia. It was GE Labs, Bell Labs, maybe RCA, and some defense contractors where I didn't really want work. I had worked during college at Rand Corporation. I forgot to tell you that

**Grad:** I'll come back to that in a minute, but go ahead. Basically, he's offering that he can arrange a job for you or at least a temporary job for you at T.J. Watson. Was it in Yorktown Heights already?

**Schorr:** Yes. I was living in Riverdale.

**Grad:** Not a bad commute. When you finish your term at Columbia in the middle of 1964, if I have it right, you start in the T.J. Watson Research Center. Who are you working for?

**Schorr:** Bertram, and John Cocke was my manager.

**Grad:** He was already there.

**Schorr:** Yes.

**Grad:** Bertram was the head of the Lab at that point in time, the Research Lab?

**Schorr:** Yes. He was head of the Computer Science research activities.

**Grad:** Who was running the Lab then? This is pre-Gomory, I think, isn't it?

**Schorr:** I don't remember his name, but you can look it up anyway.

**Grad:** That's your first job there. How long did you stay at the Watson Lab?

**Schorr:** Well, depends how you figure. We spent a year. We designed something, a computer. IBM was worried. Sperry had come in with the machine, I think, the 1003—something like that—and was getting all the scientific computing. People weren't going to 360 for the scientific projects.

**Grad:** The 360 had been announced, but it wasn't delivered until 1966. It was announced in 1964, I think. We had operating systems problems, if my memory serves me correctly.

**Schorr:** Yes. But they had trouble in maybe 1964. The machine was not being bought by all their scientific customers...

**Grad:** That's true.

### **Project Y**



**Schorr:** Watson had set up this project at Yorktown where we were designing a supercomputer, which would work for the scientific mission.

**Grad:** What was the name? Do you remember, the code name?

**Schorr:** Sure. Project Y.

**Grad:** This is Project Y. Okay. Who else were you working with?

**Schorr:** Ed Sussenguth, Fran Allen. Who else? Brian Randell, who went back to England eventually.

**Grad:** What was your role in that team?

**Schorr:** I was doing the architecture of the machine. We've skipped one thing. There are two important things we should talk about at Cambridge. One, I joined a team which was designing a computer based on tunnel diode technology. Unfortunately, the Elliott Brothers were supposed to provide the tunnel diodes. They never were able to get them to work, but it whetted my appetite for doing machine design and architecture, which is what I wound up doing when I joined Bertram. I did the architecture of his machine.

**Grad:** You were definitely doing hardware architecture. Even though some of your work would've been software oriented, but this was really hardware design.

**Schorr:** I did software also. Wilkes had a version of Lisp which he ran on his computers. His computers were not as powerful as American ones, so he devised a language which he called Wisp.

**Grad:** That was a subset of Lisp?

**Schorr:** Yes. CERN came and said they wanted that program, I think, on their 7090. He had to get the garbage collector for that machine, and he plucked me out and said, "Why don't you write the garbage collector?" I said, "Well, I worked on a CDC machine at Princeton, and this is an IBM machine." He said, "Oh. All these American machines are the same." So, I went and did that, and as I told you the other day, we invented an algorithm. When I went to Columbia, I had a student by the name of Bill Waite. He was great. **He** eventually left for Australia—I don't remember why—but he and I finished the programming of this job. He was a better programmer than I was and could get into the guts of the operating system more than I knew. He and I finished that up and wrote a paper. Knuth eventually said in his book that this was the fastest known garbage collector. I don't think you can do better than that. Then it turned out that Peter Deutsch at Berkeley had simultaneously and independently invented it, but it also became very popular. You looked at data in two ways, so proving the correctness of it became a sport for the theorem-proving crowd. So, I did do software at Cambridge. I had also done software at Columbia, at Princeton, in my thesis.

**Grad:** But it sounds like you were an architect system designer type rather than so much an implementer or a coder.

**Schorr:** Correct.

### **Teaching at Columbia and Berkeley**

**Grad:** Okay. Let's keep going. You're at Yorktown. At this point, do you think of this as a permanent job, or do you think of this sort of an interim before you go back to teaching?

**Schorr:** No, a permanent job.

**Grad:** Why?

**Schorr:** I liked designing machines, and I figured out I couldn't do that at a university.

**Grad:** You had only taught really a couple of classes, I guess, at Columbia. Did you enjoy that?

**Schorr:** No.

**Grad:** But you liked training people and teaching people. I see that later on.

**Schorr:** Yes. As I like waggishly to say, I taught at Columbia and Berkeley and there were riots in both places.

**Grad:** Is that really true, or is that just fun to say?

**Schorr:** Yes, it's true.

**Grad:** Give me example.

**Schorr:** Well, there was the Vietnam riots.

**Grad:** Oh, oh. The riots were—not in your classroom?

**Schorr:** No. The engineers were dead. I went up to the Berkeley campus. To teach, you go through a whole mishmash of crowd to get to the engineering building. You wouldn't know anything was happening.

### **IBM Product Division in California**

**Grad:** I'm going to move ahead a bit. You were certainly in a very interesting part of IBM and at a very interesting time. The 1960s were a period of great excitement and great development going on. Did your system, your Project Y, did it actually result in a computer that was implemented, built, sold?

**Schorr:** Yes. But by a much more circuitous route. Watson plucked the project out of Yorktown, and we went to Menlo Park.

**Grad:** Oh. In California, not the one in New Jersey.

**Schorr:** No. Not with Edison.

**Grad:** Why was that changed? Why was that moved, do you know?

**Schorr:** One, they didn't want us to get under the influence of Poughkeepsie, and two, we were going to work with the Lawrence Radiation Lab, Lawrence Berkeley Labs, and Los Alamos. So, they figured this was good. Contrary to this being called Silicon Valley, IBM produced a lot of magnetic bits in this area.

**Grad:** And became the tape drive place and so forth at some point in time.

**Schorr:** And disks. Disks were invented here.

**Grad:** This is what? 1965?

**Schorr:** Something like that.

**Grad:** You were being asked or told to move to the West Coast? Okay. Did you have any problems with that change?

**Schorr:** No, not really.

**Grad:** Did your wife have any problems with it?

**Schorr:** No.

**Grad:** Of course, you had family here in the East Coast.

**Schorr:** Yes.

**Grad:** That wasn't a strain as far as you were concerned. Okay. So, 1965, 1966, you're moving out to California, to this same area we're in now.

**Schorr:** Exactly. We started in Sunnyvale in a warehouse and then built a laboratory on Sand Hill Road, which is now the home of several VCs

**Grad:** Three hundred of them I think the last I looked.

**Schorr:** Our own particular building got taken over by a VC.

**Grad:** What department, what division were you in at that point in time? Were you still in Research?

**Schorr:** Oh, no. We were part of a product division.

**Grad:** SDD?

**Schorr:** SDD.

**Grad:** But you were then on the engineering development side.

**Schorr:** Well, I was in charge of architecture for the machine. Then the programming guy sort of went off the deep end, and I took over architecture and programming for this machine.

**Grad:** Wow. Pretty significant responsibility for a new product.

**Schorr:** Yes.

**Grad:** What happened with the project, with Project Y?

**Schorr:** The 360 was doing very well, thank you, so they decided they didn't need a non-compatible machine. Gene Amdahl, who was stationed out here, became part of the project. He argued he could do as well with a 360 architecture as with our architecture. Our architecture essentially became RISC [Reduced Instruction Set Computer].

**Grad:** Ah. Is that the connection with John Cocke?

**Schorr:** Yes.

**Grad:** When did the Project Y, as such, terminate?

**Schorr:** I don't know.

**Grad:** Well, how long did you work, a year, two years?

**Schorr:** Oh, at least two years. Two, three years.

**Grad:** So probably about 1967, 1968, somewhere along there.

### Return to Yorktown

**Grad:** You had been at SDD. This project is now terminated.

**Schorr:** It didn't terminate. They changed direction to make it 360 compatible, and a bunch of us left.

**Grad:** When you say left, what does that mean?

**Schorr:** Oh, we moved to different parts of IBM.

**Grad:** Where did you go?

**Schorr:** I was given the job of being the Director of the Computer Science Department at Yorktown.

**Grad:** I'm trying to match it up here. So now you become Director of Computer Science. Okay. I have that connection. Fair enough, and that starts when? Probably around 1967, 1968. Do you remember?

**Schorr:** About then.

**Grad:** Close enough. Okay. Now, you note being part of the Advanced Computer System project when you went there. Was that ACS already, to be started then or worked on then, or is that later?

**Schorr:** No. That was what we went to Menlo Park with. Project Y became ACS.

**Grad:** Ah, okay. Now I got it. You show yourself as Director of Computer Science Department, programming and architecture for ACS. Now the next thing you're showing on your printout is Advanced Systems Division, Product and Service Planning.

**Schorr:** That's wrong. I ran the Computer Science Division at Yorktown.

**Grad:** So now you come back to the East Coast.

**Schorr:** Yes. I was Director of Computer Science

**Grad:** Okay. Now you're back at the IBM Research Lab.

**Schorr:** Yes.

**Grad:** Who is running the lab then? Do you remember? This is 1968, 1969?

**Schorr:** Anderson was his last name. Arthur, I think.

**Grad:** You're now the Director of Computer Science. Who were you working directly for? Were you working for the lab director or somebody in between?

**Schorr:** Yes, Anderson was the lab director.

**Grad:** You were reporting to him. Any problem as far as moving back to the East Coast. You seem to have gone back and forth quite a bit between East Coast and West Coast in your life.

**Schorr:** Why, we moved to Cambridge. Princeton, Cambridge.

**Grad:** That wasn't an issue for you particularly.

**Schorr:** No.

**Grad:** Some people have strong preferences. That was not a driving force for you. Okay. Now you're back in Yorktown Heights and running the Computer Science Lab. Who do you have working for you?

**Schorr:** Well, I had the APL Group working for me. Ken Iverson.

**Grad:** Now, was Cocke working for you at that time or not?

**Schorr:** No.

**Grad:** Did he ever work for anybody? John was very independent, from what I'm told.

**Schorr:** Yes, and I had worked for John. And then Bertram, when we went to the West Coast, took me out from under John and I became the manager. John, I guess, was sort of an advisor to Bertram or something like that. Bertram did that because he didn't think John was a great manager.

**Grad:** He probably was accurate.

**Schorr:** But John resented it, nevertheless. John eventually came back to Yorktown, but he first went to the Math Department. Then after a few years he came back into Computer Science.

**Grad:** Well, his contribution, the development of the RISC thing, too bad IBM didn't take advantage of it early enough.

**Schorr:** Yes.

**Grad:** One of those things. How long do you stay as the head of the Computer Science lab? Is that a couple of years?

**Schorr:** Yes, a couple years.

### **System A**

**Grad:** What were your major projects that you were working on?

**Schorr:** We did something which was called System A. All I know is systems, basically.

**Grad:** What was System A supposed to do?

**Schorr:** We defined an architecture that had three levels: a supervisory level, then an intermediate level, and then the high level. We were working on this as a research project, and then IBM ran into the first time where revenues went down in a recession.

**Grad:** We're down to about 1970 at this point in time.

**Schorr:** Yes. They needed something, and I don't know. I think Bertram was in Armonk or something like that.

**Grad:** He was by then, yes.

**Schorr:** And they took me. They said either we're going to produce another 370 or they would pick an alternative. The only other systems project around was my System A.

**Grad:** Was that to be a general-purpose computer?

**Schorr:** Yes.

**Grad:** Was it compatible with the 360 architecture?

**Schorr:** No. No. That was the thing. What happened was that we showed them that, they liked it, they gave it to Bob Evans to implement. Bob Evans said, "Forget the bottom two layers," about which we knew how to do. He settled on the top layer, and he was going to do everything below that in microcode, which we thought would be as slow as blazes and not very good.

**Grad:** That was the system, this was DSD, right, at that point in time? That was Poughkeepsie headquartered, if I remember correctly.

**Schorr:** Yes. He ran the machine guys, and he decided to do that. At this point, Bertram started up a new division which was ASDD [Application System Development Division]. The old division, well,

they turned it completely around. They were not doing applications particularly. The assignment we had was to understand, to come up with a set of market requirements for this system which was now called FS.

**Grad:** This is what they called Future Systems.

**Schorr:** Yes.

**Grad:** Okay. Now, did you have a new title now? I see here a title change. Vice President, Product and Service Planning for Advanced... now that is correct. Where were they headquartered?

**Schorr:** Mohansic.

**Grad:** That was still Mohansic, where ASDD had been forever.

**Schorr:** Yes. Well, we closed it down, I think. We got rid of it.

**Grad:** Now, ASDD had had the responsibility, my memory serves me correctly, also was the location, to do the timesharing system, TSS.

**Schorr:** Correct.

**Grad:** By this point it was either done or not going to ever get done.

**Schorr:** They had more or less cut it off at seven or nine systems

**Grad:** I think they delivered less than 10 systems finally

**Schorr:** Yes, something like that. They eventually got that to work really well, but by that time it was too late.

**Grad:** Well, I was involved in that. VM/CMS was the thing we used to actually sell to the timesharing market. I mentioned to you the other day a side story that IBM had lost the first two timesharing contracts and brought in Watts Humphrey and said, "Don't lose anymore." He won the next 32. But in the process promised that TSS would do everything anybody ever dreamed of doing.

**Schorr:** That's right. We were involved from Yorktown on doing that and in fact they used my WISP version of LISP as a benchmark for something.

### **Shift to the Marketing Group**

**Grad:** Okay. Let's talk about what you then did at ASDD . You have FS. Are you running it, or are you just part of it? What was your role?



**Schorr:** No. I was getting market requirements, but we were getting market requirements with a revenue number associated with this.

**Grad:** You weren't on the technical side then on doing that?

**Schorr:** No.

**Grad:** That seems like a strange change for a guy who's a top architect, had the System A architecture responsibility, and now you're doing market requirements?

**Schorr:** Yes. We were doing them, we had to do them by really understanding what was required, what the hardware was, what the cost was, and what the benefit was. It was a lot of fun because I talked to a lot of customers as to what they needed. Maybe that was preparatory to what I did later at IBM, talking to customers. So yes. We did that, and we wound up then taking a look at FS itself and doing an analysis of it.

**Grad:** Now, this is interesting. Let me probe that. You had done the basic architecture. They wanted to take the top level but not those other two levels. Now, this was not any more involved with Bob Evans, per se, though. This was in the ASDD.

**Schorr:** No, no, FS was in Poughkeepsie. We were in the marketing group.

### **Killing the FS**

**Grad:** Ah. You were no longer involved in the design of FS or the specification. You were given the requirements and looking at the market side and then seeing how FS—I hope I'm not putting words in your mouth—but looking how FS might meet those requirements and those market needs. Is that a fair statement?

**Schorr:** Yes, we soon came to the conclusion that it was a disaster. It wouldn't meet the market requirements. It would perform very slowly. We went up, we drew up a list of about 26, I remember, in that neighborhood of things that had to be done. It wasn't cutting the mustard, so we had a shootout. And who ran? It's Dick [Case]. The chief architect and I had a toe-to-toe, head-to-head fight on this, and the bad news was I won, so the FS project was killed.

**Grad:** That was what? About 1974, 1973? 1974? Somewhere around there, I think.

**Schorr:** Something like that, yes.

**Grad:** You were involved for quite a few years in doing this?

**Schorr:** Yes.

**Grad:** Let's stay with that, because that was a major thing. IBM announced the System/370 in I guess about 1970 or so as a replacement for the System/360. As I remember the story, there was then work going to be going on for the System/380, which would stay with that architecture, but hopefully FS might completely replace that and we'd go through another change in architecture, and FS gets killed. You think the work, you did, the evaluation, was a factor in the killing of FS.

**Schorr:** Absolutely.

**Grad:** Bob Evans must not have been very happy with you.

**Schorr:** No. At one point he came back years later and offered me the architecture for 380, the chief architect. I said, "How come you're giving it to me?" I said, "Bob?" He says, "Well, nobody else I can think of." It was not very good for inducing me to take the job. So yes.

**Grad:** Stay with this. I don't want to lose it. FS was a mammoth investment for a period of time by IBM, as I recall, and it had a number of very different new concepts. Were many of those based upon the work you had done on System A, or were they original for that team?

**Schorr:** No. A lot of it was System A.

**Grad:** Can you describe briefly what was so different or unusual about the architecture of System A which was then carried over to FS?

**Schorr:** Well, it was actually implemented by Rochester [Minnesota].

**Grad:** By Rochester later on. But what was so special?

**Schorr:** It was a one-level store machine. It had a lot of high-level functions built in. The idea was to make it easy to write applications and so on, but that had then zero toward compatibility with the existing 360/370 base. That was the Achilles heel of the damn thing. The thing was going to run the 370 in emulation mode, so that they would run a lot of the 370 stuff, but the performance was anemic.

**Grad:** Was there any significant hardware changes required or involved in the FS project in terms of the chips and things?

**Schorr:** Yes. Well, we did things. We had floating channels, It's the ability that the machine would determine which channel to use.

**Grad:** Was that because of the timesharing needs? Was that one of the reasons for doing it as against a Blaauw box type of thing?

**Schorr:** Timesharing needs.

**Grad:** Remember, in the 360/370, the Blaauw box was just an add-on. It wasn't part of the basic design concepts.

**Schorr:** No. The Blaauw box came about because of Yorktown, by the way. We had answered the TSS sort of thing, so we worked with him to help.

**Grad:** You had actually done some work with that as well.

**Schorr:** Yes. Which led to that.

**Grad:** Was it the CP/67 or something? No, the 67 was the first machine, I think that had timesharing capability.

**Schorr:** Yes.

**Grad:** Was it was relative addressing or something? There's some name that was used for that kind of function where you didn't have an absolute; you were actually working, replacing things and not having to do it.

**Schorr:** I don't remember, but the base, yes.

**Grad:** Let's keep going. Who were you reporting to? Who heard your stories? Who was the one who made those judgments that, "Hey, we're going to kill that"? That'd be pretty high up in the corporation. How high?

**Schorr:** Well, we had sold FS to John Opel. Not the CEO, but he was close.

**Grad:** He was a CEO in training. Yes. Cary was the CEO during the 1970s, I believe.

**Schorr:** Opel succeeded him.

**Grad:** Yes, and then Akers.

**Schorr:** But Opel had a strong role. They regarded him as the technical guy

**Grad:** But he was an MBA.

**Schorr:** They regarded him as the technical guy.

**Grad:** Did you report directly to the management committee at IBM at this point in time?

**Schorr:** No. ASDD was part of data processing.

**Grad:** Well, you were a separate division though, I think.

**Schorr:** Yes, separate division. But whoever was the czar of all the marketing divisions is whom we reported too.

**Grad:** To override Bob Evans on the FS, you had to be at the top level. It didn't go to the management committee?

**Schorr:** No. We had a shootout at O.K. Corral between me and whom?

**Grad:** I think I know who you mean. Was it Dick Case? He had worked for Brooks.

**Schorr:** Yes.

**Grad:** Actually, I interviewed him. Nice man. Anyway, let's follow. When you had the shootout, it's in front of whom? Is this Opel? Who makes that decision?

**Schorr:** I don't know, Opel or Rizzo or somebody. Somebody at that level was listening.

**Grad:** These were corporate level people. DSD, ASDD, are saying, "Here's the different stories."

**Schorr:** Yes. This thing won't cut the mustard is what we were saying.

**Grad:** They had hundreds and hundreds of people, to my knowledge, working on FS. It was a mammoth project.

**Schorr:** Yes. In retrospect, politically, it turned out that everyone put me forward. You know, they all pushed back, and I was the spokesperson for doing this.

**Grad:** I want to get to that, because that, to my mind, is an unusual characteristic. Here you are basically architecture, mostly hardware, some software. You've been coming up, very technical. You're a PhD and now they put you really to look at it from a marketing standpoint, a business standpoint. Which is a little different from the role that you had up to then. Yet somehow you are able to, number one, do it, and apparently enjoyed it from what you've said. But number two, you were able to articulate the stuff in a way that must've been very persuasive.

**Schorr:** Well, I'll tell you a little side story. Out at Project Y, in Menlo Park, T.J. Watson comes through, Junior, to look at what he had created. I presented the architecture to him, and I found out later that my good friends and my management had ruined my career, the trajectory of my career. Because Watson wanted to take me to Armonk as one of his AAs. Out of that I would have got stock options, which were like 28 years old and they didn't give them that frequently at that. Somehow, I impressed Watson. But the technical community. Manny Piore. You ever heard of him?

**Grad:** Yes, of course.

**Schorr:** They wanted no part of this because they had sent somebody else from Endicott down—as his AA—and it had not worked. You know, I'm not even sure they wore suits at this point.

**Grad:** Oh, yes. They wore suits.

**Schorr:** You know, they were scared to death. The last guy they had sent there had been destroyed and it was not a game for non-marketing people.

**Grad:** This fascinates me. The ability to communicate complex technical business and market information to executives is a very difficult task. Somehow you must've had the way of saying things that were net and yet convincing, so they felt comfortable making decisions. Your background doesn't necessarily say why you would be able to do that.

**Schorr:** No. But I think all of these things. I mean, we were talking yesterday about relational databases. Why did Larry Ellison succeed and others didn't? We had no one like that in expert systems really who could...

**Grad:** Which we will get to later, but I'm talking about in IBM, because, you know, I was there and I knew what it took to make that kind of communication at a high level. You must've been persuasive and very net. You must've said, "These are the facts," and been very persuasive of that.

**Schorr:** No. I don't think I'm particularly net, but I got a reputation eventually that (A) I always told the truth, which was not politically very wise. But I did, and they knew they would get the truth out of me. The second part was, "Let the guy think." They knew that my first answer was, the off-the-top-of-the-head answer, was not the one. Wait until I sleep on it and think about it. That's my characteristic in a lot of things and how I approach life. But I think they knew I'm a very bad liar.

**Grad:** Well, that may be what the important thing; they thought that you weren't trying to build your own self politically, but you were telling them what you really believed.

**Schorr:** That's right.

**Grad:** That which your research had given you.

**Schorr:** In retrospect, they said I went in there in front of the top management and told them FS was a pile of crap. That, you know, is usually not a politically positive move.

**Shift to Corporate Technical Committee**

**Grad:** No. I understand that. All right. I'm going to move ahead. You did some other things at ASDD but I'm going to move to your next assignment. When do you become the Vice President in Research for Computer Science?

**Schorr:** After FS died, ASDD died, I went then to the corporate technical committee in between.

**Grad:** The next job is corporate technical. Well, we're talking probably about '1974 or so. Somewhere in the ballpark? Okay. Go ahead. Now you're reporting to the CEO.

**Schorr:** Well, through Lou Branscomb.

**Grad:** Branscomb was your direct.

**Schorr:** Yes.

**Grad:** What were you doing there?

**Schorr:** We would analyze technical directions of the IBM corporation. For instance, I wound up looking at memory.

**Grad:** You were Yes, you're born in 1936. So, you were less than 40 years old. You were 38 years old. Wow.

**Schorr:** We looked at the memory and told them it was way too expensive. They had to cut that down.

**Grad:** Well, you had worked on some memory stuff at ASDD, hadn't you, with the 3033 and stuff?

**Schorr:** Yes. But this was production, this was component level. I told Cary I was worried about the PCs.

**Grad:** This is pretty early to be worried about PCs.

**Schorr:** I had two tours on the CTC.

**Grad:** Yes, my guess is this is the second tour because 1974 was early.

**Schorr:** Yes.

**Grad:** Your notes here indicate that you worked on the memory product strategy.

**Schorr:** Yes.

**Grad:** And VSAM?

**Schorr:** Yes.

**Grad:** What did you do? Did you assess it? Did you help develop it? What was your role?

**Schorr:** Assessing it.

**Grad:** You said it was good, bad, indifferent?

**Schorr:** Bad.

**Grad:** Okay. That's why they implemented it?... <laughs>

**Schorr:** It didn't stop them.

**Grad:** What would you think would've been better at that point in time? Did you have an alternate, or was it just you didn't think that it was not going to work?

**Schorr:** We had an alternate, yes. There were two contenders. One was the local guy, and the other one was a work that Andy Heller had done.

**Grad:** Andy Heller had apparently a great deal of influence on management during this period of time. I remember when I was at IBM Research a little later that he stymied the use of the relational database management work for years.

**Schorr:** Yes. He was a believer in access methods and so on. ISAM and those sorts of things.

### **Systems Laboratory in Yorktown**

**Grad:** Anyway, let's move ahead on this a little bit more. You also note that you analyzed the workstation market.

**Schorr:** Yes, that was later. That may be the second.

**Grad:** Okay. These may be mixed up a little. Let's go ahead. You stayed then on the corporate technical committee for what, a couple years?

**Schorr:** Yes.

**Grad:** Then what do you do?

**Schorr:** I returned to Yorktown and worked for Joel Birnbaum. He was the Director of Computer Science, and I proposed to the corporation that we set up a systems laboratory. The systems laboratory would investigate new concepts in designing systems.

**Grad:** This has got to be, what, about 1976, 1977? That's when I met you. when I was there.

**Schorr:** Yes. Sounds right.

**Grad:** That's about the right time period. Did you have a title then?

**Schorr:** I was just manager of the systems lab. We'd worked on that new systems ideas. Then my friend Birnbaum, our friend Birnbaum, took himself off to HP, and they gave me back the job of running Computer Science.

**Grad:** That's where you're a VP in the Research Division for Computer Science.

**Schorr:** Yes. Then I became a VP. Birnbaum told them, "Look. You're going to lose everyone unless you start giving out titles and money and things like that."

**Grad:** But you had gotten your first stock grant earlier?

**Schorr:** Oh, yes.

**Grad:** That's interesting because you were very young and very early when you got it.

**Schorr:** I was the youngest guy to get a grant, and I was the youngest man to make senior engineer at IBM.

**Grad:** Really? Terrific. I got a similar grant after the unbundling project that I worked on. Of course, it turned out not to be worth a nickel, because I left in the late 1970s. It was a total waste of time at that standpoint. Let me look at that, what you were working on. Now, my memory is that Birnbaum left around 1978 because of they wouldn't move ahead with the RISC machines.

**Schorr:** No. I think HP made him a good offer. He was going to run all of HP labs.

**Grad:** You think it was that. Because I remember one of first things he did was work on the RISC machines.

**Schorr:** Well, that's what they hired him for.

**Grad:** Yes. That was it, and IBM wasn't doing anything with it. Least not to my memory.

**Schorr:** Well, we did do a RISC workstation.



**Grad:** That was later, wasn't it? Maybe I'm wrong. That's why I'm asking you. I don't know.

**Schorr:** I don't think so. I think he went for ambition. They made him VP. Running HP Labs was a pretty big deal.

**Grad:** His wife was an opera singer or something like that?

**Schorr:** Yes.

**Grad:** Sticks in my mind. He was good guy. He's the one I worked for that year and a half or so that I was there.

### **IBM: Starting the AI Division**

**Grad:** What were some of the things you did when you were in that job, the VP of Research?

**Schorr:** Well, that's where I started the AI Division.

**Grad:** Okay. Let's move into that next. That's obviously a direct connection to what our meeting was about. What did you do, and why did you do it?

**Schorr:** Well, I have a long history in this technology, but I understood what expert systems were all about. I felt IBM had to be in this technology. We can argue about whether LISP was a great idea, but John McCarthy had also invented timesharing systems which had nothing to do with AI, but somehow AI seemed to be a fertile bed or incubator for new systems ideas. So, I thought IBM ought to get involved in this.

**Grad:** Well, what was your first exposure? I know you talked about doing something very early on which would later be called an expert system, but what got you re-involved? What stimulated you to say, "Hey, this looks like an interesting area"? Do you remember?

**Schorr:** No.

**Grad:** There was a lot of press, of course, and there was stuff being talked about, but I don't remember.

**Schorr:** This was before probably the press.

**Grad:** See, I don't remember it being a hot topic in the mid-1970s.

**Schorr:** No. I just felt that AI was a good thing to do, that if we're having a Computer Science Research Division, we damn well need to do it, I was a firm believer of learning from the university, so I

would have joint meetings with MIT, Carnegie Mellon, not Stanford so much, and I would listen to what they're working on. Some of the things being worked on in AI sounded really interesting.

**Grad:** Now this is pre-the fifth-generation chip Japanese project. It's much earlier.

**Schorr:** Yes.

**Grad:** You must have stayed in this job for a while. Did you end your career in that job at IBM?

**Schorr:** Yes and no.

### **IBM Research Labs**

**Grad:** You were there for quite a while and had a range of projects. Did you have direct connection with the IBM Japanese Labs and so forth that you worked with them?

**Schorr:** I started it.

**Grad:** Tell us about the Research Lab in Japan. How did you get started in that, and why?

**Schorr:** I think the corporation decided they wanted one, and I was given the job of setting it up.

**Grad:** Ralph Gomory was running the lab when I was there, when you were there. Fine man, from my standpoint. I don't know how your relationships were, but I found him very compatible. I had known him from the math stuff I think back in earlier days when I first joined IBM. You seemed to have had a wide range of things. You were initiating projects, supporting projects in the Research Lab. You must have had a large group of people there.

**Schorr:** Yes. We did. It'd grown quite a bit.

**Grad:** Couple thousand people, maybe?

**Schorr:** Well, no. Eventually, I was in charge of Computer Science activities in San Jose as well as Yorktown and Zurich, where we had a Computer Science Exhibit.

**Grad:** You had a horizontal on computer science regardless of which of the IBM Labs.

**Schorr:** Yes, at Research Labs. We were going to be involved with Vienna, but I don't think we went ahead with that. I wound up with about 2,000 scientists working for me.

**Grad:** Did you end up doing much of the hiring of these people? Or was it more people that were already there that you worked with?

**Schorr:** Well, in preparing his budget, Mr. Gomory would ask all the directors for their best ideas. You had to come in and convince him that you had some good things to do. We did well with that, so we would add a bunch. He was doing well with the corporation getting resources, and we got at least our fair share of this.

### **IBM Bureaucracy and Product Development**

**Grad:** Let me point you in a little different direction. One of the problems that we had in IBM Research, and I think this is true in most research labs, is moving the ideas, the things that they developed into manufacturing or into the market in some form or manner. Did you ever get involved in doing that?

**Schorr:** Sure, but I think we were in pretty good shape. I think. I think we did that well, actually.

**Grad:** Well, let me give you two examples, and maybe they weren't yours. One was the RISC machine, which IBM was slow in their adopting, and HP and others were faster. The other was relational database systems which Larry Ellison got the jump on that, and it took IBM until 1983 to announce a relational database management system.

**Schorr:** Yes, but that was a function of bureaucracy, basically. There were standards meeting on relational database, and Larry Ellison managed to sit in on all of them, and he figured out what that was all about, and then he just went to code and did that. IBM had become, what should we say, a little...

**Grad:** Ossified?

**Schorr:** Ossified. I mean, I love to tell the story of DOS, MS-DOS. We had to go to Microsoft, because Cary tried to get an operating system through IBM, but the procedures that had been set in place by your friend, Watts Humphrey, because partly because Cary thought they were operating... software was out of control in development. With such a standard, it would take us a year to get to specs which we could then implement under the procedures that we had. Basically, that was too late, so they went out and found Microsoft to do the stuff.

**Grad:** That's an interesting story. I'm not going to tell my story, but that was something I was involved in during that time. That was one of the key questions, whether we could get it inside the company, and number two, if we did it inside the company, would other people use it. That third party was considered to be more market acceptable looking at other people. I'm sure there was a lot of other thoughts going on.

**Schorr:** We had trouble, not only with the programming, but the hardware technology. We didn't have the technology to build microprocessors very well.

**Grad:** Did you get involved in that as part of your thing, your job at Computer Science?

**Schorr:** No, I got involved in one session at the Corporate Technology Committee. I went to Cary or Opel. I don't remember which one of them, during my second stint. I said to him, "I didn't understand it. We weren't making the microprocessors, and we weren't building the operating system. What was the competitive advantage IBM had?" "I guessed wrong," he said to me. I said, "The Japanese will copy this and eat our lunch." So, he said, "Go down to Boca Raton," and I went to Don Estridge and saw what they were doing, what they had done is automate the PC line. It didn't impress me, but Cary never came back and asked me. After he sent me down there, he never asked me what I thought. I figured there's no sense making myself completely obnoxious since he liked me a lot, and he was a good guy...

**Grad:** You really didn't get deeply involved in the PC?

**Schorr:** No.

### **Corporate Evangelizing for Expert System**

**Grad:** Let me take the AI connection a little bit further. What did you then do, because you thought AI was an important thing? What did you do at IBM to expand that, to proselytize, whatever you want to call it, evangelize? What did you do?

**Schorr:** Well, I left the research division and went to Harrison, NY which was Group Headquarters, and they gave me the responsibility to go into new areas for the corporation.

**Grad:** You were there for a while?

**Schorr:** Yes.

**Grad:** What did you do?

**Schorr:** What did I do? I was in charge of Development, Marketing and Finance, corporate-wide, and we were more or less of a goad more than anything else. We pushed applications throughout the corporation.

**Grad:** This is internal applications within the company.

**Schorr:** Yes.

**Grad:** How did you push them? What did you do? Did you help them learn the things? Did you just get them interested? Did you show them opportunities? What did you do?

**Schorr:** Yes. We didn't have money to do this. We just made it a point. They knew I was talking to the Management Committee, so the leverage was we would talk to Development or Marketing and tell them we're going to make a report.

**Grad:** Give me an example of one you thought was particular successful, that you may have helped to stimulate. Let's use that word.

**Schorr:** We did some configurators with San Jose.

**Grad:** What's a configurator?

**Schorr:** A configurator essentially—if a customer wants to solve a certain problem, we would figure out what he should get.

**Grad:** They worked out decision rules, whatever you want to call them, to help do that. And then to produce that so the salesmen could use it. Was that the idea?

**Schorr:** Yes.

**Grad:** Was that useful?

**Schorr:** Yes, quite a bit. We sold computers that way. DEC had done this before; their machines were even more configurable than ours. They really needed it. But it was good...

**Grad:** What are some of the others? Because I gathered there were dozens of these done at that point.

**Schorr:** Well, you should read Feigenbaum's book more. I don't remember a lot of those.

**Grad:** Were there any that you got personally involved in that you can remember, where you helped do the decision logic?

**Schorr:** No, I had a different job. I was evangelizing this stuff to corporate. I went all over the world talking to corporation CEOs.

**Grad:** You were talking to clients?

**Schorr:** Yes, customers.

**Grad:** That was my other point. It was not just inside the company. IBM had no product in this area, per se.

**Schorr:** Well, we had bought licenses. We were jointly marketing with Intellicorp and I don't remember, but we had some simple expert systems of our own.

**Grad:** But IBM didn't own that software. They would use IBM hardware to implement, to run it on. But this was not selling an IBM product.

**Schorr:** Yes.

**Grad:** Did any of the people in the software business approach you or talk to you, and say, "Hey, why don't we do something?"

**Schorr:** Nope, not that I can remember.

**Grad:** You didn't have a strong DPD connection with the sales division at that point.

**Schorr:** We had the sales division. I had a committee set up with Jack Kuehler, Gomory, and the head of DP—Vice-President of DP, not the head—who were supposed to look at all this thing.

**Grad:** They never came up with a marketable product.

**Schorr:** Nope.

**Grad:** That's too bad.

**Schorr:** Maybe not.

**Grad:** Maybe, yes, you're right, in a sense. But maybe they would have made it work. You never know about those things, do you?

**Schorr:** That's exactly right! Somebody had to go in with a customer, what they did on CICS, in your realm. A lot of things were done by working with the customers, looking at the problems and solving the problems. That was not done within IBM, and it was not done by any of these other guys.

**Grad:** IBM's most significant database management products and systems-like products were not done by the product divisions at that point. Because we're talking 1970s through almost to the 1980s. They all came from DPD, supporting somebody who was doing it, whoever it was. You'll agree or not, but it was whether Ken Iverson with an APL, or with Norm Rasmussen at the Cambridge Science Center with VM/CMS. Almost all these things at that point in time were initiated through customers. They were working with the customers. CICS was Chicago.

### **Software Unbundling**

**Schorr:** Well, at that time, I think we'd had whatchamacallit. Didn't we have no more bundling?

**Grad:** In 1969. I was on the unbundling task force. In June of 1969, we announced separate pricing for services and software. Then we set up all these development groups in DPD

**Schorr:** It was harder to get customers to pay for a lot of those things then.

**Grad:** It was a difficult transition, and it was very difficult. But that's what gave life to software companies. So now, IBM wasn't giving it away for free, so they felt they could do something. It's an interesting period of time here where IBM—from my view, and you probably saw it better than I—still thought of itself as a hardware company.

**Schorr:** Always thought of itself as a hardware company. As a big mainframe hardware company.

**Grad:** Even more so, exactly. Well, GSD was there, which is the System 3s and the follow-ons.

**Schorr:** Yes, that was set up deliberately to do that. Contrary to popular opinion, they sold more minicomputers than DEC.

**Grad:** Yes, but it depends on how you define a mini. But we had the Series 3; we had the Series 1s. There was another one, Series 7? There was a lot of stuff being sold there. But people don't think of IBM as that size company.

**Schorr:** No, but they did do it.

**Grad:** Well, the culmination of that was something that took advantage of all the FS work; that was the System 38 and the AS/400 done in Rochester, Minnesota.

**Schorr:** Yes.

**Grad:** Were you involved in that in any way?

**Schorr:** Well, they came to all our meetings, and they would look at all the technology we were doing in System A. I scratched my head and said, "Well, why the hell are you doing it?" It turned out, "Why are you interested? We thought we were doing a high-end system." And they said, "No, no, no. What we have to do is keep up with the printer." That was the only requirement. Ease of use was their main goal. What we had done with these layers had made it easier to use the system.

**Grad:** And easier to develop applications.

**Schorr:** Yes.

**Grad:** That was a major factor for the AS/400. I think when they announced it, they announced 2,000 applications on Announcement Day. Unbelievable!

**Schorr:** They were interested. They implemented. When we were System A, and we just aimed at the wrong market. We were all high-end types, basically.

### **Leaving IBM**

**Grad:** Interesting change that took place. Okay, you're at IBM. Tell us about the culmination, your ending of your IBM career.

**Schorr:** Well, I did this for three/four years. We had other products, and then my good friends at IBM management decided to offer people buyouts. I had been 24-and-a-half years, and they made a mistake. They said you had three months to decide this, but if you didn't take it, they gave me years to my retirement.

**Grad:** Added another five years?

**Schorr:** Not five, but they added, and they said, "If you don't take it, you lose this." Well, it turns out Price Waterhouse was wrong. The government told them, "No, once you make people eligible for..."

**Grad:** "You got to."

**Schorr:** "They're done." So, I said, "Oh, mm!" Then I said, "What does history tell me? When these corporations start doing buyouts, they do it a second time." And sure enough, they did.

**Grad:** So, you hung in there a little bit.

**Schorr:** Yes, I hung in for about a year. I had three opportunities in front of me, and I decided it was time to leave IBM. I had done what I could do there, so I went. The Cornell Supercomputer Center wanted me to run it. And I was looking at MCC. And I was looking at a startup, but I didn't like the startup game. It looked to me like instead of working for IBM, you were working for the VCs. I decided that USC with this ISI was as good a thing as I could see, as I would like.

**Grad:** What was this?

**Schorr:** Well, 1989 I left IBM.

**Grad:** 1989, okay. You went directly to USC at that point?

**Schorr:** Yes. Not completely. It was very funny. I was involved up to my eyeballs in this AI, and they had things they wanted me to do to talk with customers.

**Grad:** Who's "they"?

**Schorr:** IBM. IBM said they needed to borrow me for a month from USC. They would allow USC to announce me, but I would work for IBM for another month, which is what happened.

**Grad:** You ended up cleaning up some work on the AI stuff that you had done for there. And IBM still had no product in the AI area per se.



**Schorr:** Right.

**Grad:** Either hardware or software.

**Schorr:** As far as I know, none.

### **Information Systems Institute at USC**

**Grad:** All right. Now, you go back out to the West Coast, but not to Silicon Valley. Why did you choose USC? What appealed to you?

**Schorr:** Okay, part of this, somebody asked Ed, what happened to Rand's Computer Science activities? What had happened was... it's a long story. I don't know if I give you the long version. You remember, Daniel Ellsberg and the Pentagon papers came into being. Nixon, being the gentleman that he was, decided he would penalize Rand. What he did was a lot of the other defense contractors didn't like the fact that Rand got a bunch of these other FFR, VCs got contracts without having to compete. So, Nixon put in a limit that you could give up to so much dollars without competing, and he just set the number for Rand just at what they already had onboard. DARPA was setting up the internet, the Arpanet at that point, and they wanted Rand to do it. Rand had the choice of doing that or doing some of the strategic studies. Rand was run by economists, not technologists, so they shed themselves of that and about four or five people left Rand Corporation and came to USC. So, the computer work essentially transferred from Rand to ISI/USC.

**Grad:** What is ISI?

**Schorr:** Information Systems Institute.

**Grad:** They had existed for a while before you came out there. Is that correct?

**Schorr:** Yes!

**Grad:** I heard it mentioned yesterday in our expert systems meeting. What was the role of ISI?

**Schorr:** They essentially were a DARPA contractor. They did all sorts of systems for DARPA. Bob Kahn used them sort of as his own research lab.

**Grad:** Software, hardware concepts?

**Schorr:** Yes.

**Grad:** Was it a whole range of things?

**Schorr:** Yes, we did a lot for the internet. We were called the "plumbers of the internet."

**Grad:** Give me an example.

**Schorr:** Well, you know with the domain name system.

**Grad:** Sure.

**Schorr:** We invented that. And we did a lot of the software, which ran the internet.

**Grad:** This was a very exciting period of time.

**Schorr:** Yes, but I was not there at that.

**Grad:** No, I understand. The 1990s was an exciting period of time in terms of the broadening of these kinds of things.

**Schorr:** Yes.

### **AI Research at ISI**

**Grad:** What do you remember are the things that you most enjoyed doing at ISI?

**Schorr:** Well, again, I set up their AI

**Grad:** Okay, tell us about it. That's quite pertinent.

**Schorr:** Well, we did the whole range of activities.

**Grad:** You have some words here that may help. Networking, grid technology, cybersecurity, AI, quantum computing. Wow! And open source methodology. Tell us about the AI part. What did you do there?

**Schorr:** Basically, we set up the group. We became very good at natural language. Our natural language stuff was used in Watson, for example.

**Grad:** Did you look at hardware implementations? Did you look at Lisp machines, any of those kinds of things?

**Schorr:** For AI, no. No. To put a bookend on what was discussed yesterday, I came out there and some of the people who I formed this group with had Lisp machines. They were costing me a fortune. Aside from the cost, their maintenance bills were astronomical. These were all covered in one budget, so I split out the budget and told the guys, "You'll pay for this out of your research contracts," etc. And guess what? The Lisp machines disappeared.

**Grad:** You've ended up in an interesting position. You started briefly in academia with your Columbia experience, and now you're back to a university, but you're not on the teaching side.

**Schorr:** Correct.

**Grad:** You still were working with professors and things like that there. You were consulting with people?

**Schorr:** No, I started that. When I came there, there was nothing with the School of Engineering. I started getting graduate students onto our contracts. We would get some professors. Debra Estrin is in New York now, because she wanted to do things, and she couldn't do it on campus. There wasn't enough help, enough resources, and so on. She started doing work at ISI. She spent a sabbatical year there. She figured out that this was a good type of environment for her, so we shared her. Between the campuses, she had a group at ISI.

### **Research Funding at ISI**

**Grad:** Well, for example, you helped develop a curriculum in informatics, didn't you?

**Schorr:** Yes.

**Grad:** What was that about? Who did you work with?

**Schorr:** I reached a conclusion that this research thing, it was very bad, that you had to get tuition dollars; this was important for keeping flywheels for things going. For instance, at one point, I wanted to do what's now called machine learning. I had a guy lined up to come, but I couldn't get funding for him. I didn't have enough spare money to do that, so Google eventually did that. We also had a group on face recognition, and I couldn't find money to support that from DARPA and other things. Getting contract money alone was not enough for my thing.

**Grad:** So, ISI had been surviving on that kind of money before. That was the case?

**Schorr:** Well, ISI had a better deal, but it had ended. That's what caused my predecessor to leave ISI. ISI had a deal where they went in and talked to DARPA, and they got a budget for the year. No contracts, just that one.

**Grad:** The one budget, wow.

**Schorr:** It was a great deal, but they lost that just a year or two before I came. The guy who had founded the place quit. He knew he was not going to be the guy to invent new projects to sell them. He was very good at working Washington and getting a budget for ISI. I guess one of my capabilities is to think new things up and so on. And that was not his.

**Grad:** Are you still working there at USC?

**Schorr:** No.

**Grad:** When did you finish then?

**Schorr:** Three years ago.

**Grad:** That was about 2015, probably.

**Schorr:** Yes.

**Grad:** Let me go just a little further on what were you able to. Did you get AI introduced into the curriculum at USC, for example?

**Schorr:** No, they had stuff. We got more involved with teaching the courses. People would teach as adjuncts there.

**Grad:** You seemed to be an advisor there at USC, besides your ISI role.

**Schorr:** Correct.

**Grad:** You consulted and advised the Vice Dean of Engineering, people like that.

**Schorr:** Well, I wound up getting the High-Performance Computing Center I designed and got funded, things of that sort.

**Grad:** You ended up being able to raise money, which was not one of your jobs. I guess inside the company you were, but you weren't outside.

**Schorr:** That's right.

**Grad:** That's definitely different skills, getting people to provide money to an organization. Grant processing, I'm told, is very difficult. You have to know your way around.

**Schorr:** Yes, yes. That's why my latest scheme, which has nothing to do with this, but I did invent when I was at ISI, but it wasn't going anywhere. I had a lab to feed, so I couldn't spend the time I can now spend developing this and trying to sell it.

**Grad:** Are you willing to mention what it is, briefly?

**Schorr:** Sure, I'll be happy to. I'm looking at how you protect a power station from cybersecurity in attacks.

**Grad:** This is basically a software approach primarily?

**Schorr:** Yes.

**Grad:** Have you actually presented it for funding to major organizations?

**Schorr:** Oh, yes! I tried it. I went to the swamp as Fritz said. He wound up in the swamp. You want to hear all this basically?

**Grad:** We'll have to cut it off, unfortunately. That's another whole direction, but you had good connections there in getting the money at USC.

**Schorr:** Yes, that's at a certain level. This has got to be done at a much higher level. It's got to be dedicated money.

**Grad:** This is not just DARPA kind of funding.

**Schorr:** No, I tried DARPA funding and didn't succeed.

### **Personal Art Collection**

**Grad:** We have just a few more minutes. I want to talk about you as a person and these things you've done, which are obviously significant outside of your work at IBM, outside of your ISI work. What do you do for fun?

**Schorr:** Well, my wife and I are great art collectors, if I have to say so myself. In fact, that's one of the joys of my old age is that all sorts of artists we discovered, found, and nurtured have now become extremely popular, extremely desired. Pieces from our collection are going into museums all over the world.

**Grad:** When did you start collecting?

**Schorr:** Oh, we started when I went to IBM, basically. It was in the 1960s. Way back.

**Grad:** You couldn't have had a lot of money then to buy stuff.

**Schorr:** No. Originally, I bought works from professors at Stanford and Berkeley, and they were a few hundred dollars. That's all.

**Grad:** Was there a particular kind of art that appealed to you at that time? Other than being cheap enough for you to buy?

**Schorr:** No, when I was 12 years old, there was an article, I believe it was *Life*, maybe *Look*, on Jackson Pollock. They said, "Is he the greatest American painter?" I looked at it and thought it was terrific! I liked that, and that was sort of my impetus.

**Grad:** So, abstract art; as a 12-year-old, you found it interesting?

**Schorr:** Yes.

**Grad:** Wow! Did you ever paint?

**Schorr:** No, but I can draw, maybe better than a lot of these characters could, but not good enough. I mean, my advice to young artists is, "Go to Barcelona and look at the Miró and Picasso Museums and see what they did when they were 9 years old, how they could draw and paint.

**Grad:** I've always been excited by the fact these people, we see abstraction, but they really were good drawers. They really, really could do with that.

**Schorr:** Yes, and paint. They really knew how to paint.

**Grad:** Colors and stuff. Okay, so you're now on the West Coast in the 1960s. Are you looking for abstract types of things? Is that the nature?

**Schorr:** Well, in 1968, the Museum of Modern Art had a show of Miró prints, and it was the first time he had done large with a process called aquatints, which was new. They were like having a painting, almost. We started buying them.

**Grad:** it was aquatint?

**Schorr:** Aquatint. And we bought Picasso prints. Then we went to Rauschenberg and Johns. Then someone pointed out what I'm paying already for a Picasso print, I could buy a small de Kooning painting, and we did.

**Grad:** Boy, you have all the right names, don't you?

**Schorr:** Well, yes, but those days were easy. Then we went into young art, brand new art, because de Kooning, you could only buy so much for a lot of money. You could buy a big painting from a young artist.

**Grad:** Was this a particular location you then focused on? Or were you looking internationally?

**Schorr:** No. New York, t basically based in New York.

**Grad:** You were looking at young painters, young artists in that area?

**Schorr:** Yes, it was hard. Europe, buying European art, well, it was hard to see. We had to see.

**Grad:** Did you have a particular gallery that you worked with or people there in New York?

**Schorr:** No, not particularly.

**Grad:** Because sometimes you use them as a birddog to find interesting people.

**Schorr:** No, we were the first collectors of Basquiat. I think you probably never heard of him.

**Grad:** I've heard of him.

**Schorr:** And we were the first collectors of Keith Haring.

**Grad:** How did you find these people? We just have a minute or two, but how did you find these people? Did they find you?

**Schorr:** No, we didn't find these guys until 1980. We had been collecting since 1968. We bought some young artists in the 1970s, and they didn't make it for us. We gave them away. We eventually started seeing young artists going to the galleries which showed young artists.

**Grad:** Because that's what I was wondering, whether you had a particular gallery or a couple of them which specialized.

**Schorr:** No, it varied by artists. I mean, there are some people who just buy from one gallery, and that's their collection.

**Grad:** Okay, you have apparently a very large collection, I gather. You're putting these pieces in museums around the world at times? Are they exhibiting your stuff?

**Schorr:** Well, at Princeton, we have 100 pieces.

**Grad:** Are those donated, or are those on loan?

**Schorr:** Yes, half-and-half. We've given them half.

**Grad:** Other places that you've either given or have on loan?

**Schorr:** Yes, when we left California, we gave about 60 or 70 pieces to local museums, Santa Barbara, Riverside, Mulgrave a few, and Hammer a few.

**Grad:** You've been very generous donators, then.

**Schorr:** Yes, we're the largest donators to Princeton in terms of numbers. I'm not sure in terms of value, because Forbes is one of the alumni and he's got a big, expensive collection.

**Grad:** You still have a major number of pieces that you still own.

**Schorr:** Yes.

**Grad:** Where do you store them?

**Schorr:** Half are at Princeton on loan.

**Grad:** I mean, the ones that you haven't out on a loan? You have your own gallery, your place that you exhibit?

**Schorr:** Well, we have a couple houses. My sons have stuff. We have storage.

**Grad:** Where's your home right now? Where do you live most of your time?

**Schorr:** Manhattan.

**Grad:** The other part of your time, are you out here on the coast?

**Schorr:** No. In Westchester.

**Grad:** Manhattan and Westchester are your two primary locations.

**Schorr:** Yes.

**Grad:** This has been fascinating. You know, as I said, I met you many years ago for a relatively brief time where we were both at IBM Research.

**Schorr:** Yes.

**Grad:** I knew nothing about your collections and so forth, but you were working for the same guy that I was working for at the time. You continued on and I left and went to do consulting for software companies. Now we've reconnected some 40 years later with AI.

END OF THE INTERVIEW