

Oral History Interview with

Paul Ceruzzi

November 24, 2020

Via Zoom

**Conducted by William Aspray
Charles Babbage Institute**

Abstract

Ceruzzi discusses his upbringing, education at Yale and Kansas, and work at Texas Tech, Clemson, and the Smithsonian Institution's National Air and Space Museum. Topics include his books on Aiken, Stibitz, and Zuse; on flight in the computing era; and on Tyson's Corner; as well as the several editions of his general history of computing. He discusses the computer history community – individuals, Annals of the History of Computing, and the Society for History of Technology special interest group on computer history. This interview is part of a collection of interviews on the early history of the history of computing.

Keywords:

Texas Tech, Clemson, Smithsonian Institution National Air and Space Museum, Korad Zuse, Tyson's Corner, Annals of the History of Computing, SHOT Special Interest Group in Computers, Information, and Society.

Aspray: All right. So, this is the 24th of November 2020 with an oral history with Paul Ceruzzi, who's in his home in Maryland. I'm in my home in Boulder, Colorado, and we're doing this interview over Zoom. I thought we should start, Paul, by asking you to tell me the year you were born, where you were born, something about your parents and about siblings.

Ceruzzi: Well, I was born in Bridgeport, Connecticut in 1949 and lived in a suburb of Bridgeport. My parents: my mom was a housekeeper. My father worked for an insurance company. Bridgeport at that time was one of the most industrially advanced cities in the country: machine tools, aircraft parts, automobile parts, lots of what was advanced technology at the time. Since then, it's completely deteriorated. It's a very sad story, but at that time it was a very prosperous city. I attended parochial schools, one year of a Jesuit high school. And then I went to prep school in Northern Connecticut. Then from there to Yale, a degree in American studies, I started out as a math major. I was always good at math, but as is very frequently, the case, I ran into a brick wall in my sophomore year and just couldn't go further. Although I never lost my enthusiasm for math, but I ended up being an American studies [major], which is sort of a fallback, but it actually turned out to work very well for me.

Aspray: When you were growing up, did you have particular hobbies?

Ceruzzi: Yes, I did. I had a ham radio license for a while, and that was a sort of interesting story about [it]. I loved electronics and ham radio and all that sort of thing. But at the same time, I never got very good at Morse code. And if you want to be a ham, you've got to know Morse code. And I think it's the same thing happened later in life where I studied German to go to

Germany, and I never got as good in German as I really should have been (or any foreign language for that matter). I studied Spanish. I tried to learn French. I don't have the talent, let's put it that way, but I had the desire. But yes, I was interested in electronics. Also, the town I grew up in, Easton Connecticut, was surrounded by lovely woods, and I would spend hours and hours walking through the woods. It was a wonderful place to be a child.

Aspray: And when you were growing up, did you have some goals or sense of what you wanted to do with your life?

Ceruzzi: Well, not really. I assumed I was going to be a scientist, but I had no idea what that meant. My parents would have liked [me to] be a doctor, a medical doctor, and I didn't feel any desire to do that. Although I studied biology in high school. I loved biology. I still do. I studied chemistry and physics, and I just felt like [I have] to see where things go.

Aspray: Now, you must have been a good student along the way because you got into Yale. Why did you choose to go to Yale as opposed to someplace else?

Ceruzzi: Well, that was really pretty much my parents. We were in Connecticut, 30 miles away from New Haven. I don't think there was much... It's interesting because I also applied to other top schools. I got into Stanford, and of course in those days Stanford, wasn't what it is considered today, you know? We can talk about that some other time maybe, but who knows what would have happened had I gone to Stanford? I got into MIT. I did not get into Harvard, but whatever.

They were all sort of on the same level. I suppose I had no idea what I was getting in for, to be honest with you.

Aspray: In your time prior to college, were there any individuals who were shaping influences on your life?

Ceruzzi: I don't think so. No. I had excellent teachers at Hotchkiss prep school. Chemistry was excellent. They were all pretty good. They were different. I'll tell you a little story about that, because the head of the math department at Hotchkiss was very much enamored of something they called the "new math." You know what it is, Bill. A lot of people don't know what it is. Of course, everybody should know that Tom Lehrer wrote a satirical song about it. You can Google that. It's really an attempt to put mathematics on a solid theoretical foundation based on the work of Alfred North Whitehead and Bertrand Russell. Some of the faculty kind of laughed at it. I loved it. The head of the department had his own textbook, School Mathematics Study Group (SMSG), which one of my teachers said [contained] "some math, some garbage." But I actually liked it. Though the irony of all this is that, of course, when computer science comes along, it's exactly what computer science is all about; the logic of a microprocessor is based on Russell or Whitehead or Hilbert, or stuff like that deep down inside. So, I guess you could say I was lucky that I had that background.

Aspray: Why did you choose an American studies major?

Ceruzzi: It just sort of fell into my lap really. I was always interested in American history and I knew I just couldn't continue the math program as much as I wanted to. It was just there. There were some interesting professors at Yale. Some of whom were later controversial. This was the 1960s, late 1960s. So, it just sort of happened, I guess.

Aspray: Did you enjoy your time at Yale?

Ceruzzi: No, not really. It was a very difficult time to be a student, with the draft and everything else – riots. There were riots in New Haven about a trial of a Black Panther. The head chaplain of Yale, William Sloane Coffin, was indicted for conspiracy; you know the whole story. I probably would have been better off avoiding all that. It's interesting because other schools did avoid it. I think Princeton and Stanford escaped through all that, more or less, but Yale did not. I was, uh, sort of torn about all of that, but I got through just barely, I suppose.

Aspray: And as college was going on, did your career plans start to solidify?

Ceruzzi: Absolutely not. No.

Aspray: Okay. That's fine. Did you go directly on to graduate school after completing your undergraduate degree?

Ceruzzi: No, I didn't. For reasons that I'd rather not get into, I ended up in Kansas City, Missouri. My first real job, I had a few little jobs, but my first job after graduation was at the

Linda Hall Library. As you probably know, Ben Gross is now there. Yes, that's right. Excellent technical library. I was a "page.", I fetched books off the shelves, but I also became the assistant interlibrary loans librarian. It had an enormous, world-renowned collection of technical materials from all over the world [matched by] very few other libraries in the world [and] certainly in the United States. We got interlibrary loan requests for things, and my job was to find them. They would [at] times be very, very sketchy. And my job was to find them. And nine times out of 10, we had it. Then I would fetch it off the shelf and hand it to somebody to Xerox. In the process of fetching it off the shelf and handing it to the Xerox people, I would glance at it. That, to me, was more of an education than I ever got at Yale. It was like I was on top of everything. In fact, I remember very clearly a number of requests coming in for something called complementary metal oxide semiconductors [CMOS]. As we now know, that's the basis of Moore's Law and everything, our whole world depends on. I was right there right there at the beginning of it. Of course, I didn't know what was going to happen, but I was there right at the beginning of the interest in CMOS. (I think that's how you pronounce it.) And so, things like that, it was just good luck. The other thing that was very crucial about this job – I didn't have it very long – was that there had a good collection of books. Some were very rare books, the *Philosophical Transactions of the Royal Society*, and all that. But I just glanced at one book. It was the catalog to the IBM exhibit on computers called *The Computer Perspective*, which was edited by [Charles and Ray Eames]. [with research done by I. Bernard Cohen of Harvard.] I glanced at it. You know, we had a little bit of leeway. We could browse, goof off a little bit. But I looked at, and there was something in there. A picture of Konrad Zuse - German, computer German built, you know [a] calculator. I don't have the book anymore. I think I gave it to the Babbage. I remember this, I was intrigued by the fact that he [Zuse], for reasons of economy, couldn't afford [an] expensive paper

tape reader. So, he used discarded movie film, which he punched holes in to run the program. Oh, this is really cool! Well, as we will probably get to later on, that ended up being a big, big influence on my life by total chance.

Aspray: So, how long did you do this?

Ceruzzi: I think I was there about two years. Then I applied to the University of Kansas, which is just down the road, for American Studies again, not really knowing what I was going to do there, but I just wanted to continue my education.

Aspray: Kansas has a very good American history department, if I remember correctly. Did it turn out to be a good place to be for you?

Ceruzzi: Yes, in a number of ways. It had an American studies department, which also hosted a journal. The journal was called the *Mid-Continent American Studies Journal*, which is now called *American Studies*. It was edited there and [the program] had a faculty of four, and they were fine. There was also a professor of sociology who taught a course on the history of computing, which in the early 1970s was quite rare as you might imagine. His name was Professor Walter Sedelow.

Aspray: I've heard this, why Sally was a linguist published.

Ceruzzi: We didn't know this, but he must've worked in the defense establishment. He talked about SDC [System Development Corporation], a place I'd never heard of before. Nobody knew about SDC. He mentioned [J.C.R. Licklider. He mentioned DARPA, ARPA back then. He mentioned Bolt Beranek and Newman, another company that-- who would have heard of that tiny little lab? So, he knew some things that the rest of the world didn't know. I would give anything to find my notes from that course, but I've lost them over the years. But it was also a lot of traditional stuff about IBM, Burroughs. But the textbooks... there were three textbooks. I remember them Herman Goldstein, [The Computer from Pascal to von Neumann], which is still in use. What was the second one? [Canadian computer scientist] Kelly Gottlieb published a book on social issues and computing. And then a compilation of essays by Zenon Pylyshyn, a compilation of essays, which included the famous essay by Vannevar Bush and one by Norbert Wiener. And the usual people back then; this was the early seventies. Bernie Williams was in the class with me, small class, but it obviously was quite lucky. I stumbled on it, and there it was, I was not really a computer person. I had programmed with cards. I hated punch cards. I never, never understood how to program with punch cards. Never, and I probably never will.

Aspray: Right. And so, you chose to do a dissertation in this area?

Ceruzzi: Well, yes, but that's where Konrad Zuse comes in because I applied for a Fulbright. I wanted to go to Germany. I'm not quite sure why. I can't remember why. I just wanted to get out of the country and travel and see the world and broaden my education. I applied for a Fulbright [but] was turned down. Then I reapplied the next year and got it. It was actually not literally a

Fulbright. It was called DaaD [Deutsche Akademische Austausch-Dienst] German academic exchange service grant. The other interesting thing is, but Michael Mahoney had one also.

Aspray: Yes, I did know that.

Ceruzzi: We had a lot in common. Mike and I both went to prep schools and Ivy league. I didn't know any[body], didn't know what to do there. They arbitrarily sent me to Hamburg. They looked at my resume and said, he'll go to Hamburg. And I found myself at the Institute for the History of Natural Sciences [IGN] in Hamburg that was run by Professor, Christoph Scriba, a historian of mathematics. I attended his lectures. His lectures were very much old-school internal math. You probably know that kind of stuff, Bill, better than I do about the history of math. There were some other lectures, Hans Schimank. I think I pronounced that right. He had been a student of Max Planck. So, just think about that for a moment. Rather elderly. I still have my, I found this, my student course book, from there.

Aspray: What year was this?

Ceruzzi: 1977, 78. And I even have the courses that I took. One of them was a German remedial course because my German was so bad. [And because he was a professor of mathematical analysis, Christoph Scriba taught a course on that. [inaudible] And a course in the history of science. There was no history of technology back then, or very little, and certainly not in Germany. So, I'll just go on a little bit further here. I went into his office and he said, "Welcome. You don't worry. You don't have to do anything here. We don't care. You don't have to write

anything, just have a good time studying what you want.” Okay, fine. I don't really know what I'm doing here, but I remembered that there's this -- I didn't say it at the time, outrageous claim -- that the Germans claim they invented the computer, which goes back to that I.B. Cohen image in *The Computer Perspective*. And Scriba said, “The guy's still around. He lives in Germany. Why don't you just write to Zuse and ask him?” So, what, you know, it's like, Oh my God. So I did, I wrote to him, I actually got a student in the dormitory to help me write the letter in German. And he invited me to see him in Huenfeld. That's his house, Konrad Zuse's. We had a wonderful two days of discussion about computer architecture and everything. So, that's where it all began really; that, combined with what I had learned from the course from Sedelow. The other thing that happened while I was in Germany is I stumbled across a copy of this book [Computer Lib, by Ted Nelson], which I [still have], a first edition, it's in terrible condition. I kind of totally fell overboard with some of [Ted] Nelson's stuff. I cherish this, but anyway, that's sort of set me [going in the right direction], it kind of got rid of the stigma of the punch card world that I had so much trouble with. I just couldn't do it. That's how the dissertation [came about]. Now, the funny thing is that it's an American studies dissertation. So, how are you going to let American studies allow a dissertation about the German? I said, well, I'll figure out a way to do that. I will compare [Zuse] to Howard Aiken and George Stibitz, who were Americans and say, they're all working approximately the same time. So, that went okay. By a miracle, it was accepted. Somehow, I managed to do it. It ended up being my first book, *The Reckoners*, which is now available online, [published by] Greenwood Press.

Aspray: A few questions. Who was your advisor at Kansas?

Ceruzzi: Uh, a professor named Jerry Stannard, who was actually a natural history professor.

Aspray: Okay. And was he valuable in the process?

Ceruzzi: He was very rigorous about scholarship. He was not an expert in technology, but he was very rigorous about sources, primary sources, the bibliography, that sort of thing. And I really appreciated that.

Aspray: Did you continue to have contact with the people in Germany after you came back to the US?

Ceruzzi: I did. I went back a couple of times. I met Zuse again. And, of course, what was happening there later became much better known [than] at the time I met him. He was not very well known at all, even in Germany, but now so he's [much better well known], increasingly; so I would like to take credit for having brought his work to America, but I don't think I did, other people did that too. But I did publish the book about the question of how was he the inventor? Well, you know how that is, everybody wants to claim this and that, and that's not what I wanted to prove that he was or was not the inventor of the computer. We all were guilty of that. I think we've all moved on a little bit.

Aspray: How would you say that your training in American studies prepared you to be a historian of computing?

Ceruzzi: I don't think there was much of anything really, to be honest with you, it's hard. The only thing I can remember was Stannard's emphasis on bibliography. You have got to have a solid bibliography. And, to this day, I still agree with him. Although, you know, with the advent of Google digitizing books and Wikipedia collecting books, [the situation] is not really what it used to be. And I don't know what else to say about that.

Aspray: Okay. Tell me about the process of writing *The Reckoners*.

Ceruzzi: Well, that was my dissertation. I don't know if it was Stannard who said, "well, what you want to do now that you've got your dissertation is take the smell out, take all the stuff that you put in there to satisfy your committee and just tell a story." [This is advice] I passed that along to other people at the Air and Space Museum, and sometimes they look at me funny, but I anyway, I actually did quite a bit of primary research in Germany, in German. That involved me ... that led me to getting involved with Zuse's dissertation, which I guess. because of the war. I don't think he was awarded [his degree] until much later. But I found something very interesting. And this goes back to the Goldstein book [The Computer from Pascal to von Neumann], that textbook, where he talked about Shannon's master's thesis equating symbolic logic and electrical circuits. And Goldstein said, this is the most important master's thesis ever written. You know that, Bill, right? You ever heard that? Well, it turns out that all of this was going back to David Hilbert and the German logicians, who were in contrast to Whitehead and Russell, they actually really did a much better job of this to put it mildly. And Zuse, he told the story and it's in his book: [Zuse said] "Well, I went to a professor and said, I've just discovered that you can use symbolic logic to do electrical circuits. And his professor said, no, that's all been done by Hilbert

already.” And he went to Hilbert; and I found myself immersed in all of that. And still to this day, I believe that that's the real story about the origin of computer logic. [It] is not Shannon, but rather the Germans - and not just Hilbert, but people who came after him. And I'll tell you one more thing here. If you look at Turing's paper in 1936, he says, its application to the Entscheidungs problem. He used the German word [for] decision problem, because Turing understood where it all came from. It was derived from something that Hilbert proposed in 1901. Anyway, that's what I did. A lot of that. I ended up going down rabbit holes of other German logicians and mathematician and I feel very good about that. Then, of course, I had to do relatively the same thing for the Americans, but that was a little bit easier because there was lots being written and published about the Americans.

Aspray: So, the dissertation compared to *The Reckoners*, you did additional research? You took out the--

Ceruzzi: The first chapter yes, but it was pretty much [the same]. This was another funny thing. Paul Armer was the head of the Babbage Institute at the time. You knew him. He had been with RAND. He just took the dissertation and sent it to Greenwood Press without even asking me. And Greenwood Press just said, yeah, fine. I was at Clemson at the time, just starting out and, and I said, “oh yeah, by the way, I got a book coming out.” And they all went, “What, how did you do that?” You know? Because Clemson had some faculty who struggled with [getting] published, just [to] put it mildly without going into a lot [of detail]. I did a few things at the end of the [book to change it], [but] it was very close [to the dissertation]. It was rewritten. Basically, I sat down and re- typed the whole thing from scratch. One thing I added is I wrote programs for

a Hewlett Packard calculator that replicated the work of the programs. So, these computers, Zuse had one to invert a three by three matrix, Stibitz had one to do complex numbers, and Aiken had one to evaluate a long polynomial. So, I wrote programs for a pocket calculator. I remember Martin Campbell Kelly said, "all that's crazy, you know," but I just felt I was going to do it. The proof that this was real, [that those early reckoning machines actually did useful work]. Of course, that calculator is no longer around, and you can get an emulator on the internet, but I doubt anybody [tried it], but it did work. I actually was able to replicate complex number arithmetic, which is what the Stibitz machine did, with a HP 41 calculator, which is kind of cool. I still think that's cool.

Aspray: What was the reception of *Reckoners*?

Ceruzzi: I think it was pretty good. I don't know the sales. It eventually went out of print. Greenwood Press wanted me to do more. So, I guess they must've liked it. I liked it. There was a one little wrinkle in it, which I don't know whether you want to preserve this or not, but I managed to discover that Zuse had a collaborator, Helmut Schreyer, who had been a member of the Nazi party; and I put that in the book. I was naive kid, didn't know much about Nazi history. But when I would mention to people that I was working on this dissertation, first thing they said was, was he a Nazi? First thing! Or they'd come out and say he was a Nazi, you know? So, I couldn't *not* look at that question. And in those days, the US Army had jurisdiction over the list of [Nazi] party members. And as an American citizen, I had access to it by writing them a letter, on which German citizens may or may not have had [membership]. Anyway, I wrote them a letter, the Berlin Documentation [Center] sent back a letter saying they had no record that Zuse

was a Nazi. They said that some of the people he worked with were members of a youth group affiliated with the Nazis and that Helmut Schreyer was a member. At the time he was living in Sao Paulo, Brazil. Schreyer wrote me a very personal letter saying, how did you do this to me, ruin me, all these other things. I felt terrible, but I had no choice really. Now it's interesting. And, like I say, we may want to edit this out, but now there are several German scholars, I think, [Hans Dieter] Hellige and [Ulf] Hashagen, who are doing some further research about Zuse's [political] background. Maybe I was a little naive, I don't know, but I had decided not to pursue that any further. I met [Raul] Rojas recently, and he told me this latest [news about the German historians], but I don't do that anymore. So, that was in the book. I loved the book. Some of the Germans, I think they felt like it should've been a German writing the book, not me, but whatever.

Aspray: Tell me about Zuse as a person.

Ceruzzi: He was a wonderful guy. Really. He was just absolutely the nicest person you'd ever want to know. And we got along really well. He had some incredible stories about World War II, the end of World War II, how he survived and how he managed to get out of Berlin. While the bombs were falling, he went to Goettingen. Then he went from there to a place called Nordhausen, which is where von Braun had established a factory to build V2 rockets using slave labor, concentration camp labor. You can read Mike Newfeld's book [The Rocket and the Reich] about von Braun, the man [who] put Americans on the moon, but Zuse claimed in his book [that he was there]. This is a very interesting story. This book [Zuse's autobiography, Der Computer, Mein Lebenswerk], this first edition was written... I'll have to look at it here... in, I think...

well, 1970 is the copyright. Although I think he wrote it even earlier than that. The von Braun story had not come out at the time. But [Zuse] claims in his book that he saw the facilities there and said, no, I don't want to have my factory there. I believe him. Now, some people don't believe him, but I do – just from my knowledge. He then went to Bavaria, hid out in a barn and was interrogated by the British. And eventually went back to [what was now West Germany]. He claims that IBM wanted to take his patents. It's a complicated story there, but the Z4 computer was eventually installed in Zurich. It did a lot of work for a long time. It was one of the very few functioning computers in all of Europe.

Aspray: By the time that you actually had a chance to meet him, how old was he?

Ceruzzi: Well, he was born in 1910, so he was in his sixties. He was very, very alert, very healthy.

Aspray: Was he still working?

Ceruzzi: Yes, he was. Well, this was an issue... his company. He founded a company, and this is very much the parallel with Eckert and Mauchly. It ran into financial troubles and was eventually absorbed by Siemens. I remember I said something in the book about that, and he very forcibly corrected me saying, "No, I didn't go bankrupt. We entered in that merger". You know, he wanted to be sure he had that [stated correctly]. I think in the United States, to fail is part of the Silicon Valley ethos, but in German you don't want to admit that you've ever failed. He did have a successful business. There's no question about that for a while.

Aspray: You mentioned in passing Paul Armer and the Babbage Institute, do you want to talk about them?

Ceruzzi: Well, I mean, that was founded right around the time I was in graduate school and the [fellowship] helped support my dissertation. They gave me some money, which I very much appreciated at the time. We had a meeting in Minneapolis with Paul and, you know, in those days a lot of the pioneers were still alive and active. You could talk to them. I can't remember specifically who was there, but we had a great time. Paul was a wonderful mentor in a way, although I don't think he was a detail[-orient]ed person, but he certainly helped me with the dissertation, encouraged me to keep going with it and everything like that. I didn't have much other interaction with the Babbage. I interviewed for the job of director but didn't get it. And I'm really lucky I didn't get it. I'm not a manager person. So, the Babbage had been moved to Minneapolis by that time. I guess it started in Palo Alto. Is that right? Yeah. Right. I never went to Palo Alto for that anyway. I mean, I went to Palo Alto, but [when I went to the Babbage Institute] it was in Minneapolis. I don't know the exact date, but you could probably find out.

Aspray: Right. Tell me about your going on the job market and ending up at Clemson.

Ceruzzi: Yeah, well, I was married, my wife was pregnant. I was finishing the dissertation. I had a defense scheduled and I heard that there was an opening at Texas Tech University in Lubbock, Texas. The professor there was Bob Seidel, whom I'm sure you know, later the head of the Babbage. He had a sabbatical and I applied. I didn't hear anything. And then, you know, uh, here

in the middle of a hot summer in Kansas City, Missouri, where I was still working on a dissertation and blah, blah, blah. And I suddenly got a call saying come to Lubbock in two weeks and start teaching. My wife was eight months pregnant and I had an ancient car anyway, make a long story short. Yes. I went there. That was my first teaching job. It was not tenure track. It was visiting, to replace Bob in the history department. Of course, I had to sink or swim, develop courses and all that. Not history of technology obviously. The first thing I did... we didn't have any health insurance, but we went to the hospital at Texas Tech and said, my wife's going to have a baby and we've got to do something. They set me up, everything went fine. So, my daughter was born in Texas in [September] 1980. Then, we moved back to Kansas City after the year. Bob [Seidel] was still out. I don't know what happened to him, but then the same thing happened. I got a phone call. Oh, I do know what happened. I applied to Clemson, went down there for an interview. I remember, I went down there the day of the air traffic controllers strike, where President Reagan fired all the air traffic controllers. So, the airlines were in a total mess. It took me hours to get to Greenville, South Carolina. I had no sleep or anything like that. I was put up in a hotel in Atlanta and there was a big loud band playing in a bar next door. Anyway, I had the interview. They offered it to someone else, whose name I will not give you because he ended up at the very last minute taking another job. They were really, really angry at this person. They called me, and I could just feel the anger in their voice saying this guy did not [show up, so could] you come down? So, I went to Clemson. So, I was there for three years, and that's when the book came out. Clemson at that time, it's, it's a wonderful school. Their computer science department is excellent. [The] history department, they were trying to raise themselves up at the time, which they were doing successfully. I don't know whether I was one of them, but, uh, um, I do remember before the book came out, I managed, I wrote a review for Science magazine, I

guess, Katherine [Livingston], you probably know her name, the book review editor of Science. I wrote a review of, um, the book by Burks about Atanasoff, Eckert and Mauchly and published it in Science. That really made an impression on the faculty there. None of them had ever come close to anything like that. The other interesting thing was that Mel Kranzberg was at [Georgia Tech in] Atlanta and, I don't know how many people can tell this story. You give a comment or something at a SHOT meeting, [and] the next week, Mel writes a personal letter to the Dean of the college saying that Ceruzzi, he's brilliant. He wrote the greatest [paper], you are so lucky to have him on your faculty, and all that kind of thing. It really, really helped because I struggled, for a while, but I got through. Then, I got the call to go to Air and Space.

Aspray: Did you like being a professor?

Ceruzzi: Yes and no. Some of the students loved [my classes], they thought I was the best professor they ever had. It had its moments. I'm not sure what would have happened [if I had stayed at Clemson]. Would I have gotten tenure? I'm not sure that whether I would still be there or not. It's very hard to say. I never thought I'd be anywhere very long, but I was in Air and Space for 35 years. Pam Mack took my place [at Clemson]. She's still there. You know [her], don't you? I do.

Aspray: Yeah, not well, but I do. Tell me about going to Air and Space.

Ceruzzi: Well, that was another one of these crazy things. We may get into this, although it could be a little bit controversial. IBM was very interested in having this installation and do

something about the history of computers. They went to the Museum of American History, naturally. It may have even had a different name then; [it] may have been called the Museum of History and Technology. For various reasons, they [IBM] felt that the people there were stalling. You probably know more about it, Bill, than I do - about why they were stalling. You probably know about Hank Tropp doing oral histories for the American History museum. Anyway, I didn't know about any of [this], but they then went to Air and Space, [suggesting they] do an exhibit at Air and Space. Well, they didn't have anybody who was an expert on that. So, they somehow found me. I was not an aerospace person, but I've always had an interest. I watched the moon landings, all that sort of thing. I understood the whole story about the computer on board and all that. So, they hired me. They called me up and hired me almost on that moment... I aced the interview there. It was a struggle. We eventually did open an exhibit called "Beyond the Limits" about flight in the computer age. I have the catalog here somewhere. 1989, it opened; and the catalog is still referenced. We had a Cray 1 in there, which still is a big coup for us to get the Cray. What else did we have in that? We had this X 29, this airplane with forward swept wings. It was computer controlled, which is the basis for all modern aircraft controls today. We had some interesting things in there. We had a flight simulator that was based on an amusement park ride, looked like an amusement park ride. [Was] the whole basis of flight simulation, virtual reality, all that. The exhibit came down with a few years ago. So, that was what they hired me for, but I ended up staying on, as you know. Little by little, I ended up falling into this history of modern computing book, which took many, many years of my career.

Aspray: We'll come to that in a minute, but tell me, what it's like to be a historian in the Smithsonian? And, in particular, do your historical skills come out, are they valuable? And in what ways, if you're doing an exhibit?

Ceruzzi: This could be easily 10 zoom [call]s about how curators clash with exhibit people. Exhibit people have this feeling that you can't have more than 50 words on the [label]. They always talk about, "don't put a book on the wall." Well, we all have to put up with that. I would like to think I didn't do that, but on the other hand, it was tough, but we did get support. The front office didn't really understand why we were so obsessed over scholarly publications, but they accepted it. They understood that this was our reputation. Certainly, when one of my colleagues, David DeVorkin, had a planet named after him – a minor planet – the people in the front office can't ignore that. Let's put it that way. So, when I got letters from Paul Allen inviting me to his [museum] in Seattle, it's like, "Oh, wait a minute. Maybe Ceruzzi's got something." They were supportive, but on the other hand they couldn't quite figure out why do you do this? But on the other hand, as long as you could get an exhibit done, it was okay, you were respected. I did a number of exhibits. I think that worked out okay. It was tough. I think you could talk to other people. I know you've talked to Peggy Kidwell and David Alison and John Eklund, people over at American History. They have their own version of the same story, I'm sure.

Aspray: Right. Was your department within Air and Space a congenial place? There were a number of other historians in that department. Were there good conversations?

Ceruzzi: Yeah, I think it was a wonderful place. In fact, the irony of it is that, at that time, American History had this stellar reputation. *Technology & Culture* was published there. I think the *American Quarterly* was published there. We were looked at as kind of the step-sister. We were [regarded as being] in bed with the aerospace [industry], which we weren't, but that feeling [persisted]. It turned out, we had a much better comradery and respect for scholarship than any other place really. We had some very stellar people: David [DeVorkin], Robert Smith who wrote the book on the space telescope. We had lots of people there. Alan Needell had written about Lloyd Berkner and Martin Collins was writing about the RAND Corporation. So, a really, really stellar group. I don't say we all got along because we did not at times, but it was a fun place to be. Yeah, absolutely.

Aspray: I don't know the story about IBM coming first to American History before coming over to Air and Space. I do know some of the people who were there at the time, for example, Uta Merzbach was the curator of mathematics.

Ceruzzi: That's right.

Aspray: And I guess Peggy [Kidwell] came to work for Uta some point as a support person and eventually rose into the position. Can you tell me about the environment in American History in those early days when you first arrived at Air and Space?

Ceruzzi: Well, it was weird. You've had dealings with Uta, she was old school, which is fine. I don't have a problem with that. Never did. But there was also this environment where there was

this pressure to do something about this huge topic, which the Smithsonian had not really done much on. The Smithsonian had, and it still has, a bit of arrogance about it, which people have talked about over the years. They said, “who are you to tell us what to do?” Even though I spent a lot of time over there, I really stayed away from the internal politics of what was going on. I do know that there was that oral history project, which was [conducted by] Hank Tropp of Humboldt State University and Robina Mapstone. I think her name is on a lot of them. They apparently had difficulties getting those things processed properly and had complaints. They wrapped [the Smithsonian’s] knuckles [and the response was], no, don't complain. We're the Smithsonian. Anyway, I, I stayed away from that because I don't want to get [involved]. I had enough problems of my own. Let's put it that way. I'm trying to get an exhibit done. So, I didn't really want to get involved. And eventually they hired David, Allison, he got their exhibit open, “The Information Age.”

Aspray: One of the things I was thinking in preparation for today, is there were some people who were not historians of computing who came into my sphere as I did historical work on computing. For example, Bob Multhauf, who, you know, had been a curator and then was the director at History and Technology, was actively involved with the Babbage Institute and was a buddy of Arthur Norberg.

Ceruzzi: I didn't know that.

Aspray: And Nate Reingold, I would cross paths with him on almost every [archival] collection that I went to in American science. It seems like there were lots of human over there who could

have been interested in these things. I'm not asking you necessarily to tell the story, but it's just curious to me that there wasn't more [interest in computer history].

Ceruzzi: I don't know the story, to be honest with you. In some ways, I'm glad I don't, because there were some messy things going on. I just assume that Mike Williams was involved with that too. He was brought in at one point. He may have his version of this story. Like I say, I'm not a manager and I don't know much about management, so I couldn't really get involved in the management issues. Besides, like I said, I was trying to do an exhibit at Air and Space, and I was also bootstrapping myself into the aerospace story. I [knew] very little about it, but I bootstrapped myself into that and ended up really having a tremendous lot of fun, hanging out with astronauts, and pilots and, and space engineers and rocket people. I learned something from the inside. Of course, they use electronics. 90% of the cost of any rocket is in the electronics. The rest of the rocket is just a big gas tank. [That is] a little bit of an exaggeration, but there's a lot of electronics. I was also backing up to my days at the Linda Hall Library. One of the biggest, by far the biggest, customer [at Linda Hall] we had was Autonetics, which was at the time doing the guidance system for the Minuteman missile, which I didn't know about. Of course, that was secret. They put in [interlibrary loan] requests every day; they would send in requests for tons and tons of material. So, we knew that they were up to something, and they had a lot of money, obviously. That's what I was doing at the time. I had a mentor [at the Air and Space Museum], an aeronautical engineer who worked for Bell Aircraft, an elderly gentleman. We would sit in his office. I was learning at the feet of the master here. And in his desk drawer, he had something called a planimeter, which is a handheld device that would compute the area under a curve. He used it. I think there's this link between the computer age and the mechanical age; and of course

we all should know that the mouse was invented by [Douglas] Engelbart based on his experience using a planimeter, when he was at NASA, the idea of moving something around on a table.

Aspray: You reflect upon the contribution that your exhibit and then the catalog made to the history of computing?

Ceruzzi: They talk about silos. And I think that the historians of aerospace and the historians of computing don't really interact as much as they should. I mean, some of them, some of us, do, but you would think there'd be more. There's been an awful lot published about the Apollo guidance computer and about Margaret Hamilton, the programmer, especially with the 50th anniversary, of course there's all of [Donald] Mackenzie's work on guidance, but there's so much else that should have been done. For example, the Hidden Figures book came as this big shock, just a couple of years ago. It was a book that should have been done way back right from the start, but it wasn't. I think that there's not, [but] I wish there were more dialogue. I'm out of the business now, so I can't do much more about it, but I think it's a silo. They are looking for a [computer] curator at Air and Space, although, because of the virus, they're stalled on hiring, but it will be interesting to see who they find.

Aspray: In a moment I'm going to go on to your history of modern computing book. But before we do that, are there some things that you want to say about either the big exhibit over American history or about David Alison or about Peggy Kidwell, for example?

Ceruzzi: Well, Peggy and I collaborated on a book together and that was wonderful. A little booklet on digital devices from the [Smithsonian] collections. I don't have a copy here, but to this day I'm so embarrassed because I had a picture of what I call the transistor, and somebody wrote to me and said, "that's not a transistor, that's a diode." Oh my God, what a mistake! [It has] only got two leads, but anyway, [Peggy] had the Comptometer and, and I had some other stuff. I think it's better that I not get involved in [talking about] American History. Really. You could probably find people there who, well, a few, [there are] not very many left, of course. But we were in different worlds, in a way we really were. When "Beyond the Limits" opened, there's an award that they [SHOT} have, this thing called the Dibner Award for excellence in exhibits. The year that I opened Beyond the Limits [and] put in for that award, they awarded it to Nobody. Hmm. This is an exhibit which still people talk about; [it] is pretty good. So, I think that reflects something about how the people at American History felt about Air and Space, that we were not part of this movement towards social construction history from the bottom up, and all that sort of thing. We weren't. I don't know, I assume we are. I don't know whether we are or not. I have no idea, but they couldn't bear the thought of giving us [the award], although, our "America by Air" eventually did. It is a good work and it had a lot of social history in it. So, I didn't have [strong connections with NMAH]. No, I had very little.

Aspray: So, was there any sense of community? I know that you were friendly with Peggy. Did you see Peggy on a regular basis? Did you see David Alison on a regular basis?

Ceruzzi: No. David was pretty much off insulated in a way, but I did have a lot of interactions with John [Eklund]. Yes, absolutely. He was a wonderful guy. We had our moments, but he was

a chemist who got into computers, reluctant[ly], sort of backed into [the topic] as many of us did. We had wonderful conversations. A lot of time was spent with him.

Aspray: Let's turn to talking about your history of modern computing book. Why don't you tell me the story?

Ceruzzi: Well, I don't know whether this is true of everybody. I talked about stumbling across the reference to Zuse in I.B. Cohen's book. This was another, crazy thing, where I was in my office at Air and Space. I don't even know if it was email back then. It might've been a letter, that Ralston and Reilly were updating the *Encyclopedia of Computer Science*, a big thick thing. I'm sure you know it. [Doing] a new edition. There was a long essay by a man named Saul Rosen on computer architecture. [Ralston and Reilly] wrote to me and said, "Saul is in poor health. He can't really do an update on this. Would you be willing to update this essay?" I [said] okay, fine. Well, seven years later, a "History of Modern Computing" comes out! That's the short answer. I got into the story, and it just became an obsession with me. The essay that Saul wrote had a lot of emphasis on architecture, on programming IBM's systems, and various IBM mainframes at the time. I immersed myself in that. I struggled and struggled to come up [with something like that]. I knew that there was this cliché about history of technology: [that it] is one thing after another, that we are just "rivet counters," I struggled on what's a theme that I can come up with. Eventually, I hit upon a theme, which I don't know whether it's going to survive the third edition. We're putting out a third edition. But the theme was that IBM had built this enormous structure based on batch processing, where you would collect the data, let's say utility, reading, utility meters, or something like that. You had a program written in COBOL. Basically, all you had to

do was run that same program. Maybe tweak it a little bit but run it with some new data. Once a week, you'd print out the utility bills on the chain printer. That was how you got the data; that was the basis for IBM. During the anti-trust trial, I remember there was some testimony by somebody that nobody's going to ever challenge IBM on this. They are absolutely impregnable with this business model. This was right. The testimony was given the same year that the Apple II came out. Obviously, somebody missed it. I realized that what was happening was this transition from batch to what we now do today, where you interact with a computer, which IBM was very nervous about. They had the Model 67. Then time-sharing came in – through CTSS [Compatible Time-Sharing System] at MIT. They used an IBM [7090] computer. DEC came out with the PDP 10, which was time-shared, which the hackers used to develop the “incompatible timesharing system” at MIT. But of course, time-sharing had its issues. I delved into that. But of course, as we all know, the interactive mode prevails today. You type something into Google, milliseconds later the answer comes out ([or] what purports to be an answer). You assume that you can interact. It was a very difficult transition. It nearly killed the IBM Corporation, but time sharing is still with us in a very different form, of course, as we all know, with the cloud and client server and Xerox PARC. But that [insight] was to be the key to make the book intelligible. I don't know whether... I'll let other people decide whether that succeeded or not. But to me, that was the big move in computing, from a batch processing world to the interactive world. I remember focusing on the trouble, the trials and tribulations of the Internal Revenue Service, because they were wedded to this whole batch system. They collected tax returns and they punched them in with key punches. They have a whole room full of key punch people with this incredible racket. I don't know how their hearing survived. Then they would run the batch. They had a big center in Martinsburg, West Virginia, where they ran mainframes, and then they would

do the taxes. They wanted to replace that [system] with smart terminals, and they ran into a hostile Congress. It's a section of my book, and I got some primary sources on that. To me, that encapsulated all of the troubles and difficulties of trying to get this[interactivity] to work. Of course, eventually [it] did work. And I think it eventually did work primarily by abandoning the timesharing paradigm of [John] McCarthy [of timesharing] as a utility, and moving over to the Xerox PARC paradigm of the client-server, where you've got intelligence on your desktop. Then you've got a server which does the heavy lifting, and you have Ethernet connecting the two. That happened. It took a while and Xerox had to do it, but eventually that's what we've got today.

Aspray: Every historian, when they write a book, has to deal with boundaries about when to start, when to end, whether to include things that happen in other countries, whether to include users or just developers, and so on. Could you tell me about how you thought about those issues and what kinds of decisions you came to and why?

Ceruzzi: Well, [the book] was long enough as it is. I couldn't make it much longer. I consciously decided not to talk about the Maniac or Babbage or Pascal or all that, or about Turing. I just decided I had already done that with "Reckoners" anyway, and I didn't talk about Zuse. I'll tell you a little story. Don't ever read your reviews on Amazon because people [say], "this book is terrible because he doesn't talk about [X]." Well, excuse me, I wrote a whole book about [Zuse] it, but anyway. "This book is terrible because he doesn't talk about somebody who's the inventor." Okay. I started with Eckert and Mauchly commercializing the UNIVAC, which to me was the real beginning. [One has to] begin somewhere. That's where I began. I also decided that I was not going to talk about artificial intelligence. I said the best, the best way to write artificial

intelligence and to get an intelligent computer, to write it as a joke. I don't know how funny it was, but I didn't do it. Of course, AI is big now. AI today [is] not the same as AI of 1954, let's face it. That was a world that I just decided I wasn't going to get involved in. So, I was very much interested in obviously many computers: DEC and Data General, and Max Palevsky's SDS. And the Seven Dwarves [the early competitors to IBM], I knew I had to cover them. I remember sending a manuscript to J.A.N Lee and he said, "there's not enough about IBM in here. What about IBM?" But IBM dominated the story, obviously, back then. Getting closer [to the present]:, obviously, the personal computer, Xerox PARC, I knew how important those were. The biggest regret I had -- and some of the reviews caught this -- was that, before the IBM PC came out, between the time of the Altair in '84 and the IBM PC, there was an incredible burst of creativity, all these machines. There were Altair clones, the IMSAI, Southwest Technical Products, Chromemco. I didn't talk about them and I kicked myself for not doing it. I should have, I didn't, I'm sorry. It was a big mistake because that was this incredibly creative time. When you started with this machine, if you could get it to add two numbers together, that was a triumph. And you end up with the IBM PC running DOS, or the Apple II. In between those years was a lot of hard work and creativity that I missed, I'm sorry. The internet was just started [at the time of the] first edition, [but in] second edition I had to put in the internet. I did it, I guess, based on Janet Abbate's work more than anything else. Also, the second edition talked a lot about the Microsoft antitrust trial and about Linus Torvalds and Linux. I made another joke that said that the most important thing about Linux is how to pronounce it. Because Linus, Torvalds was named after Limus Pauling [with a long i], but the software is named Linux [with a short i]. I don't know why, why don't they call it Linux [with a long i] anyway? You can tell them, I tried to put a few jokes in there. I don't [remember] most of them. I made a joke about John Perry

Barlow, who wrote lyrics for the Grateful Dead. I said, well, he wrote these lyrics, but that was when the Grateful Dead were not good anymore. Well, I'm not cut out to be a standup comic.

Let's put it that way.

Aspray: Okay. Tell me about the reviews of the book.

Ceruzzi: Oh, they were pretty favorable. Yeah. Like I said, forget the Amazon [reviews]. They didn't talk about much. But [the reviews] were pretty clear and the sales have been pretty good. And, of course, I did a second edition; and Tom [Haigh] and I are doing a third edition.

Aspray: I'll come to that in a minute. One of the things that I think is a mark of the success of the first and second editions has been how widely it's been adopted, especially in science and engineering departments.

Ceruzzi: Yes. Well, as you know, Bill, it was up against your book with Martin. You had Basic Books behind you, with their marketing capabilities. And I didn't, of course [but] I had this absolutely wonderful relationship with Larry Cohen, who was the acquisitions editor at MIT. I couldn't have done it without him. Really. He was just absolutely what every writer wishes an editor could be; he had just the right touch, and he knew exactly where to push the narrative in the right or wrong direction. And of course, as you know, Bill, [you & I] ended up writing very different books. I love to get into the nitty gritty hardware, which I still do. I love that. [This interest] goes back to my ham radio days, I guess.

Aspray: That seems to be what the engineering faculty and students want anyway. Right.

Ceruzzi: Well, absolutely. You know, it's funny because now the history of computing is really pretty much a social history about women and workers and programs, but somebody's got to do the hardware. The weird part about it is that the hardware gets done by Intel and gets burned into the chip and nobody ever sees it again. Back in the early days, it was a big deal, how many bits are in a byte. What's the word length, what kind of storage, all that kind of stuff. Big questions. Now the historians don't really delve into these debates that go on with Nvidia about parallelism or multi-core processing. It'd be very hard to do that. I couldn't do it. That's for sure. I don't know if anybody can do it, and on top of that, you've got the whole issue about software, but that's another thing.

Aspray: So, you were not trained in computer science, you did some programming, you knew some mathematics. How well did you feel like you were prepared to do your writing?

Ceruzzi: Well, that's something else I wanted to bring up. I mentioned the I.B. Cohen pivotal moment of coming across. The other thing that happened... I believe it was in 1976. I had an issue of Popular Electronics magazine, and there was an article in it by a man named Forrest Mims who worked with Ed Roberts at Altair. He was right there at the beginning of the creation of the PC. He wrote an article about programmable calculators, and there was a programmable calculator that came out in the early seventies. They were expensive [but] relegated the slide rule to oblivion. He said, "there's a new generation". And he listed them all. He mentioned one in particular, the Hewlett Packard, HP 25. He said, "this is a very interesting calculator. It's

inexpensive. it's cheapest, price is very low.” It didn't have a whole lot of capability compared to the other HPs, but it had something [called] conditional branching, which meant that based on the results of your program, it could branch to another set of instructions. And then Forrest said, ” this is the distinction between a calculator and a computer”. A computer is a device that can actually conditionally branch. I completely fastened on that statement, which by the way, has since become somewhat controversial; we might go into that later. But, as you know, this ended up... well, [to] make a long story [short], I bought one, and with very limited student funds I programmed the heck out of that machine. I've got a list of programs that I saved somehow, like compound interest, algebra, binomial coefficients, Greatest common denominator. combinations, Bessel functions, gamma function, random numbers, Diophantine equations. I taught myself all this stuff. There is this primitive little calculator that was doing these incredible things with 10-digit accuracy floating point. Meanwhile, [with] the Altair, you'd be lucky if you could get anything out of it. When Microsoft Basic came along, they were able to get six-digit accuracy out of it. Guess, I don't know, they have floating point. They had floating point. That was the guy Monte Davidoff, the third founder of Microsoft who is often forgotten by the history books. He put floating point into basic Microsoft Basic. So, you could say I was self-taught. I learned how to program. Of course, the one thing calculators could not do, cannot do database stuff. They can't manipulate data, which is of course what we all think about Google and the cloud and everything else, the data. They couldn't do that, but they could do mathematics. I would never, probably never have the use for Bessel functions, but I knew how to program [them]. Of course, later on, when I'm writing my dissertation, what was the primary use of the Harvard Mark I – Bessel functions! In fact, the nickname for the calculator is Bessie. They did Bessel functions, that was Aiken's obsession. This machine [could do them], and [it] printed them. Of course, the

Zuse machine [was] less general purpose. Its primary use was in inverting a matrix with complex coefficients. So, I got involved. I sort of bootstrapped myself up with this little, tiny calculator. Then, of course, the question became, is this conditional branch in fact that important? This led to some big controversies. In fact, Tom [Haigh] and I had had some discussion on the third edition about this. We'll get to that later. The Mark I did not have the conditional branch. When it reached a point where something had to branch, a human being, Grace Hopper or somebody else, had to come in and load another tape. The Zuse Z3 did not have it. Although, you know, Zuse was obsessed over this capability independently. He kept telling me, "I could have done that with a single wire, but I chose not to." Well, of course the ENIAC did have it. This, later on, got hijacked by the computer scientist who ended up saying whether a machine is "Turing complete." Have you heard that phrase, Bill? I never understood. I'm back in the time when I thought about conditional branch, not whether something's Turing complete or not. That's led the computer scientists to have their own battle about these early machines.

Aspray: So, tell me the story about the third edition.

Ceruzzi: Well, I guess the acquisitions editor was Marguerite Avery. I don't know, but it may be [the editor] who followed her, Katie Helke. She wrote to me and said you need a third edition, [with] all this stuff going on. In the meantime, I wrote the short history, for the MIT "Essential Knowledge" [series], very brief, which also was doing very well. I managed to insert [there] that issue about the creativity of the 1970s that was missing [in the earlier book]. I obviously had to talk about Facebook and Google and Twitter – reluctantly, because I still don't quite understand them. I understand Google, but I don't understand the other two. Anyway, they said, you have to

do a third edition. I said, “well, I'm getting on in years. What I need to do is find a young person,” young being anybody younger than me. I initially wanted a young woman [or a minority], somebody who could bring in this new world of scholarship that I was very uncomfortable with. I put out some feelers [but] didn't really get very far. [Then] Tom jumped on it and he said, “yes, I'll do it now.” I don't know. He's younger than me, [so that] fits that criteria. He also shares my emphasis on the nuts-and-bolts hardware, and also software, the ins and outs of the various versions of Windows and DOS, and Linux and all that. I'm not too good at that either. So, we hit it off. Tom did a lot of rewrite. I sent him the Word files of the earlier additions and we worked on them back and forth. Then the virus hit, but we were working remotely. The biggest issue that developed, I realized, is that he was really taking the lead, he had more energy than me, which is exactly what I wanted. I ended up taking primary responsibility for getting images, which was a real bear. In the first edition, you would ask for an eight by ten glossy print, and the company would send you something and [allow you to] use it any way you want. Go ahead. No problem. Well, you can't do that anymore. You got to get a formal agreement, mainly because of digital rights, since it is so easy for the images to get sent around. So, it was getting permission to use [that was] a real bear, but we did it, it's in the works. Now we're expecting copy editing back soon. Later on in the process, Tom wanted to emphasize that this is going to continue the good sales and good reputation are the first two editions, with my name there. I said, at some point, “Tom, why don't you put your name first? I don't need that [recognition] anymore. I mean, I'm retired. I go off for bike rides, play my guitar.” So, he said fine because he's got a career, he's got tenure, but he still wants to be... We fought over the title. I didn't want to get rid of the title, but we ended up [changing it slightly to], A New History of Modern Computing. By the way, the title, the original title came from Larry Cohen. The other brilliant thing, that guy.

Aspray: One of the things that strikes me about the third edition is the organizational structure is different in that you play upon the fact that the computer is a universal device. So, it's the computer as X. The computer as Y; the computer as Z. Did that require a lot of rethinking about what went into the book?

Ceruzzi: Yes, it did. Because, as I've mentioned, the structure of the first edition was primarily chronological with the pivot being this transition from batch to interactivity; this very painful transition involving time sharing, client-server, and personal computers. There really isn't a corresponding pivot to the third edition. There's rather a series of pivots, I guess you could say. So, we ended up having the Cray 1, in the same chapter as ENIAC, which is totally appropriate in terms of what they were, but chronologically, no, but it works. And Tom had this great insight. When somebody turns on a TV today to watch Netflix, they don't say, "I'm going to program my computer." No, they say, "I'm going to watch Netflix, I'm going to watch TV", but their TV is like a Cray computer. You know, it's got that microprocessor inside it. I have a Roku micro, it's got a microprocessor. That's huge inside that thing, but you don't think, "Oh, I'm going to program my computer today to watch a movie". No, you're not programming your computer. You're watching TV. Tom had that insight. We talked a lot about the Tesla and Elon Musk. The Tesla is a computer [that] happens to have four wheels. I don't quite agree with that because I'm an old gear head [from] back in the day when I had a Dodge Dart. I don't own a Tesla. I've been looking at them very carefully, but I don't know. In the virus, I don't drive anymore. So, I don't even need a car.

Aspray: I neglected to ask you how you ended up with the first edition with MIT Press.

Ceruzzi: I actually don't know how that happened. I didn't go to MIT. You were the editor of their series, weren't you?

Aspray: I was the associate editor. I.B. Cohen was the editor at the time.

Ceruzzi: I don't know. All I know is that I did that essay for the encyclopedia. Somehow, I must have met Larry [Cohen] at some point, [but] I don't remember what...

Aspray: Let me switch topics for a while and ask you about some of the infrastructure for the profession of the history of computing. One of the things was Annals of the History of Computing. Can you talk about your experiences with Annals and your observations?

Ceruzzi: About Annals? Well, I published an essay on Zuse in one of the very early issues. Bernie Galler was just a wonderful editor. [The journal] had this interesting early history where there were scholarly articles such as mine. I was new. You and I were both new. The idea of people who are not veterans of the computer industry, writing memoirs. We were actually scholars writing based on historical research, using archives, et cetera. But there was also this big chunk of the Annals [consisting] of old timers or retired people writing about their personal experiences, which, as you know, can be a little bit biased. But also, the question was whether publishing in the Annals would help you get tenure or promotion at your university or not. Now that problem is solved. I think Annals has an incredibly solid reputation, but they didn't want to

get rid of the tremendous value of these memoirs from retirees. I drew on them very heavily for my volume. In fact, in the History of Modern Computing could not have been done without going extensively through the Annals. In fact, this particular section that J.A.N. Lee edited about timesharing, Project Mac, and everything was really crucial to me, especially the debates, as you know. Bernie Galler was involved with IBM, and IBM had this huge crisis about the 360 not having what they called “dynamic address translation”, which is a bit of inside baseball, but it basically meant time sharing was somewhat difficult to implement on a360. And here was a machine that they literally bet the whole company [on]. They were in a bit of a panic to [know] what's going to happen when then MIT went to General Electric, time sharing. IBM ended up with model 360 /67 and then the TSO [time sharing option]. Well, you can read all that, but JAN Lee got interviews with people, which to me were absolutely crucial to my book, to get into the guts of that transition, which IBM managed to weather, although eventually they had troubles. I was also the book review editor for a while, and that was fun. Although putting the thing together, back in the early pre-internet days, was tough. We used email, but it was quite different. It was an IBM mainframe email system, but we did it. It was, it was definitely a challenge, uh, but the Annals... You know, my subscription ran out, and now it's not done in print. I don't like getting stuff online anyway, but I'm not really following now. But it certainly was important. There's no question about it. Bernie Galler, at the same time as they were doing these memoirs, he also understood that for a young person like myself, it was very important to publish in a scholarly journal and establish your reputation with your Dean and your faculty, if you want to get ahead. He understood that very well. I took his advice, and I remember he said, “if you publish in these conference proceedings, some of them are not very well edited. And some of them are not very well perceived by tenure committees. So, go ahead and do a

conference proceeding, but really concentrate on scholarly articles in a refereed journal, if you want to get ahead in the world.” And I took that advice to heart.

Aspray: I didn't go back and look, but I assume that you continue to write articles from, to time in *Annals*.

Ceruzzi: I did. Yeah. Small ones. Yes. Nothing major, not that I can recall.

Aspray: How did your colleagues at Air and Space feel about publication in *Annals*, or did they even think about this?

Ceruzzi: I don't think they thought about it really. They tolerated it. I don't know. They knew that I had this reputation there, so that was fine. Really. The other thing that I don't know, whether you plan to get involved in that, but at some point, I dropped down this rabbit hole of writing about Tyson's Corner.

Aspray: Yes. We'll talk about that. Did you also feel like it was important for you to publish in more general journals, for example *Technology & Culture* or *Isis*?

Ceruzzi: I had a lot of trouble getting into *Technology & Culture*. I eventually did, but it took a long time and I kept getting rejections. At some point, I realized, well, I, I have to get something out if I'm going to stay employed. So, I ended up sending [manuscripts] someplace else, which I have mixed feelings about. I did get into *Technology & Culture* where I wrote stuff about Mel

Kranzberg and general essays, and then I wrote something about Moore's Law, which they tell me is one of the most downloaded articles in all the history of the journal, which is kind of cool.

Aspray: Yeah, absolutely. Continuing this theme about professionalization of the history of computing, can you talk to me about the History of Science Society meetings, the SHOT meetings, and SIGCIS?

Ceruzzi: I started out as a member of the History of Science Society and subscribed to ISIS, but I dropped away. I found a better home at SHOT and I also subscribe [to Technology & Culture]. I think I was a member of the ACM for a while. I'm not sure. I'm an honorary member of the IEEE, but I would get their publications. History of science went off in a different direction. Although I think now they're coming back, which is kind of interesting. They're very interested in computer science, which I am too. But I don't do it anymore. SIGCIS, I think I'm the founder, unless you are Bill. Is that right? One of us is.

Aspray: I think that I was the chair before you were okay. But I don't remember that how it got founded.

Ceruzzi: I just remember having to circulate a piece of paper where people would put their email address on. That was the whole thing. I started a listserv; I had IBM equipment at the Smithsonian, and we had listserv and I started that. That was a crazy, but it worked out. I remember because there was an alternate listserv that was coming out of Silicon Valley by a guy whose name escapes me, but he was a computer guy, Silicon Valley guy. He looked down on us

as being totally clueless, whereas he knew everything there was to know about... but that's the Silicon Valley ethos, they know everything. And these people on the East coast are kind of backward, but, um, they faded away, But the listserv eventually got migrated over to the internet, where it's still around.

Aspray: So, my recollection, and maybe you can amplify on this, is that there were times set aside for special interest groups to meet at the SHOT meetings. We would typically meet for lunch. There would be like four or five tables of people and everybody would get up and talk for 3 minutes. And that was the full extent of what it was about at that time.

Ceruzzi: That was it. They were very informal, a lot of fun. You had this feeling that in that room, you have the entire knowledge of the history of computing in one room, which was obviously not true, but you felt that way. It felt that way. And it was fun. I'll just tell a little story about the meeting in Charlottesville, Virginia, a SHOT meeting, and JAN Lee drove in from Blacksburg and Jean Sammet came down from Washington, and the younger people there were in total awe. It was as if it was as if [you had] Michael Jackson, Bruce Springsteen. It was like, "Oh my God, it's Jean." They couldn't believe that they were in the same room with this legend. And, of course, she was in heaven. We all were, I mean, she was having a great time, but that was sort of the fun part of the whole thing. I don't know whether that's still possible today. We're not going to get Zuckerberg or Gates to show up at a SHOT meeting, although it'd be nice if they did, but I don't think that's going to happen.

Aspray: Do you want to talk about what happened to SIGCIS as it got older?

Ceruzzi: Well, it moved over to a web-based cloud thing. Tom [Hiagh] took it over for a while. Now, it's this guy from Stevens, Andy Russell. Yeah. I dropped it. I still am one of the biggest contributors, which I often wonder whether people [get] sick of hearing me talk about stuff, but whatever. Me and Jim Cortada can always be counted on for something. It was in the early days, when it was listserv, there was a flame war. That's very interesting because flame wars were new back then. I can't remember what it was about. It was some really, really obscure principle about timesharing systems. "I programmed this thing and you don't know what you're talking about!" I remember getting an email from a sociology professor who said, "This is fascinating stuff. I want to write this up in a journal to show about flame wars. It's just the most amazing thing I've ever seen in my career." And I said, "Yeah, here's all the files. Go ahead." And he wrote it up. He published it in a journal. I think I may even have it somewhere, but anyway, as you know probably better than I do that, it took an ugly turn later on. By that time I was out of the picture, but flame wars are now are now unfortunately morphed into this whole fake news and conspiracy theories and all the stuff that we've seen, which is kind of destroying the fabric of the country. The computer is now a tool for abetting this, which makes me very sad. As it does to a lot of other people who were involved in creating that world in the very beginning. We've seen a creation out of our control. Not that I ever had any control over it a little bit... listserv, well, as you, you can look at the archives. It's very different now from what it used to be. And that's fine. It's helping; it's very healthy. In fact, I say that the computer SIG in SHOT is the tail wagging the dog. It's become very big. And the other SIGs, like for example, the SIG that deals with communications, Alexander Graham Bell and more, they've fallen by the wayside. Nobody seems to be interested, besides all communications are done with computers nowadays. Nope,

nobody even has a wired phone. Well, I do, So, I think that's a danger for SHOT, but it's not my problem. I'm a member of the committee that gave out the, uh, the Barney Finn award, the electrical engineering award. I said, well, we get a submission of a paper. Let's say, hypothetically, somebody submits a paper about Facebook's server farm. Well, that certainly fits. I think it fits IEEE absolutely. Somebody else submits a paper about bullying, cyber bullying on Facebook. That doesn't really fit. Should they get the award, maybe a very, very good paper? We're getting more and more of the latter and less and less of the former. And this is something that somebody else is going to have to worry.

Aspray: Were you involved at all, did you participate or attend any of the AFIPS Pioneer Days?

Ceruzzi: I wish I had, but for various reasons I didn't. I certainly had plenty of opportunities to interact with computer pioneers in other ways, not just Konrad Zuse and [Stibitz], and that was obviously one big, big difference between our generation and the current generation. Although the current generation may or may not be able to interact with Gates or Zuckerberg. I don't know but can tell you a story if you have the time. This is a wonderful story. As you know, I wrote a review in *Science* criticizing [Arthur and Alice] Burks, their book, one of my very first publications. It was some time in the late 1980s. I know it was before our second daughter was born. I don't know the exact year, but I know it was Columbus Day and the trees were changing color. My wife and I decided to go for a bicycle ride along the C&O canal in Western Maryland, through the mountains, and enjoy the foliage. So, we put the bikes on the car, started driving west and we decided, okay, we're going to stop for breakfast in Frederick, Maryland. We stopped at a restaurant and get in line to be seated, and in front of me in the line is John Atanasoff.

Really? And I go up and I say, I don't know what I said. I said, "hello." Then at that point I had a complete panic attack because I was wondering if he had read this review in which I claimed that he was not the inventor of the computer, unlike the ruling of Judge [Earl] Larson in Minnesota. Oh my God, he's going to be [angry], he's going to shoot me. But he did not. He either did not read the review or else he did and was so gracious that he decided not to harangue me about it. We had breakfast, he invited me to his house outside of Frederick. He designed and built the house itself. He poured the concrete and slabs and tilted them up. He designed all the kitchen fixtures. I guess by seeing that house, I learned more about Atanasoff [than from] all the published scholarly stuff about him. He was a born inventor. He was the kind of guy who said, "why buy something when you can make it yourself in your basement?" "I loved that. We had a great time, visited a bit, got in the car and drove to the West for our bike ride. That's the kind of stuff that happened. There was a time, you might've even been with me, when we were in the basement of this lab at Harvard where the Mark 1 materials were kept, and Richard Bloch shows up. Yeah, one of the pioneers of parity checking in computers, which every computer today uses. Martin [Campbell-Kelly] was right there. And [Bloch] started haranguing us about Aiken. I can't remember exactly what he had to say about it. He was present at the creation of the universe, Richard Bloch. And here he was in the basement rummaging through these photo files.

Aspray: Did you have a chance to talk in any, uh, at any length with Pres Eckert?

Ceruzzi: No. I had a phone call with him. Mauchly passed away too early for me to ever get a chance. I did have a long conversation and a lot of correspondence letters written by hand with Kay Mauchly Antonelli. And also, a couple of the women who worked on ENIAC, Betty

Holberton, I guess she was on the UNIVAC. I met Grace Hopper, but we never had much of a conversation. But the woman who just published a book of... she recently passed away... about working with Eckert and Mauchly. Can't remember her name now. I had lots of chances. I had a phone conversation with Eckert. He was still an executive at UNISYS and he'd kind of bent my ear a little bit about history. What he felt was history is unjust, which I agree with, by the way, totally agreed with, but I'm not necessarily in the majority on that, but I do agree with him.

Aspray: Are there any things that you want to say about the personalities of some of the technical people who got interested in history of computing, JAN Lee, Bernie Galler, Jean Sammet.

Ceruzzi: Well, you know Jean, she was very opinionated. She had her way. We had this conference, HOPL (history of programming languages), and she had a bell and you knew your time was up. She rang the bell and heaven forbid if you'd say two more words beyond that bell. She would just come at time is up. Okay. But of course, she was wonderful, what a wonderful person she was. But on the other hand, her domination of the history of programming languages also meant that alternate histories had difficulty getting told. We're going to fix that in the third edition now. While that was going on, there was this whole ground swelling coming up out of Bell Labs and other things going on that I don't know. we're, we now move all that stuff. Other people, JAN was a wonderful, great guy. Never had any issues with him really. I don't think I haven't really had trouble. You know, there were people who would get up and they would be a little bit bitter about their role. I remember, um, Cliff Shaw there, everybody knows about Allen Newell and Herb Simon, Nobel Prize winner and all that. Well, Cliff Shaw actually wrote the

software, and he wanted everybody to remember his name. He'd got up one time and said, "Hey, you know, it's not just Newell and Simon. I'm in there too." I remember that. Rightfully so. He didn't get the credit. He should, and then, you know, it's usually they call it the Matthew Effect that people who are already famous get credit for things that they really, they really shouldn't have.

Aspray: Aaron Finerman?

Ceruzzi: No, I never had any dealings with him.

Aspray: Well, I'll just tell you a little story, because it's probably never going to be recorded otherwise. He was on the advisory committee for the Babbage Institute. Every time he spoke, he prefaced his remarks by saying, "my wife is an archivist; therefore, I know about X, and this is the way you should go ahead and do things."

Ceruzzi: Good for him. Herb Grosch had a Smithsonian fellowship. He bounced around. I made a joke with him. I said, "How, how could you be the only person who left IBM without a pension?" Which apparently, they didn't give him, he was broke all the time. What the heck? And of course, somehow, he was broke, but he managed to drive these fancy sports cars and go skiing in Switzerland, which I've never done. Of course, he had this other reputation, of personal issues, which I try to stay away from obviously. But we got along. He was quite a character. Some people didn't [like him], he rubbed some people the wrong way, but I got along fine with him.

Aspray: Let me change topics. Could you talk about your Tyson Corner study?

Ceruzzi: That's another one of these crazy rabbit holes. I was living in, I guess it was Clemson, and there was very, very little opportunity for media back then, there were very few radio stations or television [stations]. And at that time, this is very important. The solar sunspot cycle was at its peak at the time. Now what's the relationship to that? Well, it turns out that because [of the sunspot peak, the short-wave radio broadcasting was really very healthy. I had a short-wave radio and I used to listen to the BBC, Voice of America, and other radio broadcasts. So, I was kept myself pretty well informed on the BBC, who had Alistair Cook, also this jockey named John Peel. And if you have a chance to ask Martin Campbell-Kelly about John Peel, he'll tell you some very funny stories about the guy. I would listen to him. I can tell you offline about John Peel's effect on my whole life, but the Voice of America had a guy named Willis Conover, who was world famous, famous everywhere in the world except the United States, because the VOA was not allowed to broadcast to the United States, but you can figure out a way to get it. Among the things on the short-wave bands was a series of random numbers, a woman's voice reciting numbers, random numbers. And this was constantly incredible. What is all this? Who are these people? Sometimes they were in Spanish. I subscribed to a ham radio newsletter, which had a whole column every month about these numbers. What are they, how? I would listen to them. They were transmissions for spies who had what they call a one-time pad. They would record the numbers and they would look up. Anyway, the issue of the newsletter said, these numbers are coming from a place called Tyson's Corner, Virginia. I'd never heard of it before I was in South Carolina. The following issue said, "no, that's not right. They're not coming from Tyson's

Corner, Virginia.” Well, of course that set me off: nothing sets off a conspiracy buff like an “official” government denial. Is something going on? So, when I got to Washington, first [thing] I did was drive to Tysons Corner. I saw this antenna giant radio antenna. It was still there with this ominous sign. Don't take pictures of this Installation, Internal Security act of 1954, severe penalties. Of course, I took a picture of it. This was before 9-11, but anyway. From that modest beginning, I decided that something's going on here? I decided to look into it a little further. Then, in the middle of all that, comes the internet. Then I discover that there's this place called Mae East, where 50% of the world's internet traffic went through a parking garage in Tyson's Corner. And that America Online, which at that time was really big, had its start right across the street from Mae East. Although you weren't supposed to know where Mae East was. In fact, the Wikipedia entry for Mae East was wrong. It gave the wrong address, but I knew the right address. I remember trying to find it once and getting chased out by a security guard. Then there was this whole issue about the root servers for the internet, which I don't even know what that's all about now, but there were something like 13, is that right? There was the a: root server, which was the top of them all, and which was in, Herndon, Virginia, just down the road. I thought I found out where that was, [but there was] obviously security. They have nothing on the wall, nothing on the door, but I took a picture of that anyway. So, one thing led to another, Vint Cerf was working in Reston, Virginia and Bob Kahn was working separately, a couple of blocks away, at another building. He had his own Institute, Corporation for National Research Initiatives. So, UUNet was there, PSINet was there. And I remember getting into Network's Solutions' location in Sterling, now called Verisign. They moved the root server. I got a tour of it somehow, but there was all this hush hush conspiracy stuff. I wasn't really interested in all that. I just wanted to see what was going on using unclassified sources. It was just a lot of fun. And of

course, people said, “what are you writing about this for?” Well, it turns out that they call the [contractors] “beltway bandits”. You couldn't use that phrase at the time. They had a lot of government contracts, mostly with aerospace about Star Wars and ballistic missile defense and stuff like that. So, I didn't have any problem convincing people that this was relevant to the Air and Space Museum. I managed to convince Burt Grad to convene a meeting of some of these founders of these companies. And although Burt never followed through the way he did with his other work, the guys who showed up – it was mostly men. They loved it. They wanted to talk about their work. It was a different world. It was government contracting. They would look at something called the Commerce Business Daily, the daily newspaper indicating contracts that they would bid on. There was a place called Melpar, which had super top-secret research about chemical warfare, but they built the mobile quarantine facility that the astronauts went into after they came back from the moon. In case they brought bugs with them from the moon, they quarantine them for three days, and Melpar built the filtering equipment. They obviously knew something about germ warfare, although you're not supposed to know that. I didn't really care about that. I just wanted to say, hey, there's this company [that] had this contract with Apollo, something else they're doing. Somebody ought to do a history of Melpar someday. But, I had more fun with that book than anything else in my whole career, to be honest. It was just fun hanging out, driving around, visiting people, it got mixed reviews. And the funny thing was that there is a shelf full, maybe two shelves full of books about Silicon Valley. Some of them are really good. Some of them are not; and some of them go into very, very great detail about the chips and manufacturing about Noyce and Fairchild. There's only two or three about Northern Virginia and, and Northern Virginia is really, really important. I remember one of the reviews said, “why didn't Ceruzzi write something like a recent book about Silicon Valley? How come he

just has this sort of like...”? Well, nobody else did anything about it. Even to this day. Somebody wrote a dissertation at Yale. It talks all about the CIA. Well, the CIA wasn't really behind it. They had offices [in Tysons Corner], they still do, but that's not the real story of Tysons Corner. It's something else. I had fun teasing all that out. I think MIT Press was probably the wrong publisher. They had never heard of the place. So, what can I say? It went out of print, unlike my other books. It went out of print pretty fast, but I'm still very proud of it. I think it's held up well on the test of time. I think so. Tyson's Corner is still going crazy. Okay. Here's what's going on now? I don't go out there very much. I'm going out there to a place called Ashburn, Virginia, where at the time that I was writing the book, it was farming. It was farming. I went out there, it must be like what Northern California was during the gold rush, in 1849, these cloud servers are going up like mushrooms everywhere you go. These giant, giant buildings, cloud servers. Everybody knows the cloud, as Jeff [Yost] has talked about, the cloud is this thing is dispersed all over the world. In fact, it's not. [that] Ashburn, Virginia is the center of the cloud. It is. The cloud starts in there and why it is there, which I'm doing this sort of as a hobby now, not for real. Ashburn has really got more cloud traffic than just about any place else in the world. And it's growing. It's still a big story. Jeff caught some of it in his recent book about “Making IT Work.” Yes. Great book by the way, love that book, but there's more to be told.

Aspray: What topics have we not talked about that you want to talk about?

Ceruzzi: Gosh, I think we've pretty much covered it. I guess just the kind of fortuitous, uh, way the history got established and how, uh, it's become. I think the topic to me is that the, history of technology and science has had these specialties about the history of the automobile, the history

of the telephone, the history of these various machines and things, and the computer is this universal machine and it swallows up everything. This is one thing we're going to talk about. It is a universal solvent. This came from a professor, David Lewis at Auburn, [who] said, it's the universal solvent. It dissolves everything it touches: newspapers, Yellow Pages, television broadcast, television, broadcast radio. I got a list. I put this list up once at a conference [of philosophy professors]. And I said, one of the things that's dissolved is college professors. And they got mad at me for that one! But anyway, as you know, you better than I do, it's dissolving everything. And of course, if it's a universal solvent, what is the container you can put it in? And I said, the container is obviously in the history of computing. We're the ones who can contain it. Well, I don't know whether that's going to fly or not. Maybe it's a little bit of a conceit, but it is true. It's dissolved. And I mentioned money (you know, Bitcoin) and, uh, as you probably know, I like to play in a band and in my day [a] band consisted of a guitar player, drummer, and bass. . Now you go hear a concert. My son goes, and it's some kid with a laptop and the drums are a drum machine. There's no guitar. You know, Gibson guitar went bankrupt. Where are the instruments? Oh, it all comes out of the laptop, and we sample stuff now. Okay, fine. That's where music is nowadays – sample it, auto tune. You know about auto tune? [It] came out of this guy who was doing seismic work, designs his instruments, trying to discover oil. And he did these mathematical manipulations of the seismic waves. Somehow, he managed to convert that into a way of modifying singers with bad pitch. Okay. Another thing. I think that somebody, not me, somebody has to really attack this issue about what does this mean for the history of science and technology when everything is computer. Everything! What does that mean for our future as a profession? I'm nervous about it really. And I'm nervous when I see sometimes that direction of SHOT meetings. But I'm happy that young people are involved. At the SHOT meeting in

Dearborn they had a SIGCIS, this sort of rough session after the main session, and it was so popular. They had to split it into two. I think it was a mistake. I don't know if it was conscious or unkind. Anyway, I got put into what I think was the wrong session. I had a paper about what I thought [are] the big questions about the history of computing, where we should be going. And it was the wrong audience. It was the worst paper I've ever given [in my] whole career. It just felt like... One of the things I said in it, unfortunately, this was about five, five or six years ago was that we've gotten very sophisticated about talking about women, not just Ada Augusta, Grace Hopper, but generally women in general, about where they're involved in all aspects of computer science, engineering, also the manufacturer of the devices in the third world, all that stuff. But what we haven't done is the same issue for African Americans [other than] the occasional token, but we really need to do this research. I brought up two examples. One of which was when IBM established a laboratory or a facility in Atlanta, I believe that IBM went to real estate people in Atlanta and said, "you will sell houses to our engineers regardless of their race, period, or else IBM won't come here". Well, that's true. I've talked to Steve [Usselman] also a bit about that and he didn't really have anything to add. Maybe somebody could add to that. I do know that the Milwaukee Braves moved to Atlanta at the same time and Hank Aaron expressed anxiety about moving to Atlanta. They talk about themselves as the city too busy to hate. There's a lot of truth to that. IBM has a major facility in Atlanta now, and North Carolina. the Endicott New York is a ghost town. Somehow, I wanted people to talk about that. I don't know if anybody will. There was one other, one other anecdote about Digital Equipment Corporation establishing a manufacturing facility in Roxbury, Massachusetts. I don't know whatever happened to that, but they were very, very adamant about employing African-Americans and they had a very

enlightened policy at their higher levels. But, like I say, the paper went over like a lead balloon. So, I dropped it. It's coming along. It's not coming along as fast as I would like to see it.

Aspray: Okay. Anything else you want to talk about?

Ceruzzi: No, I think that's about it.

Aspray: Okay. Yeah. Anyway. Well, thank you very much, Paul.