Oral History of Harry Huskey

Interviewed by:
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William Aspray: [Interview on 7th of February, 2006 for the Computer History Museum and ACM with Harry Huskey. The interviewer is William Aspray.] Harry; let's begin by having you tell us when you were born and about your parents.

Harry Huskey: I was born in 1916 and my folks lived in western North Carolina near Bryson City, actually in a place called Connolly's Creek. I don't know how much detail you want to go into there.

Aspray: Tell me about what your parents did?

Huskey: Okay. My father worked for a lumber mill sorting lumber. It was a lumber mill that moved around from canyon to canyon in the Smokey Mountains. When they finished an area, they'd pack up and move to a place where there was better timber for them to work on. So, when the time came for this …

Well, let's back up here. Since my father worked there, he looked for a place to board and stay with a family. He stayed with my grandmother and grandfather and there he met my mother. By and by they were married. When the sawmill moved into a new valley he, instead of moving with them, quit and bought a store in Bryson City. The store sold, among other things, ice cream and milkshakes. He didn't make the ice cream. It came down on the train from Asheville each morning.

Aspray: Were there brothers and sisters?

Huskey: Lots of them. <laughs>

Aspray: Where were you in the list?

Huskey: In my family, no brothers, and no sisters. No, in my grandmother's family there were about six or seven girls and three boys, I think that's right. The thing of interest here is that one of my uncles had gone out west and when he came back he said "What wonderful opportunities there were if you go out west". He sold my parents on that. So in fact my dad went out and got a job on a ranch in Idaho in the Little Lost River area, and he planned on sending money back so my mother and I could come out and join him there. This, … I don't know, just keep going?

Aspray: How old were you when you moved out to Idaho?

Huskey: About 18 months.

Aspray: Very young.

Huskey: Very young, yes. My mother and I were on the train going to meet my dad. He came from Little Lost River to Pocatello, which is in the southern part of Idaho, to meet us. We met him and we

started to complete the train trip which went across the desert to Arco. It is about 50 miles across the desert, nothing in that stretch. Half way across, more or less, the train came to a broken rail -- they called it a broken rail, I think it was probably the connection clamps, or something was wrong with them -- but anyway the train stopped and then one of the train people climbed the neighboring telegraph pole and sent for help. So we sat there for three hours on what was supposed to be a 50 minute trip. There was no food, no water, nothing. The conductor gave me his milk from his lunch so I fared alright. But this was an interesting situation. They finally got the rail fixed and went on into Arco. There we met the owner of the ranch that my dad worked for and we all went to a restaurant to have some food. Well, when we were finished with the meal -- so I have been told -- I stood up on the chair, reached across the table and gathered up all the remaining bread and stuck it in my pocket to be prepared for the next situation. <laughs>

Aspray: You learned?

Huskey: That's right.

Aspray: You grew up in that area?

Huskey: In Idaho, yes.

Aspray: What were your hobbies when you were growing up?

Huskey: Well, I really don't know how to answer that. On a ranch there are a lot of things to mess around with, and at three or four years old you can play with things, you know. I'm not sure that was a hobby.

My uncle was serving on the USS Arizona and he finished his tour of duty and came to join us on the ranch. On the ranch we herded sheep. The ranch was two square miles or so -- a big place. It was about seven miles from town. The nearest neighbor was five miles away and we had grazing rights two and half miles around the ranch in each direction. If we got past that two and half miles, we were in cattle country and we were in trouble with our sheep. So, our job was to keep the sheep there. Of course, you want the sheep to lamb early in the spring.

<crew talk>

Aspray: Why don't you go on and tell me about the rest of your childhood and what your experiences were.

Huskey: Well, okay. I was about four or five years old when we lived on this ranch. The elevation was about 7,500 feet so we had very rugged winters. A lot of snow and so interesting enough; the snow would drift very deep. We had stacks of hay, for example, around where they fed the sheep during the winter time when they couldn't get at the normal grass. The snow would drift around these stacks of hay,

four or five foot deep maybe, and when the sun shone on it in the daytime the top of the snow would melt and so there would be two or three inches of melted snow on top. When night would come, it would freeze into ice so the next morning the sheep could walk right up to the haystack, so you had to keep an eye on them. But, I remember one time when we were loading hay from the stack and taking it out and spreading it in the field for the sheep and we went around to the side to get to the gate in the fence that protected the stack. As we went around the corner of the...

<unknown sound>

Huskey: So we would load hay on the sleigh and spread it around the field for the sheep to eat. My dad and my mom were on top of the stack of the hay and I was up there with them and as the sleigh went around the corner it tipped over and I went sliding down. Of course, my mom was worried that I got covered up in the hay but I had enjoyed it and I was ready to do it again!

But other things for example: we had to keep the bucks separate from the ewes because we wanted the ewes to lamb during a very short period in the spring so you'd have a long growing season for the lambs. So we had to keep the bucks separate from the ewes for the rest of the year and it was my job along with my uncle to herd them. So I spent a lot of time doing that. No big deal unless there come a storm. During a real blizzard, the sheep would move ahead of the blizzard and you had to worry about them falling into the canyon or something but, anyway, not too difficult.

Aspray: As you were growing up did you take things apart, did you work on machinery, learn to work with your hands?

Huskey: Well, I made things, I guess toys, in fact was what they were. On the farm we had stuff left over from some farm machinery and we had, I remember, a large screen made of wood. (I am getting dry I think I need some water…) Anyway I remember taking apart these pieces, they were about the size of your finger -- I guess maybe my finger then -- and then nailing them together to make a lever arrangement. It didn't accomplish anything but it was something to play with. That's the closest I came to making anything of the sort that you're talking about, I think.

Aspray: Were you interested in ham radio as a child?

Huskey: Not at that stage. I didn't know about it. Later on when I was in high school my best friend was a ham radio operator and we used to sit and see how far we could reach people but I never actually did anything on it.

Aspray: I'm going to move on in just a minute and talk about your schooling. Are there some other stories that you want to tell us before I move onto that topic about this early period?

Huskey: I don't think there's anything of particular interest. We moved from this ranch to Salmon City which is further north and actually on the Salmon River. The Salmon River starts in central Idaho near

Sun Valley, where the ski resort is, flows north to the Montana border more or less then turns and crosses the state and this is through the wildest part of Idaho. There is no access to this area. It is called a wilderness area. In fact, when Lewis and Clark went west they came down the Lemhi River to Salmon City planning to go onto the Pacific that way but the Indians told them that anybody that went down the river was never seen again. So that led to calling it "The River of No Return." Lewis and Clark then went farther north and crossed over the mountains on their way to the Pacific. When my youngest daughter was in high school her math teacher lead a group that floated down the Salmon River on exactly the same trip, and it's still a pretty rugged area. No access except by air or boat,

From Salmon City we moved to Pocatello. Roads were gravel in those days and so when we drove 250 miles we had a couple of flat tires on the way. It took us two days to make the trip and in fact, we camped at the half way point at a place called Willow Creek Summit, and during the night it snowed. I slept in the car so I was fine, but the folks had slept outside and they were covered with snow. Then we moved on to Pocatello and there I went to school and played in the band when I was in high school. We went to band contests at Salt Lake and such places.

I was far enough ahead in the schooling that during my senior year of high school I also took courses at the University in Pocatello, the southern branch of the University of Idaho. And since I went to high school in the mornings, the only classes I could take were late afternoon classes and these happened to be play production. I wasn't very good as an actor. I did act in one play. It was a non-speaking bar-fly part, but not being an actor I did other things. For example, we produced "Death Takes a Holiday" and I was electrician. I hung the lights and manned the switchboard during performances. The switchboard had a long handle that stuck out and it would turn everything off. In the middle of the play I sat down in the chair and also on that switch handle, turning the lights out! So that's my main contribution to the theatrical scene. At Pocatello the university was just two years at that time, and so I went to Moscow, to the four year school, where I majored in mathematics and got involved in other activities.

Aspray: Let me ask a few follow up questions about this earlier period first. Were there any members of your family who had gone to college?

Huskey: No.

Aspray: So you were the first one? And how important was education to your parents?

Huskey: Well, very important. My parents had gone to school in Connolly's Creek All eight grades were in one room and they went through the eighth grade. That ended their schooling. My mother had a very strong opinion that I should get as much education as I could, and that was the main reason for moving from Salmon City to Pocatello -- because of the better schools and the university there.

Aspray: Were you a good student when you were in public school?

Huskey: I did pretty well, yes.

Aspray: Which subjects did you like and which ones didn't you like?

Huskey: I liked mathematics, and what I did not like was phys ed. I liked physics and chemistry.

Aspray: How about languages and literature?

Huskey: No problem, but I didn't particularly like them. I didn't take any language until college. I remember I didn't take any until I got to Moscow. When I was a junior I took French and German.

Aspray: As you were growing up what did you think about wanting to do for a living when you were an adult?

Huskey: Well, I don't know. I guess I didn't really think very much about that. I was going to go on to school as far as possible. With a degree in mathematics for example, you'd probably end up teaching some place. So that's as much as I had thought about it.

Aspray: Did your parents have any particular expectations about your career?

Huskey: No. They just wanted me to get schooling.

Aspray: Did you think about going to school anywhere other than where you had gone?

Huskey: Oh yes. Of course it was natural that we go to University of Idaho, because it was far cheaper than anyplace out of state. So, as far as a Bachelor's degree that was kind of automatic. Then, during my senior year there I tried for a Rhodes scholarship. Some fellow in physics got the one that was offered, so I didn't get that. Not sure if that was a good thing, by the way. I was offered a teaching assistantship at Ohio University. I had never heard of Ohio University, but I accepted it. It paid $30 a month, which wasn't enough to live on even in those days. But, anyway, I started on graduate school in Ohio.

Aspray: Before we move on to talk about that, let's talk a little bit more about your college experience. Did you feel that when you got to college that the education you had gotten in public school had prepared you well for college?

Huskey: I think so. There were no particular problems in that respect.

Aspray: Were you a good student in college?

Huskey: Yes. I got C's in physics, otherwise A's.

Aspray: How did choose your major?

Huskey: I don't know. I always wanted to do mathematics from the very beginning that I thought about it, not even knowing what mathematics was about.

Aspray: In the course of college or even before, had you had any experience at all with any kind of automated calculating machinery?

Huskey: No. Nothing.

Aspray: Nothing at all?

Huskey: No, but when I was at Ohio University I designed an automatic computer using relays. I didn't complete it because I decided it was much too expensive and that there wasn't any use for it.

Aspray: How did you come to undertake this project anyway?

Huskey: Well, I had spare time and I was taking all the courses and teaching a class. First year graduate school was easy. I was working in a restaurant for meals and I still had time to take photographs. I made an enlarger out of a pasteboard box and a camera. I had an old Voigtlander camera that used cut film, so I could put that on the box and make perfectly good enlargements. The landlady didn't mind my using the bathroom for a darkroom. And even before this, when I was still in high school, I made a reflecting mirror for a telescope. The directions say you buy a disc, a glass disc six or seven inches in diameter and an inch thick. I didn't have money to buy any such disc, but my dad had a second hand lumber yard store at that point and there was all kinds of plate glass scraps around, so I cut a couple of circles and I glued them together and ground them. If you take the two glass plates, place grit in water between them and move the top one of them back and forth 1/3rd the diameter, as you move them around the ground surface becomes parabolic said the directions. So I worked away and I worked away. I wet it and looked at the reflected image of the sun. The image became smaller and smaller until it was about 3/4 of an inch and then it wouldn't get any smaller. I decided I better figure out how large image was for a six foot focal length. I convinced myself that the ¾ inches was the actual size of the image.

There's also a procedure for testing the lens to see how good it was. This involved a light source and looking at the reflected pattern. There it looked like a relief map of the Rocky Mountains, and so I gave up and I said that wasn't going to really get there in the time that I had to put on it. So I was doing things like that like in high school days.

Aspray: Let me ask a couple more questions about college. Were there faculty members or other students who had a lasting shaping influence on your life, your career?

Huskey: Well, I think at the University there was nobody in mathematics. The mathematic teachers were just ordinary. The physics professor in Moscow in my junior and senior year arranged that I would do a senior thesis project under him. If you take two quartz rocks and strike them together, they glow where they strike, and the question is what is that glow. So I built an arrangement with a prism and camera so I could record the spectrum of that light. The light had a continuous spectrum. Studying the photograph of the spectrum, I found that where the intensity decreased was where the sensitivity of the film decreased. So I didn't know whether it was really down or not. I tried to learn how to treat the photographic films so as to increase the sensitivity. I never got very far with that. Anyway that project in college was an interesting one and I think supported my interest in physics at least.

I was Interested in astronomy too. We used to sit on the roof of one of the buildings of the university and count meteorites.

Aspray: Was it common for students at the University in Idaho to go off to graduate school? What did a typical math major do when they graduated?

Huskey: I don't know what the math majors did. There was no graduate program there and there were few people that were interested in further education. This fellow that I was very friendly with in physics was doing a thesis there because the physics department had one year of graduate program and so he and I worked on projects. They had a telescope lens and we put it together and photographed the moon. So certainly my friend was thinking about going on to graduate school and he's the fellow that got the Rhodes scholarship that I had hoped for. I don't remember anybody else that was interested in graduate school.

Aspray: How is it that you choose to go to graduate school?

Huskey: Well, I was just going to get as much education in mathematics as I could.

Aspray: So you didn't consider, for example, getting a job after you finished college?

Huskey: No, and I guess I finished college in about 1936. It was still a little difficult to get jobs.

Aspray: Because of the economic conditions in the country?

Huskey: That's right.

Aspray: How is that you choose to go to Ohio University?

Huskey: Just chance. I think I applied to about four different schools. They offered a TA and I took it.

Aspray: What did you find was the educational situation at Ohio University when you arrived?

Huskey: Well, the head of the department was a nice guy to work for and not particularly interested in any branch of mathematics. In fact, I don't think any of the only four staff members were working in a particular field. There was another fellow younger than the rest of them who had been to the University of Chicago. I was pretty good friends with him. In fact, while I was there -- no this happened later, so I am getting mixed up with my timing.

Aspray: You didn't stay at Ohio University very long. You moved on to Ohio State.

Huskey: Just one year.

Aspray: Just one year?

Huskey: Yeah.

Aspray: And how did that come about?

Huskey: Well, because Ohio State is in Columbus and you have to go to Columbus to go anyplace from Athens, Ohio. So I applied there and got a TA there and...

Aspray: Still in mathematics?

Huskey: In mathematics, oh yes.

Aspray: And you finished your schooling there?

Huskey: Yes. Ph.D.

Aspray: What was your topic?

Huskey: Area of surfaces. The best known professor there was a Hungarian, his name was Rado and he was interested in area of surfaces. He was a very strict, disciplinarian. He came from the Hungarian aristocracy. He was in the first World War and was a prisoner. He and some other guys stole a Russian train and took it all the way to Vladivostok.

Aspray: Were there some things that happened during your doctorial work that you want to tell us about? People that you met, fellow students, experiences with others, that sort of thing.

Huskey: I think the main thing that's worth mentioning is that I really learned what mathematics was about then. Before that it was calculus and plain geometry and whatever. Now I got involved in set theory and more advanced mathematics and I learned how to prove theorems and whatever. So it was a change in that respect and of course, I was interested in that sort of thing, so that was fine.

Aspray: What year did you finish your doctorate?

Huskey: 1943.

Aspray: 1943. So the war was well under way.

Huskey: Oh yes.

Aspray: How was that coloring your decisions about what you were going to do when you got finished?

Huskey: Well, I think it didn't make any difference in concentrating on mathematics. Actually I got an offer from the University of Pennsylvania Department of Mathematics, and I accepted that. That was an instructorship and I was supposed to teach V6 [Navy] students. So I was interested in the war and in fact I tried to enlist, but I couldn't pass because of glasses, so I went back to teaching the students and I got involved in the ENIAC accidentally.

Aspray: Can you tell us how that happened?

Huskey: Well, you know, teaching I made $1,800 a year and I think actually in the 12 months year I'd actually got up to $2,500, but it would be nice to have a little extra money, so I took on extra jobs when they would come. One of them was teaching calculus to a couple of students at a girls' school, and another one was teaching people at Pen Mutual Life Insurance Company so that they could pass the actuarial exams. I also taught some applied mathematics at the Brewster Aeronautics Company, but they were making airplanes that the tail fell off of and nobody knew why. So, anyway, I heard that there were projects at the electrical engineering department of the Moore School at the university, and I applied for part time work. Since their work was classified they couldn't tell me what they were doing, so I had no idea what I would be doing. When finally clearance came I was the showed the ENIAC and I've worked in computers ever since.

Aspray: What were you assigned to do when you got there?

Huskey: The input/output on the ENIAC were punch cards so there is a card reader and a card punch. I was supposed to make them work with the panels that had been designed on the ENIAC to communicate with them. So I worked on that. When I finished that then I was assigned the job of writing the manuals for the machine.

Aspray: Are there some stories about the ENIAC development that you want to tell us?

Huskey: Well, I think we used to have a joke. The ENIAC was classified -- confidential, actually, so you can tell people the mathematics it could do, but you couldn't tell them about the circuits. We had lots of drawings, you know; something like the multiplier had all the details of the gates, and the multiplier takes about three 36 inch sheets. We used to joke, saying we were not sure about this classification, but the best thing to do would be to give it to the Russians. They would stop, and try to figure it out, and not win the war. I don't know.

There were other things that happened for example, you build a multiplier, okay, and this had circuits to shift the multiplier and add in the multiplicand and so on, and you think well, if you have circuits for each one of the digits, and you say if the digit is zero there is no signal so you don't need to have any circuit for it. They forgot the signal is inverted, and by the time that it got to this part of the circuit it was supposed to be positive instead of zero. So when they did the first test on the multiplier it wouldn't multiply zero by anything correctly. Other things -- three times four -- is fine, but zero times four is no good. It was a shock but it was easy enough to add in the zero circuits and get it going.

<crew talk>

Aspray: Can you tell me about some of the people you met on the ENIAC project?

Huskey: Well, the two people-- sort of the head of the project was Eckert and Mauchly, of course. There were 15 people or so, I suppose, on the project. Arthur Burks was the person that I worked for directly. And he was interested in-- he was really a philosopher, I think. And so I'm not sure of his interest. But anyway, they were, I think, in terms of… Let's talk about the individuals. Let's talk about Eckert, for example. He was an engineer with a background in radar circuits and such. And he was very careful. For example, the circuits were generally designed with a 2:1 safety factor. For example, if something was supposed to be 0 instead of 20 volts, it could be wrong by 50% [10 volts] and still the circuit would work correctly. And so for reasons like that, the machine worked pretty well. And, of course, you think about this 18,000 tube thing, and you look at your home radio in those days, which was a 5-tube set. You had to go buy new tubes for it at least once a year. You do that arithmetic and it says that the 18,000 tube machine will run 30 minutes or so. Well, most failures in tubes at that time were mechanical. As the heater element was turned on and off the thermal expansion caused it to fail. They went through a 100-hour test of tubes before they were used in ENIAC, and that made a big difference. In fact, I think it made the difference in the working or not working as far as other people were concerned.

Aspray: Would you say that Eckert was a good engineer or an exceptionally good engineer?

Huskey: I would say exceptionally good. Now, Mauchly was a-- his background was meteorology and he was interested more in the computational aspects. He didn't participate very much in the engineering and the actual circuit details.

Aspray: What were they like as people?

Huskey: Nice people to deal with. No problems there at all. I think, later on there's friction between some of them relative to patent claims and such. I don't know the details on these, but I think if it wouldn't have been for that, there'd never have been any question about friendship or whatever.

Aspray: Did you get to know Goldstine during this time also?

Huskey: Oh, yes. He didn't contribute much technically, but he was helpful in acquiring things and dealing with the Army and so forth. He was in the Army while he was there. He worked for Aberdeen Proving Ground, in fact.

Aspray: He was sort of the liaison between Aberdeen and the Moore School.

Huskey: That's right.

Aspray: At what stage did you enter the ENIAC project and at what stage did you leave it?

Huskey: Well, I guess when I was first introduced to it, it was about half finished. There was a room full of partially finished panels and people working all around on circuits and so on. That was in 1944. Yeah. And when I left it in June of '46, of course, It had been... what do they call it—demonstrated? and so on, in February of '46.

Aspray: Dedication.

Huskey: Dedication is the word I'm looking for, yes. And it worked satisfactorily most of the time, as we expected. And, in fact, in '46 most of our effort was going into the EDVAC design.

Aspray: What was the feeling and attitude at the Moore School at the time on this project? Did people believe that this was critically important to the war, that it was an important technology that they were working on?

Huskey: Well, when you say the Moore School, I can just sort of talk about the average people that I dealt with. The people in charge there, the dean, I don't know what he thought about all this. But I think the people that were involved [took pride in the success of and interest in the ENIAC]. Other than, at that point in June of '46 the war was over and the purpose of the mission that motivated the construction of the machine was no longer there. No need for firing tables. There was interest from the atomic energy people, and I guess people who knew something about that knew how important that was, because that was more highly classified than the ENIAC itself. We didn't know much about that. The main thing we knew about is that in order to take care of the complexity of the atomic energy problem, they had to build buffers to add to the communication trays that worked around there. So otherwise, we probably would never have known what was going on.

I think nobody thought about computers developing like they did. There were two sides to this question. We were working on the EDVAC, and it solved a lot of problems that existed at ENIAC. The memory was much larger, for example. And I think we had--at least the people working on it had -- great confidence in that "We can make this work." It wasn't clear what to do with it if it was finished. I think people who had computational problems understood what might happen, but the average person wouldn't have any particular feeling. Does that answer your question?

Aspray: Somewhat, yes. Did you meet von Neumann at this time?

Huskey: Yes. He was a consultant to the project for a while.

Aspray: And were you party to the discussions that were going on between von Neumann and Eckert and Mauchly about the design for the EDVAC?

Huskey: I wouldn't say I was a party to them. I was working on EDVAC designs myself and there was no contribution to that. The von Neumann report was not helpful, in my opinion. So I think the answer--well, we had general meetings in which von Neumann participated. And I think the people who were actually working on the project took the feeling that, "Well, he doesn't worry about the details. He waves his hand." That sort of position. But--

Aspray: He wasn't really much of an engineer, right? His mindset wasn't for engineering.

Huskey: No. Logic really was his background. But I think his main contribution to that whole project was the fact that he wrote his report, even though people faulted him for not giving credit. That told everybody else that it is important. If he wouldn't have done that, people would have gone on thinking, "Well, this is not worth much."

Aspray: So he was a kind of legitimizer of it?

Huskey: That's a good way to say it, yes.

Aspray: He was already a distinguished mathematician. Eckert and Mauchly were still fairly young and not nearly so well established.

Huskey: Newcomers, yes. They had no-- as far as the general computational community, they had very little background or experience or whatever.

Aspray: From the visit of von Neumann, from your discussions with Art Burks, did you have any inkling that they were going to start a project at the Institute for Advanced Study?

Huskey: I guess at first we really-- the first I knew about it …One of my problems was I was teaching in the math department, and was only over there part time in the Moore School. So I may have missed things that other people would have run into. But my learning about the project at Princeton was really in that spring when Goldstine and Burks gave notice that they were going to go there. And I guess, by that time Eckert and Mauchly had resigned and were going to start up their company.

Aspray: Can you shed light on this discussion about the patent concerns that Eckert and Mauchly had? Not the disputes with von Neumann, but the disputes with the dean of the school and with the people who were concerned about patent rights being assigned to the university?

Huskey: I just don't know what went on there. It was presented to us that they couldn't-- Eckert and Mauchly could not, in the framework of the university, go ahead and build further machines. So whatever it was, it wasn't satisfactory from their point of view.

Aspray: I think that the university council had insisted that they sign patent waivers to the technologies and they were unwilling to do so. They chose, instead, to leave the university. They may have chosen to leave anyway, because of their interests. Was there talk around the ENIAC project about what to do after the war was over and to commercialize this technology?

Huskey: Well, not really to commercialize it, because I don't think anybody working on the project had that kind of interest. Not even Burks. I think only Eckert and Mauchly were in that category. And everybody was working on EDVAC and the goal there was to get it running and I think nobody looked beyond that point.

Aspray: Were people surprised when Eckert and Mauchly decided to form their own company?

Huskey: Well, we were anyway.

Aspray: And were people who were working on the project invited to come join Eckert and Mauchly?

Huskey: Well not in an outward or public sense. Maybe some were privately invited. I think Brad Shepherd went, as I remember, and not many others.

Aspray: What was the attitude at the university about finishing up the EDVAC project, given that Eckert and Mauchly, as principals on it, were moving on?

Huskey: I think... I guess I don't really know how to answer your question. What actually happened, as far as I was concerned, was I was offered an assistant professorship and the director of the EDVAC project. And so, I guess the university -- at that level at least, the people in the dean's office, I'm not sure the university was very much involved -- saw the project going on with putting it in my hands. But what happened, of course, is they did all this without saying a word to J.R. Kline, who was the head of the

math department. So he hit the ceiling and forced them to withdraw the offer. Of course, that made me mad, so I resigned.

Aspray: So this is a job you would have liked to have done?

Huskey: I would probably have gone ahead and done it, yes.

Aspray: So you resigned, and what did you choose to do?

Huskey: I didn't have anything to do. I had an offer from the University of Oklahoma, and I figured that I could do that if I didn't get anything else. Actually, Rado at Ohio State offered me a summer job teaching at Wright Field, so I took that.

Aspray: That was summer of '46?

Huskey: That's right.

Aspray: And what did you work on there?

Huskey: I just taught, I guess -- applied mathematics. And about July we got the cable from England. Before that, Hartree had been running problems on the ENIAC and I'd talked to him and asked him about opportunities in England. He didn't say much, so the cable offering the job was a surprise. But we accepted it. We didn't know what NPL was, but we accepted it.

Aspray: Did you know much about what work had been done in England at the time?

Huskey: Somebody had-- I think we didn't know about the computer projects. I'm trying to think about whether we'd heard about Charles Babbage at that point. I'm not sure quite when we'd heard about Charles Babbage.

Aspray: So even though it was after the war, you hadn't known there had been projects during the war, for example?

Huskey: Yeah.

Aspray: And did you know that there were groups formed in places other than NPL and Dollis Hill or wherever?

Huskey: I missed the first part of your question. What'd you say?

Aspray: Even though you didn't know about the wartime work, which was still secret I guess, did you know that groups had been formed in several places in England to work on this kind of technology?

Huskey: No. I didn't know that.

Aspray: So what was your mandate for going to NPL? Were you to work on applied mathematics or work on computing technology?

Huskey: We knew it was something to do with computing machines. But just what, we didn't know.

Aspray: This was later in 1946 you went?

Huskey: Yes. We were ready to go right away. But you couldn't get transatlantic passage easily and it was December before we could get tickets.

Aspray: What did you find when you got there?

Huskey: Surprise! The math division was operating in a couple of private houses outside of the NPL grounds and when I got there, they had arranged to put us up, our whole family, in an English boarding house. So that was fine. And so the first workday in the morning I went over to NPL and discovered the math division wasn't there. So I went over there and found Mr. Womersley, the superintendent, and he proceeded to introduce me around to everybody and show me a desk and whatever.

Aspray: Who were the principal scientists working there?

Huskey: In the computer area it was just Wilkinson and Woodger. And Turing was back here in the States.

Aspray: But he was on staff there. He just was absent at the time?

Huskey: He was the head of the computer activity, of the design and construction activity. There was a fellow running the punch card equipment they had. His name was Boss. Then they had a group of analysts that worked under Goodwin.

Aspray: What was the goal of the project?

Huskey: Under Turing?

Aspray: Yes.

Huskey: It was to build a stored program computer.

Aspray: And what was the state of it at the time you arrived?

Huskey: Everybody on the project was working on software, with a tentative design, to see whether we had all the kinds of instructions that one needed and so on. It had been decided that delay lines would be used and Turing wanted to take advantage of locating things so as to have minimum latency. And we just went to work.

Aspray: Were there engineers?

Huskey: Not at that stage, no. Just Wilkinson and Woodger had worked on computational things. But there were no engineers.

Aspray: Did that have an effect on the design that was arrived at?

Huskey: I don't think so. I think that it had already been pretty well decided that it would be mercury delay lines and Turing had settled that, as far as I know.

Aspray: I would think that architectural issues and choices of basic technologies could come back to haunt you if you weren't careful about some of the practical electronics.

Huskey: I don't think that would be a problem. The problem was you had to design a memory, and if you decided on delay lines, then it's just a question of what is the amplifier like and how is the circuitry inserting the signals at the other end. I don't think there's any surprises there. You might have to build a stronger amplifier than you thought, or things of that sort. There are other kinds of problems. For example, when the sound wave goes down the mercury, there'll be reflections. Will those cause you to gain bits in the memory, or lose them, or whatever? Questions of that sort. And that's an interesting one because any of the rest of us that ask that question would say, "Well, we'll have somebody build the lines to see if there are any reflections." But not Turing. No. He got out his pencil and paper and worked out the mathematics and said that he didn't think there was any problem. Of course, there were ideas on how to attenuate the reflection. You put in a baffle at an angle, and things of that sort.

Aspray: What did you know about other machines that were underway, or about technologies that were tried during the war? What kind of "technology transfer", to use the modern phrase, was there available to you when the group was making its choices at NPL?

Huskey: I think the answer to that is that there's experimentation going on at the Moore School. We had a person working on CRT storage -- Williams tube stuff – still trying to decide whether the mercury lines or CRTs or whatever. In England, the first month I was there, they sent me around to visit all these places. And so here was Williams with his Williams tube. Here was Wilkes with his mercury delay lines.

And that's all we visited at that point. We got some hint that there was military interest, but never much. I forgot the post office -- the post office was working on mercury delay lines.

Aspray: That was Dollis Hill?

Huskey: Dollis Hill, right. But whatever else was going on was classified, I guess. At least we didn't hear about it. In this country, of course, there's work going on at MIT with special storage tubes, of mercury delay lines at the Moore School, and Raytheon was doing a mercury tank. That was about all that was underway at that stage of the game.

Aspray: What was your job?

Huskey: My job in England?

Aspray: At NPL.

Huskey: Just worked with Wilkinson and Whittier. So I sat down to do programs to see whether we had the right set of instructions or not.

Aspray: What was the challenge of this job? What were the problems you had to face and how did you resolve them?

Huskey: We would program something and decide that this was too complicated, and if we had some other instruction, it would be simpler. So we were doing that kind of thing. And all three of us would discuss the problems as we went on about this. Then, of course, I think about April or something I told them, "Well, let's build one."

Aspray: They weren't ready to build yet?

Huskey: They had not been thinking about building, at least as far as I know. But they toyed with letting a contract to the post office to make mercury lines and something of that sort. So when I suggested to Womersley that "why don't we go with a prototype to see if this kind of thing is going to work?", he was receptive to that. And so we got underway.

Aspray: This was a scaled-down version?

Huskey: Yes.

Aspray: Do you want to describe it to us?

Huskey: Of course, Turing was interested in what we came to call the "Big ACE", which was a much more complicated machine than the… What we wanted was one that would prove all the different techniques to outsiders, for example. What we all wanted to do personally was build a computing machine that would work. As far as the machine is concerned, you took a look at Turing's design and say, "What can we cut out and still have something that does a reasonable computational job?" So we did that.

Aspray: What were the challenges of getting this to work?

Huskey: Getting parts. Wilkinson and I went around to military dumps where at the end of the war the various military operations had all kinds of parts left over, from bombsights to you name it. We were looking for things we could use. So that was a problem. And I got the machine shop at NPL to start making a delay line so we could work that out.

Aspray: So NPL already had all these laboratories. They did all this research in physics.

Huskey: Oh, yeah.

Aspray: So they were, presumably, pretty well prepared to do this kind of work for you. Is that correct?

Huskey: Yeah, that's right. Yeah. They could make a mercury delay line if you told them what you wanted.

Aspray: Would you say that the capabilities at NPL were stronger from that laboratory perspective than the Moore School had been?

Huskey: I think it was much better organized. The machine shop had much better capability. At the Moore School there was a machine shop, but a much smaller operation and I assume they could do the precision work that we needed, but I don't know.

Aspray: My recollection of NPL was that there were many physicists who knew a lot of electronics there also.

Huskey: Yes.

Aspray: Were they helpful to your…

Huskey: Not digital electronics, though. Not much there. And very little help as long as we were running the-- building the interim machine.

Aspray: Could you take a couple of minutes to tell me about some of the principal people you worked with at NPL? What they were like as people, what their skills were, what their weaknesses were, if there are things that you wanted to mention that are relevant.

Huskey: Yeah, well the people we worked with, I guess starts with Womersley as superintendent of the division. He was an organizer, a supervisor of people. He had no technical capability, either on computation or in hardware or whatever. But he could get things done. Above him, of course, was Sir Charles Darwin and I don't know what his capabilities were.

Aspray: Right lineage, though. And what about Wilkinson?

Huskey: Wilkinson, he was good at writing these programs. And he had a background in computation. He had worked for -- the Ministry of Supply? That's not quite right. Some other outfit that had done computing. Woodger, I'm not sure what he did before he came to NPL. But anyway, they were pretty smart as far as doing these programs.

Aspray: So they were numerical mathematicians, but they were programming as well?

Huskey: Yeah.

Aspray: What about Turing?

Huskey: Turing was an interesting character. He had no patience for stupidity. None whatsoever. And he wouldn't talk to newspaper people or news magazines and so on. But if somebody had a little problem and they were having a terrible time, he would help them and go way out of his way to help them. So he was that kind of a mixture. I think there's no hint, as far as I was concerned, about his homosexuality. None whatsoever. He was an Olympic class runner, of course, at that time. In fact, I raced him to Dollis Hill.

Aspray: On the train, isn't that right?

Huskey: Yes.

Aspray: Do you want to tell that story.

Huskey: Okay. Well, Wilkinson had raced him with a bicycle, you see. But when it came to me, I clearly was not the bicycle type. So the challenge was: I would take the train, and we'd leave at the same time and see who got there first. Because going by train wasn't too simple. You would take-- the train from Teddington did a loop back into Waterloo Station. So you go part of the way into town and at Clapham junction, I think it is, there you pick up a train that goes circular around London to the north edge. There

you pick another train that goes out to Dollis Hill. Well, I think I beat Turing by five minutes or something of that sort.

Aspray: What was the distance that Turing had to go?

Huskey: About 16 miles sticks in my mind. I think that's right. Maybe the answer to something else is 16. I don't know. But anyway, in a little briefcase, I carried his clothing and he changed at the gate at Dollis Hill and we went to visit the people there.

Aspray: …say about Turing's personality other than what you've told us already. Was he interested in particular things? Was he outgoing and friendly to people?

Huskey: I would say that he was not friendly in trivial situations. He didn't want to waste time in a case like that. He was interested in athletics. He had-- I can't think of what it was called. The whole NPL would have a sports day, and he would participate in things of that sort. One interesting case: we had invited people over to our place to have dinner in the evening, and we invited Turing, of course. He didn't come, and he never said anything about not coming. I never understood that, because that didn't seem quite consistent with his behavior at work and so forth. So I don't know why. That leads to another interesting…

Let me back up a little bit. I mentioned that we had an English boarding house when we arrived there. and that was not really-- The food wasn't what we liked or were interested in; we were not used to smoked fish for breakfast for example. It didn't go too well, particularly with three and five year old daughters.

It was the worst winter that England had had in 30 years I think. We had about five inches of snow the day we arrived. We took the train up from Southampton. Then we changed at Waterloo and took the train to Teddington. We got off at Teddington with all our baggage and took a taxi cab and told him where we wanted to go. He said that's just over across the bridge, cross the railroad tracks. I knew we couldn't manage all our baggage so I got him to agree to drive us around. We drove about a half a mile up the to the overpass and back down the other side. Right there at the railway station was the boarding house. We had one room in the boarding house, a high ceiling, a little gas heater and a place to put the shillings in to keep it going. So it was a little cold to start with.

After that we found a place in Sunbury, just about-- I guess it was 10 miles from NPL. Maybe not quite that far. It was a doctor's house and he was on leave for a few months so we were on our own. We learned to deal with the ration system and all the other things that you do as a visitor to England.

Our time there was up in about July, so we went to a real estate agent in Kingston, which was the next town over on the river [Thames]. We told him what we wanted, and he said he had just the place. This turned out to be a house in Bushy Park, one of the "grace and favor" places. This one had been given to the retired secretary of Queen Mary. We went to look at it and the landlady took us on a tour. We started out in the kitchen -- scullery -- and it wasn't impressive at all. We go on into the next room and she bangs on the table there and says, "You can't hurt this table. It's Chippendale. But be careful of the table in the

dining room because that's Georgian." In the living room was a grand piano and there was a cabinet of china that had been given to Queen Mary when did her world tour. On into the dining room and there was this Georgian table.

Upstairs in the hallway were many autographed photographs of the royal family. So that was pretty nice. And this was where we were inviting Turing to dinner! The house was about a couple hundred yards from the NPL fence. I walked the path to NPL when it was pea soup fog. The only way you could tell you were on the path was the feel of the grass where it had been mashed down before. But anyway, it was a wonderful place. I guess I didn't realize at that time how wonderful in fact it was. For example, the present Queen was married the year we were there. Of course I went to Cambridge that day on an official visit, so I couldn't get involved. But my wife went up to London to hold a mirror over her head so she could see the parade. Then the landlady came in after that and said, "Would you like to visit Buckingham Palace the day after the wedding?" We said, "Of course." She said no one would be there -- they all take off. So we went there and there we walked through Buckingham Palace with all the debris from the party still on the floor. It had not been cleaned up yet.

I should back up. This is back in Philadelphia. We lived about eight miles out west of town and when you went to the University; you rode about four miles on the Red Arrow transportation system and then four hours on the elevated train--

Aspray: Miles.

Huskey: Well, that's not right. Anyway, it was four miles on the elevated train to the station next to the University. A Professor in the Math Department named Shohat, a Russian, and in fact refugees from Russia in 1922-23, lived out on Eagle Road where we did. Frequently I would meet him going to the University or coming home. When they-- and he died later on and then she finally died. It turned out that in her will she had given us her kitchen appliances, which didn't amount to much, but she gave us a set of Royal Doulton china, which is really something. And so when we go through Buckingham Palace, there they've got this big cabinet, high ceiling with all this Royal Doulton china. Didn't look as good as ours! So we've been lucky.

Aspray: One last question about Turing before moving on to some other things. You talked about his being willing to help people out when they had problems. If you think about him and his capabilities, was he good at solving only mathematical problems or scientific problems or programming problems or engineering problems? What was he good at and what wasn't he good at?

Huskey: I think mathematical or logical problems. I would say.

Aspray: So what happened to you after your time at NPL?

Huskey: Well, in December… Actually I had been offered to come spend six months or so with Wilkes on his machine.

Aspray: At Cambridge?

Huskey: Right. And I would have done that, except I had accepted the job at the Bureau of Standards, and they wouldn't give me the time off to do that. So I came back from England to the Bureau of Standards.

Aspray: Why didn't you stay at NPL?

Huskey: Why didn't I stay at NPL? They didn't offer me a job, anyway.

Aspray: Would you have liked to?

Huskey: Oh, I don't think so. By the time, later in the year, we were working away on the pilot model. So Sir Charles [Director], in his great wisdom, decided we didn't know enough engineering to really do a proper job. We were a bunch of mathematicians, of course, so he had some right to say this I'm sure. But anyway, he gave the project to the radio division. Of course that upset all the guys on the project. This was about October or November when this happened. So I just didn't have anything to do for the rest of my stay there. I worked on the smaller version of an eight bit machine just to illustrate the principle, the Turing principle, of locating instructions and operands so you get optimum timing. As far as the other people are concerned, they were disappointed, but they had to live with the situation. By then we had hired a couple of people, so some of them transferred to the radio division and they went on and redesigned the machine.

Aspray: Now I--

Huskey: So anyway, in January I came back to -- in '48 this is -- came back to Washington with a job at Institute for Numerical Analysis in Los Angeles. I was supposed to spend six weeks in Washington to find out how the Bureau did things. I spent a year there.

Aspray: I'll move on to that in just a minute. I'm not going to ask you very many technical things about the Ace developments because we have the copy of your lecture where you talk about a lot of those things. But could you take a couple of minutes to talk to us about what you think the significance of all of those NPL early computing developments was overall?

Huskey: You mean in contrast to what was going on in the U.S.?

Aspray: Right, or for the history of computing. What's the place of those NPL activities?

Huskey: Well, certainly the Turing design was produced as a faster computer than the corresponding ones using the same principles at Cambridge -- Wilkes' [EDVAC] delay lines -- or for example IBM with their IBM 650. The ability to place instructions so as to minimize the wait time was a significant difference between the work at NPL and the work on any of the other computers. And it was the same principle once carried on down to the G15 that I designed. So I think as far as-- The answer to your question as far as NPL is concerned is: that principle was important, but it didn't last. Other things, core memories and so on, made the whole idea obsolete.

Aspray: So let's talk about NBS. First of all, how did you learn about there being a job there?

Huskey: I just heard. In England I heard a rumor, and I don't know where I heard it, that they were going to set up an operation at UCLA, and that sounded good to me. When we were waiting for the appointment to go to England we had decided to drive down the Oregon-California coast and see what it's like, and we decided that we liked that.

Aspray: You liked southern California.

Huskey: Yeah.

Aspray: Did you give consideration to any other jobs?

Huskey: Not at that time.

Aspray: Would there have been other places you could have gone at the time?

Huskey: Oh I'm sure, looking back, that I could have gone to any of the places where there was computer activity -- primarily around Boston, Raytheon, or MIT, or whatever.

Aspray: Would you say that by the time that you were heading back to the United States that your experience and your background made you pretty unusual? How easy was it for these programs to find people who had the same skill sets that you had?

Huskey: I think there weren't many, no. I learned my electronics while in England.

Aspray: You learned your electronics while you were in England?

Huskey: Yes.

Aspray: And who taught you that, or did you just learn on the job by yourself?

Huskey: No -- MIT published a book on digital circuitry and that had answers to most of the questions I had.

Aspray: What was your understanding of what NBS was going to do and what you were going to do as part of that project?

Huskey: Well, they were going to establish a numerical analysis research activity on the campus of UCLA, and I was part of that. Nothing was said about what I would be doing.

Aspray: Your position was as a research scientist working for NBS?

Huskey: That's right.

Aspray: You just happened to be on the campus because that's where they chose to locate.

Huskey: They had an arrangement with UCLA to have a building there.

Aspray: Why did they choose UCLA?

Huskey: I think they talked to other places and got a better offer from UCLA.

Aspray: To use the modern term, what was UCLA's "organization capability" to take this on? Were there people there who were already working in this area? Who were the principals?

Huskey: Nobody.

Aspray: Nobody.

Huskey: No. We tried to get them involved some. They sent a couple of low level people over to work for us for a while. At that stage of the game, they didn't do much.

Aspray: There weren't, for example, good numerical mathematicians in the math department?

Huskey: Well, there was. I can't think of his name at the moment. He had published a book on applied mathematics. I'm not sure how much he was interested in computational activity. There wasn't much interest in computational activity outside of places that required it for their actual business, like insurance companies, or the U.S. Navy activity in Washington. Comrie, of course, had a reputation, but he was about the only one. I suppose Howard Aiken -- you could say he had an interest.

Aspray: What was the work that was set out in this UCLA operation?

Huskey: Support research in applied mathematics.

Aspray: This was just by bringing in visiting professors?

Huskey: Having a support staff, and bringing in visitors for one or two years, or things of that sort.

Aspray: I remember Magnus Hestenes, for example, was involved, right?

Huskey: Yes, of course. He was a professor at UCLA that was interested in that.

Aspray: Who were some of the other people?

Huskey: Other people that were there? Oh there was Barkley Rosser for example. Derrick Lehmer from Berkeley.

Aspray: Was John Todd there?

Huskey: John what?

Aspray: John Todd.

Huskey: [John Todd was primarily in Washington.]

Aspray: Okay. There was the statistician too, Churchill Eisenhart?

Huskey: Yeah. He was in Washington.

Aspray: He was in Washington.

Huskey: Associated with the Bureau's Mathematics division in Washington. He didn't have anything to do with UCLA or INA.

Aspray: What was the relationship between the east and west coast operations if any?

Huskey: Well, they accused us of-- We started building a computer finally at UCLA. I called it the Zephyr. This was because people on the east coast were building Whirlwind and Typhoon and what have you.

Aspray: So you had a wind theme?

Huskey: That's right. So the people in Washington called us -- is it Socorro? -- I think, a hot wind from the desert.

Aspray: Right. But you didn't have close relationships with them?

Huskey: Oh, technically we tried to visit them frequently and I think we -- both ways -- we kept track of what the other one was doing.

Aspray: Was there a difference in the kinds of projects that were being worked on in the two places?

Huskey: No. They were working on the SEAC, and we were working on the SWAC.

Aspray: Right. What about in contributions to numerical analysis and computational science from UCLA?

Huskey: Most of that was done at UCLA. Yes. You mentioned Hestenes, and there was some other people there. Can't think of his name but he became President of the University of California. He was around the Institute and interested in computation.

Aspray: you were to evaluate or summarize what was contributed by that group, what would you say?

Huskey: I think the contribution is primarily bringing top experts in the field together, people from England, people from Switzerland -- for example, Rutishauser. People like that.

Aspray: Were there some particularly strong results that came out of the work at UCLA at INA?

Huskey: I guess I don't know particular examples.

Aspray: What did you do?

Huskey: What did I do?

Aspray: Yes.

Huskey: I built the SWAC. That was a full time job. <laughs>

Aspray: How was it influenced by all of these applied mathematicians that were around you, if at all?

Huskey: Not much. We had some lectures telling them what we were doing.

Aspray: But they didn't say, "Oh, I have this class of problems and I need this much speed and this much storage and capability to do these kinds of things quickly"?

Huskey: Nobody said that.

Aspray: Nobody said that to you?

Huskey: No.

Aspray: If they had, would you have been able to build that in?

Huskey: Well…

Aspray: It's hard to say?

Huskey: It's possible. It's probably-- I think we felt that we had a design, which was a limited number of instructions. It's not like the Intel today. In order to make it possible to build it in a reasonable time, we tried to keep it as simple as we could. But I think as far as any computational problem that it concerned, that there's no trouble with the adequacy of the code to do that problem. The limitations were in memory, for example. If you wanted to-- if you had a big problem or a big matrix or something, there might be a problem about storing it in the computer. So there are limitations there, but we expected those.

Aspray: Why did INA decide to build a machine?

Huskey: Because I told them to. <laughs> No, literally. Curtiss in his budget for the institute had allotted money to supply computing capabilities for numerical analysis. It was pretty clear the money that was available was not adequate to buy a commercial machine. In fact, there weren't any commercial machines available. Eckert and Mauchly would contract for it, but they had a clearance problem so we couldn't deal with them. We could use our money that we had.

Aspray: This is because of Mauchly?

Huskey: That's right. And the others, Raytheon, wanted too much money, so we couldn't afford theirs. Those were the only two commercial offers at that point. So when I suggested to Curtiss that we build one, he was receptive, and it got approval by the committee that he had to advise him. I had the job.

Aspray: How was INA as a place to build a computer?

Huskey: Well…

Aspray: Laboratories, machine shops, engineers, technicians, that sort of thing.

Huskey: For the kind of computer that we built there was no problem about access. There was nothing in the SWAC that involved precision machine shop work. And there was plenty of contract ability in the L.A. area so if we wanted 20 testers [or amplifiers], we could find people to bid on that kind of job.

Aspray: Because of the aerospace industry?

Huskey: Aerospace was there, right.

Aspray: Were you using commercial tubes?

Huskey: Tubes? Yes. Yeah we used standard cathode ray tubes.

Aspray: What were the challenges in building SWAC?

Huskey: Well, the real challenge was the presence of flaws on the face of the tubes. We found out that the-- We bought tubes from Dumont. And we come to find out that they were made in a warehouse that had been a mattress factory, and the lint would deposit. There was lint everywhere, and it would deposit in the face of the tube when they put the phosphor there. And then when the tube was heated and evacuated, the heating would turn those pieces of lint to carbon, and you have these little areas that you can't store on a spot next to because it just spreads out on the piece of burnt lint.

Aspray: What did you do?

Huskey: Well, we tested tubes and selected ones, and had all kinds of problems.

Aspray: So you couldn't work around it. You just had to pick out the tubes that didn't have bad problems?

Huskey: That's right. You could-- You see you got 36 tubes and you got an array of spots in each one. And you move these in unison, because the deflection system works that way. Any number is represented by one spot on each tube. That's a necessary part of the design. So you have no way of dodging spots on just one tube. You have to watch all the tubes, and you never know when you're close to a spot because it's only when you're on it that you look at the signal and find out that there's your problem. But if you select your tubes, then you can run tests. And moving the displays a little bit and maybe you can find a place where all 36 of them are okay.

Aspray: I assume that you couldn't do all the work yourself -- that you had to have other people working with you.

Huskey: Oh, no.

Aspray: How did you find people? What did you look for in the people to work on this project?

Huskey: We didn't really advertise, except by word of mouth I guess. People applied. I got three pretty good engineers. We divided the computer into three parts: the arithmetic part, the memory part, and the control. And the three engineers worked on those parts.

Aspray: Were they experienced engineers?

Huskey: Well, not in that particular thing. General experience of some sort, but not working with cathode ray tubes and so on.

Aspray: What did you look for in hiring somebody?

Huskey: Well, smartness more than anything else.<laughs>

<crew talk>

Aspray: Do you remember who they were?

Huskey: Yes. The person who worked on the arithmetic unit was-- Oh, shoot. You ask me that kind of a question I can't think of the name.

Aspray: That's okay. We can fill it in later.

Huskey: [Ed Lacey worked on the arithmetic unit.] The person that worked on the memory was Ambrosio, Benny Ambrosio. David Rutland worked on the control circuitry.

Aspray: I know that name.

Huskey: He published a book about the SWAC.

Aspray: Yeah, okay. That's probably how I know. Was Las Angeles a good place to develop a computer? I mean you've talked about the ability to have machining done, or special kinds of activities. But was it a good place in the sense of having others who were interested? Did you talk, for example, to the aerospace industry people during those days?

Huskey: I think so, yes.

Aspray: I know there were projects at some of the aerospace companies fairly early on to—

Huskey: Yes, the MADDIDA work at Northrop was early.

Aspray: But that was a very different design right?

Huskey: That's right. It involved digital circuitry.

Aspray: So did you have meetings with MADDIDA people from time to time?

Huskey: No. We probably went to the same technical meetings. I organized a computer group under IRE at that time. We had some meetings and talked about things.

Aspray: That was very early for professional groups to get involved?

Huskey: That was pretty early yes. That was before the-- about the same time they did in the east.

Aspray: About the same time ACM was forming in the east?

Huskey: Yeah.

Aspray: That was '47 I guess.

Huskey: That was '47.

Aspray: What kind of attendance would you get at one of these IRE symposia or workshops or talks that you gave?

Huskey: I don't have any memory. It was a satisfactory size group.

Aspray: Who would have been interested in coming to such a meeting?

Huskey: Oh I think any of the young engineering crowd would be interested.

Aspray: I need a break.

Aspray: ... there was one short Turing story you were going to tell us.

Huskey: I thought I told it.

Aspray: You told it off camera, about talking to him at the...

Huskey: Oh, yes. Yeah, one day I came back and here he was sitting at his desk and working on something on the paper, so I asked what he was doing, and he said he's trying to figure out how to chastise a computer.

Aspray: <laughs> I'd like to change topics for a little while, and talk about ACM. How did you get involved with ACM in the first place?

Huskey: Well, I got involved in the starting of the professional society stuff very early when I was still working on the SWAC in Los Angeles, and set up the computer group there under the auspices of the IRE. The local LA chapter of the IRE came out and asked me to do this, so I did. And then the people from IBM in New York started the East Coast computer club activity and we ended up joining then. When it became IEEE and so on, it just carried on, and so I helped start the computer society.

Aspray: Right.

Huskey: On the ACM side, I just got involved in the activities, since I was already in that sort of thing, and I don't know who said, "Run for vice-president," but I did, and got elected.

Aspray: <laughs> And then as president later.

Huskey: Almost automatically, yes.

Aspray: And what years were you president?

Huskey: I was president ’60 to ’62.

Aspray: And who were your predecessor and successor?

Huskey: Predecessor, I don’t know.

Aspray: I can check that easily.

Huskey: The successor was Alan Perlis.

Aspray: What were the issues for the ACM at that time? What were the big things you had to confront?

Huskey: Well, I guess it was how to support the publications and what to do about the growth, and so on. It was that kind of question.

Aspray: Were the publications seen as the major product of the organization?

Huskey: They would have been, yes.

Aspray: Were there debates at the time about whether ACM was a scientific society versus some sort of professional organization?

Huskey: I don’t think we argued about it. I don’t know. I don’t think anything was ever said that I remember.

Aspray: At one point in the history, and I think this might have been a little bit later, there were -- now, I’m not sure of the timing -- there were debates within ACM about whether or not ACM should take a stance on Russian scientists and problems that they were having. Did that kind of issue come up at the time?

Huskey: I don’t think so. I think somebody in ACM was dealing with the problems of other people from other countries, but I don’t remember anything particular about Russia. No. And I don’t know who organized the exchange on the American side, but I went because the current president had a security block. I mean, he had been involved with the -- I guess the National Security Agency, or whatever they called it at that time -- and wasn’t allowed to go out of the country as freely as I was, for example. So I went as vice-president.

Aspray: And what did you find?

Huskey: In Russia? Generally, that they're about ten years behind us, and trying to do the same sort of things. You know.

Aspray: Was the infrastructure more difficult for them, funding more difficult for them?

Huskey: I guess I don't know about that. The people we dealt with didn't say they had any money problems. They were all supported by the Academy of Sciences.

Aspray: And was there a difference in emphasis? Was there, for example, more theoretical work or more mathematical work being done there then in the United States?

Huskey: I think pretty much the same, but people were very interested in languages at that time, and software tools.

Aspray: Who was the executive director of ACM when you were president?

Huskey: I don't think we had one. I think he came along after I went out of office. Myrtle Kellington handled the editorial activity, and that was it.

Aspray: So there wasn't much of a staff at the time, in the organization?

Huskey: I think she was the staff.

Aspray: She was the staff.

Huskey: Yeah. We didn't have an office and we used to operate out of her apartment.

Aspray: That's much different from today, where there are 80 or 90 people working for them.

Huskey: Right.

Aspray: Right. And can you remember other issues that came up during your presidency?

Huskey: I think that's about it. I don't remember any others.

Aspray: Did you...

Huskey: I guess we had one problem, the big snowstorm in New York City and our hors d'oeuvres were in the Holland Tunnel for three days. <laughs>

Aspray: And did you continue to do other work for ACM after your presidency? Serve on committees and things of that sort?

Huskey: Some of that sort of thing, and particularly in the first year afterwards. Yeah, that's about all.

Aspray: And what would you say was the importance of ACM to the profession?

Huskey: I think primarily the supporting of publication. And the conferences, I guess, also. Yeah.

Aspray: At that time they were… I guess somewhere along line they had a big annual conference.

Huskey: Yeah.

Aspray: Which has stopped now.

Huskey: That's right. And AFIPS was running its show at the same time.

Aspray: Were you active in AFIPS, as well?

Huskey: Well, sort of secondarily. I was a representative to them for a while.

Aspray: Now, you were active in both the IEEE's activities and the ACM's activities.

Huskey: Yeah.

Aspray: How would you differentiate the two?

Huskey: Well, the IEEE activity got more support out of the society office in doing things, and ACM-- we just didn't have any support organization like the IRE and IEEE in New York.

Aspray: Did you see the same people in the computer groups of IRE and at the ACM meetings, and stuff?

Huskey: Mostly the same.

Aspray: And was there any talk during your period about merging the two?

Huskey: There was never any talk about ACM merging with anything. There was the merging of the two...

Aspray: IRE and AIEE in 1963. Yeah.

Huskey: Yes.

Aspray: So that was just after your term as president.

Huskey: Yes.

Aspray: Are there things that you'd like to tell us about the ACM?

Huskey: Well, I don't think I can think of any.

Aspray: Okay. All right, then, let's turn back and talk for a little bit about your Bendix years.

Huskey: Okay.

Aspray: First of all, how did you get to Bendix? We left your story and you were still at INA.

Huskey: Yes. Well, the Bureau got involved in the battery acid testing deal. Do you want me to go into that?

Aspray: That story's pretty well known, but maybe not to the computer history community, so why don't you say a little bit about it?

Huskey: Okay. Well, what happened was … some company made an additive to add to batteries that was supposed to extend their life, and the Bureau of Standards was given the job of testing it. So they tested it and decided that it didn't do any good at all, and reported this. The guy that manufactured it contacted his congressman and said whatever, and that ended up with the Commerce Department appointing a committee, the Kelly Committee, I think it was, to review what the Bureau of Standards was doing, and this is also tied up with McCarthy. McCarthy was witch-hunting, you know, and I think the-- well, they're almost independent, but anyway, the McCarthy business caused the Bureau to fire a number

of people, starting at the top. Ed Condon was fired. The next director, Alan Astin I think, was forced to resign or fired, or something. In the math division, John Curtiss was fired.

The whole Bureau operated with a good fraction of its budget coming from projects that were financed by other government agencies, and almost all of that was wiped out. If the Navy had a project going on, they would transfer it back to the Navy, and that sort of thing, so there was a real cutback in operation.

The fact that INA was a project under the Bureau of Standards caused it to be terminated as a Bureau project. The SWAC computer was given to the Engineering Department of UCLA, and the mathematical research part of INA was set up as a project in the Math Department of UCLA. And so that ended that phase of things. I had gone on leave to Wayne University with Jacobson, with the charter to set up a computer center there, and so I spent the year working on that, and when I came back to the Bureau, all this other stuff had happened. So the question was, what is the future? And at that point, Lehmer and Paul Morton at Berkeley offered me a position, so I took that. It was an associate professorship .

Aspray: Was this in the Math Department?

Huskey: It was half math and half EE, and so on July 1st of that year, I moved to Berkeley. That's about the whole story.

Aspray: Okay, so we're trying to get you to the Bendix years.

Huskey: Oh, Bendix. Okay. That sort of went on independent of-- following up on the 8-bit computer that I worked on, I decided that it would be-- that you could use a magnetic drum instead of mercury delay lines to make a Turing-like machine, and so I worked on a version that was a compromise between the interim machine that was designed at NPL, that I helped design, too, and the final Big ACE that Turing was interested in. And there it was-- you know, the information flows from some source [read head] on the drum, recirculates exactly like a mercury line recirculates, and then there's the box in between that processes the information. There's only four things it could do, like change a sign, take absolute value and specify single or double precision then it's sent back to the memory some place.

Some attention was given to making it efficient at programming the floating point mathematical operations. Because that's what the real key is to the final system that was most popular at Bendix, the so-called intercom programs. The idea was that you try to pick up an operand and do a floating point operation with a virtual accumulator, in fixed point hardware, of course, and then put the result back into the virtual accumulator, and design it so that it fits into the cycle of the recirculating memory.

The programmer then operates at a higher level and he's just saying, you know, "Floating point add," "Floating point subtract," or so on. Each one of these pulls up a subroutine that does it in an efficient way, so the finished coding, which Turing made possible, is done at that level. The user doesn't see any of the details, so it simple to program for, in contrast to the ACE machine level programming. So with that design, I went around to Librascope and said, "Would you like to buy this computer design?" Likewise, I went around to Bendix and Bendix made the most attractive offer, so I went with them.

Aspray: And why was Bendix interested? Were they in this business?

Huskey: Well, they had bought from Northrop the rights for the MADDIDA and were busy designing a decimal MADDIDA computer, and so were very receptive to a general purpose computer. It fit their plans.

Aspray: Tell us about the dates for this?

Huskey: What?

Aspray: When did you go around to Librascope and Bendix to sell this, and when did they make up their mind?

Huskey: Oh, in 1953. Actually, most of the work was done while I was at Wayne. I guess that started in July of '52. So, I'm not sure what your question is.

Aspray: Okay, that answers it. What was your role in the design of the machine for Bendix? I mean, you sold them a basic idea. Were you involved in the implementation, as well?

Huskey: Well, I produced effectively a block diagram for the complete machine, and they did the circuits and made the drum and that kind of thing.

Aspray: And did you serve as a consultant to the company during the time they were making it?

Huskey: Oh, yes. That's what they wanted was a consultant, so I consulted for them for the next 10 years or so.

Aspray: And what was the fate of this machine in terms of a product for the company?

Huskey: Well, during this same period, the core memories were becoming popular, and they were improving the design, so there were less problems. It was pretty clear that any future generation would not involve a circulating drum or mercury line or anything of that sort.

Aspray: So in a sense, the Bendix design was one for a generation of technology that was ending, and being replaced by something else.

Huskey: That's right. Because I went on to work on the Bendix G20, which was a competitor for the IBM 7090 series, but that's about the time that Bendix decided this was too big a game for them to play in, and so they sold it.

Aspray: Who'd they sell it to?

Huskey: CDC.

Aspray: And did CDC use the plans for the G20 in their own product line?

Huskey: I don't think they used any of the technical information. They used the sales staff.

Aspray: Yeah, that would make a lot of sense. Right?

Huskey: Yeah.

Aspray: And this was done while you were at Berkeley, mostly?

Huskey: I was at Berkeley during that period, and Bendix put a G15 in our maid's room. Our house had a room that-- when the house was designed it was for the maid to stay in, you see, so it made a perfect office. They delivered a G15 for me to use there and then I worked on software and on this intercom program and things of that sort, and worked on a program to handle information on magnetic tapes.

Aspray: Are there some features of the machine that you want to talk about, either because they were interesting or they were challenging, or you thought that they were novel and had an impact for the future?

Huskey: Well, I think the impact was there as long as you were interested in recirculating memories, but with the coming of core memory, that kind of ended that interest.

Aspray: Okay. Why don't you tell us about Pogo?

Huskey: Okay. Pogo was a software designed to place instructions in the memory in an optimum position relative to timing. For example, you pick up an upper end and once you've got the last upper end, then you're ready for the next instruction, and then two more upper ends, and so on. So you'd place these in the recirculating memories so that they would become available at the optimum time. And the software was pretty good. It would place about-- fill about 90 percent of the line, and then it would begin to lose out, so you move to a new line to make it work, but it was a little complicated to use, so it was never very popular. The intercoms, with they're interpretive structure, was much more popular, and I think they competed. In fact, they competed time-wise, too.

Aspray: Okay, what I'd like you to do is to walk us, pretty quickly through the rest of your career. Take a couple of minutes about each of the major developments. And I'm mostly going to let you run without interruption now, though I might, every once in a while, ask you a quick question.

Huskey: In 1954 I went to Berkeley, and taught a course in mathematics and numerical analysis, and a course in the AA department on computers and begun to work on computer languages. The Fortran was developed about 1957 or so. It was IBM's effort in this direction, and so along the same lines, we developed a somewhat simpler system. And this was actually developed when I was consulting for the U.S. Naval Electronics Laboratory in San Diego under-- I worked for Halstead who was in charge of the group down there. And the charge was for a language that could describe a battle environment and run fast enough to keep up with an actual case, was the challenge. And so we didn't have any floating point, for example. It was much simpler logic than you might have. And one of the challenges that we followed was to have the system be able to compile itself. Now, this meant that you could pick out a fairly small subset and write the description of the language of the compiler in that subset language. And that, you had to hand compile to go onto a new computer, but once you got that small subset on the new computer, then you could transfer the big system and have it work. And so this was-- we called this program NELIAC captor [ph?] NEL, and I used it as a teaching environment. So at Berkeley, I taught a course in how to do such compiling, and I had some three or four fellows who were pretty smart working on it. One of them was Nicholas Wirth who--

Aspray: Yes, we've heard of him.

Huskey: You've heard of him. He went to Stanford and went on and developed Pascal. And still, I see probably something just the other day that is still active. But anyway, another person, talking about students, was Bill Wattenberg, who when he graduated with his doctorate at Berkeley, we gave him an appointment as an instructor for a year. And he had so many irons in the fire that the rest of the faculty didn't think we ought to keep him on. But he formed a company in Berkeley and went to making computers and so on, and finally sold that out and retired on the money. He lived in Greenville, up in the Sierra's and close to Chico in California, and so he retired back to the farm, so to speak. On the other hand, he became a commentator on a KGO station on Friday nights or something, used to take questions over the phone and--

Aspray: I should move your hand off the microphone.

Huskey: Oh, yeah. Okay.

Huskey: Anyway, Bill, you know, formed his own company and sold it and with the idea that he would retire. Well, he retired to work, I guess. I don't know what all else he did, but he did answer phone calls on this program on KGO and he'd take on anybody who called, and whatever they problem they thought anybody had. And he married an airline waitress that worked for Western Airlines in those days. And he bought a condo in Waikiki Beach in Honolulu, and his wife had another condo in the same building, so they had two condos. And so they, in the course of events, said why didn't I use the condo, and I've used it several times. In fact, in the filing cabinet, I've got the keys to it, and I could call up and arrange to go anytime. And so anyway, he's done a very successful job. The other students, I think, are not quite so spectacular.

Aspray: Okay, why don't walk us through the rest of your career?

Huskey: Okay, after-- well, I stayed with Berkeley, and in 1967 I transferred to the Santa Cruz campus, which was brand new at that time. And stayed there until I retired at mandatory retirement, when I was age 70.

Aspray: Why did you make the move?

Huskey: Because Berkeley was getting too crowded, too many cars and whatever. Santa Cruz was a very attractive town at that time, and being able to set up a brand new department from ground up, including the computer center, just looked attractive.

Aspray: You were the chair?

Huskey: Yes, and in the University of California, the dean appoints a chair, and you serve for two or three years, and then somebody else gets appointed. So it's not the Empire Building environment that exists in some places. But so anyway, back to Berkeley. I was on the committee that oversaw the computer center, you know, kind of a natural appointment. And as in that position, I became acquainted with the financial problems and so on that the computer center had. And they appointed a new director of the computer center, and he overspent his budget because he wanted to do certain things, and he thought that if he overspent his budget, they'd bail him out. Well, they didn't bail him out. They fired him. So I was appointed the acting director of the computer center at that point. And meanwhile, I'd applied for an opportunity to spend a year in India on a US AID project. Some eight universities in this country, MIT, Michigan, Purdue, UCLA, Berkeley, whatever, were all together in this project to build a technical institute on the pattern of MIT or Cal Tech, and from the ground up in India. So in a town that's a million people and five taxicabs, so we started this new one, and I was supposed to set up the computer center. So we had a--

Aspray: Which town?

Huskey: Kanpur, and it's about a third of the way from Delhi to the Calcutta, so it's a-- and I'm kind of getting off the subject, but maybe I'll get back. So here we fly out to Delhi, stopping at lots of places along the way to Athens and what have you, Lebanon. Calcutta, Karachi, or not Calcutta this trip, but Karachi, and end up in Delhi. And the AID indoctrinates you, so they have a two-week program before you really start your work, and they did that in Delhi. And then, we went down to Kanpur, and we got there and discovered that the building where the computer was to go was not finished, neither was the house we were supposed to move into. So the director of the project invited us in as his house guests, and the computer room-- we had about two more weeks before the computer arrived. They'd had a lot of trouble shipping stuff out, and then having it destroyed by rain on the docks or whatever, so when the computer came up, they got that out of a bunch of other electronic stuff and set it out by a chartered DC-8. One problem with DC-8s is you can't land them at the commercial airport in Kanpur. And well, the first one arrived in Delhi, they didn't have a manifest. The customs agent threw up his hands and said, "Take it down to Kanpur and tell him what you got." So they flew it down to the military airport there in Kanpur, and actually on the other side of Kanpur, where the institute was. The institute was five miles out of town in one direction, actually a little village called Kalyanpur. And the Air Force was on the other side, so we had to load the stuff in trucks and bring it through the town. And in India, they have road blocks every once in a while, where they collect custom taxes to pay for roads and so on. So the question was how do

we get US AID to pay this customs fee. And we decided, well let's try it. We'll get the Air Force to lend us some trucks, and we'll put them in front, and we'll breeze through like we own the place. And it worked, so we got the computer out to the institute. But the trouble was the room still wasn't finished. This is monsoon season, by the way, in the middle of July and a lot of rain. And there was about an inch of water on the floor in the room where the computer was to go, and we set the computer in its crate in there and so on. But they got busy and fixed up the room. Then, we discovered that this was an IBM 1620, purchased just before they released the disk, so it was a tape machine. It took three phase power to drive the tapes, single phase power to drive the computer. And when we unpacked everything, we discovered the three phase converter. India power is 50 cycles and a slightly different voltage. And the computer and stuff was financed by US AID and had a buy America clause, so it was 60 cycles. So we had to convert from 60 to 50 cycles and adjust the voltage a little bit. Well, we found a three phase converter, one made by General Electric, has a motor that would run on the 50 cycle power, even though it was a 60 cycle designed motor. That would drive a DC generator that was a Theratron control system that would drive a generator then that would generate the 50 cycle. And so-- I'm sorry, that would generate the 60 cycles, so we could actually run the tapes from these. But our question was, how are you supposed to run the computers when it said single phase? Could you run it on one leg of this three phase power? And we thought it was too much of a load for that, so there were a lot of telegrams sent back and forth between IBM and Kanpur. And finally, they decided it had to have its own converter. And within the three days, IBM found a converter in Germany, and this was a solid state one. It was <inaudible> Blats--- the GE machine. But anyway, we got the power on, and in about three weeks we had the machine up and running, so—

This is where tape 4 ends, and tape 5 begins.

Aspray: Today there's a lot of interest in what's going on in India, with the software industry, in particular. What can you tell us about the state of computing in India at the time?

Huskey: At that time, it was almost none. There was some interest in Tata Institute, but they hadn't built any hardware, for example, or things of that sort. So I think our computer center was the first such in India.

Aspray: And did you offer services, education, training, anything to go with this?

Huskey: We gave courses on how to program and how to run problems and so on. Not on computer maintenance. We left that in IBM's hands.

Aspray: And did this become one of the major centers for computing? One of the educational centers for computing?

Huskey: We liked to say yes to that.

Aspray: OK. So what happened when you came back from India?

Huskey: Well, come back from India-- well, I got sort of involved in the international scheme. And so I proposed to UNESCO a computer project for Burma. And so ended up staying in Burma a couple of times. And finally, that project was approved and so I had the job of supplying people to come out and lecture on computer topics and numerical analysis and so on. And that went on for about five years, so we'd spend summers for a month or so in Rangoon and keep things going there.

Aspray: Was this the first advanced computing activity in Burma?

Huskey: It was the first. Very definitely the first. Might be the only one still there.

Aspray: All right. And where was this located institutionally?

Huskey: In the University of Rangoon.

Aspray: OK.

Huskey: I guess they've changed that name, too, now.

Aspray: Right. What else would you like to tell us about your career?

Huskey: Well, I think we've pretty well covered all the points I can think of. When you leave the door, when you go out the door, I'll think of a few more.

Aspray: Of course. I'd like to do some wrap-up questions with you. I'd like to ask you to talk about the things that you're most proud of in your career. Things you felt best about contributing.

Huskey: Well, I think the two computers on the front of the book there, the SWAC and the G15, are the more interesting things that I accomplished. The work in languages, particularly on the NELIAC, for example, there was quite a little falling on that, but not-- it never really amounted to very much. And I still work on language stuff, but I don't think it'll go far enough that I can do anything with it. There's so much software activity going on now that any new system or whatever has a big hurdle to gain acceptance and I don't think it's-- as far as I'm concerned, it's not worth the effort. I'll do it for fun, but that's it. What I'm really working on at the present time, don't get much done on it, is computing with functions. So instead of talking about individual variables, talk about a function, which is, say, 200 points on a graph. And when you say *X times Y*, there's 200 nullifications involved. So it is an efficient way of talking about linear programming kind of problems or any matrix type of operation. And I think if you had a support organization, you could probably push it into an interesting product, but an individual, I have no hopes of doing that.

Aspray: Remember that we're recapping now. Who were the people who were most influential on your career and why?

Huskey: Well, that's hard to answer, because there are people involved starting back-- even the professor that I got my PhD under. I'm sure he influenced my career, although nothing about computers or whatever at that time. The people on the Eniac, you know, they were just one of the gang. It's a teamwork sort of thing, so I wouldn't say anybody there influenced my decision to do it, but we just all interested in doing it anyway. If you're going to Berkeley, certainly Laymer and Morton offering me the job at Berkeley was a decisive change in the direction that I was going. From there on, it's pretty stable, I think. I taught my seven years and took my year sabbatical leave then, and so on.

Aspray: Having been a witness to essentially the entire modern computing industry, are there some observations you'd like to make?

Huskey: I never dreamed they would happen. Actually, I think the key things in the development is the CMOS transistor and the fact you can get the output signal at the same bolus level as the input signal is a very significant event. Beyond that, it's technical ability to make smaller things and so on, down the line. Now, there are other physical phenomena that's of interest to people, of course, and even things like the current display capability is incredible compared to what we thought was possible even in the 1980s. And if you read the publications of IEEE, there's more to come.

Aspray: What have been the surprises to you in the way, not that the technology has developed, but the way that the industry has developed over time?

Huskey: You mean the Bill Gates phenomena? [laughing]

Aspray: Whatever you want to talk about here.

Huskey: Well, I think it's, from where I sit, it's a gamble. What do you bet on, you see? Because there weren't a lot of other physical developments that didn't pay off. And some paid off long after you thought they were dead. So I'm not sure that you can say what happened. I think there's some social questions. What is the effect of almost instantaneous communication on society? The fact we can look at what's going on in Burma today and other places. The Constitution was written when you had to go from New York to Boston by horse and it took you three days or something. And if you look at it purely as a dynamic system, the stimuli can arrive much faster than you can respond to it. And what do you do about it? I don't know.

Aspray: You talked a bit about your students, in particular, when you were at Berkeley. What about some of your colleagues? Berkeley became a real powerhouse in computing over time. You want to say some things about some of your colleagues?

Huskey: I don't know. Certainly when there's a lot of activity, it's very stimulating, so I think it tends to support itself to a considerable extent. For example, when I went to Santa Cruz, I had a project with National Science Foundation to build a simplified time sharing system. So I got a very small computer, with core memory and so on, and somebody came out with a disc-- or the drum, rather, that a track on a drum would support a display. Well, that looked pretty good, so you can have twenty tracks in the drum,

twenty stations, and build a little self-contained time sharing system that would sell for maybe less than 100K. But the technology went the other way. We got solid state terminals now and they're cheap. So that's not the limitation. I think the other surprise is how far they've gone in disk storage, for example. All the current software and whatever depend so much on size. You take the Microsoft stuff and its all five megabytes or 20 megabytes or whatever that you could never have though of back when a byte cost a dollar to store, you see.

Aspray: Right. Stop for a second.

Gardner Hendrie: Did you ever meet Max Palevsky at Bendix?

Huskey: Oh yes.

Hendrie: Because I think he did the digital differential analyzer. Or worked on it.

Huskey: He worked on it, yes. And at Bendix, he worked on the G15 project.

Hendrie: Oh, he did?

Huskey: Yeah. And he quit and set up his own company, SDS.

Hendrie: Yes. So what did he do on the Bendix G15?

Huskey: Darned if I know.

Hendrie: But you know he worked on it?

Huskey: Oh yes.

Hendrie: You were just consulting and doing software.

Huskey: Yeah, that's right.

Hendrie: OK. Very interesting. I don't have any immediate questions that come to mind.

Aspray: Well, maybe we should just stop it at this point.

Hendrie: Yeah.

Aspray: I guess the question for you is, is there anything else you want to talk about that we haven't talked about today?

Huskey: I can't think of it at the moment.

Aspray: OK. Well, why don't we call it a day?

Hendrie: Yeah.

Aspray: Yes, thank you so much.

Huskey: Oh, you're welcome.

END OF INTERVIEW

