

An Interview with
FRANK C. MULLANEY

OH 110

Conducted by Arthur L. Norberg

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Abstract

Mullaney begins by describing his early life, electrical engineering education, radar work in World War II with General Electric, and sonar work with the Navy. He discusses the various projects to which he was assigned at Engineering Research Associates (ERA), especially the Atlas (ERA 1101) computer. Other topics include the ERA 1102 and ERA 1103 computers, John L. Hill, the acquisition of ERA by Remington Rand, J. Presper Eckert, and the formation of Control Data Corporation.

FRANK CHARLES MULLANEY INTERVIEW

DATE: 2 June 1986

INTERVIEWER: Arthur L. Norberg

LOCATION: Minneapolis, MN

NORBERG: Frank, can you tell me a little about your family background? Where were you born?

MULLANEY: I was born in St. Paul, Minnesota, in 1923. I had a brother and a sister.

NORBERG: What did your father do?

MULLANEY: When I was a very young boy, he was a jeweler. He had a jewelry store. Well, he was first with my uncle and then he started a jewelry store of his own. And then in the depths of the Depression that wasn't too good a business and they closed the jewelry store. He got interested in politics, city politics, and became a deputy commissioner of public safety, which got him interested in the public safety business. He was in law enforcement one way or another the rest of his life. He was the superintendent of the Ramsey County Workhouse as his last job. So he did a variety of things. The things I remember best as a boy was the jewelry store.

NORBERG: Was your mother active in the jewelry store as well?

MULLANEY: Not after I was around. I think she worked in the store in their early married days and I think before.

NORBERG: Did she participate in community affairs after that?

MULLANEY: I would say not to any great extent. No, her activities were mostly built around the home and the children, as I recall.

NORBERG: Were you educated in St. Paul, Frank?

MULLANEY: Yes.

NORBERG: Where?

MULLANEY: Well, I started at Gordon School, a public school, about a block from my home, two blocks. And then I went to St. Mark's School, a Catholic school, and I went to St. Thomas Academy for high school and the University of Minnesota.

NORBERG: Tell me a little about St. Thomas Academy. What sort of program was offered when you were there?

MULLANEY: Much more military than now. The military program in those days resulted in being able to get a commission as a second lieutenant in infantry, when you got right out of high school. Now some were interested in that and some weren't. The academic program was strictly college prep. You had to have so many years of a language, so many of a science; it had a regular college prep curriculum. And everybody in the school had that type of curriculum.

NORBERG: So what sort of courses were offered in this curriculum?

MULLANEY: Well, for example, I took four years of Latin; I took physics; I took four years of math, and the usual social studies, and English, of course. But it was a pretty good school, especially for its time, I think.

NORBERG: Do you remember any of the science courses? Were any given? You mentioned physics.

MULLANEY: I think physics was the only actual science course I took. I didn't take any chemistry, which was a mistake and had to make up for that by taking extra chemistry when I got to the university. Yes, I remember my physics course very well.

NORBERG: I assume it was the standard things, with weights and pulleys and...

MULLANEY: Yes. Mostly mechanics and the usual electrical experiments, the classical ones.

NORBERG: How about mathematics?

MULLANEY: The math was pretty good. In those days, it wasn't, I don't think it was very usual at all to start calculus in high school and we did not. So the math consisted of a couple of years of algebra and a year of geometry and then I think a year of solid geometry and trig, that sort of thing. But no more - not into calculus. But it was a good preparation, I had no trouble with engineering math. I never was much of a mathematician.

NORBERG: Did you consider other places besides the University of Minnesota?

MULLANEY: No, I didn't. I knew I wanted engineering and in my economic circumstances - I earned most of my tuition and so forth - I knew I really had to stay home. So as far as I was concerned, there weren't really any other options. I was headed there and I had a lot of friends that had done this and that was it.

NORBERG: This would be in what, 1939 that you entered?

MULLANEY: Yes, exactly. You've done your homework.

NORBERG: All right. Now when you entered the University of Minnesota, what is it that you expected to study?

MULLANEY: I expected to study electrical engineering with an option, let's see, what did we call the option in those days. They called the option communications. There were only two options, power and communications. And if you wanted electronics, it was the communications option that you took.

NORBERG: How did you know you wanted the electronics?

MULLANEY: Because I was a radio ham and I'd been fooling around with radio every since I can remember.

NORBERG: Had you belonged to a radio club?

MULLANEY: Yes, oh yes.

NORBERG: There was one in St. Paul, then.

MULLANEY: The St. Paul Radio Club. I think I met Jack Hill there in about 1938.

NORBERG: Who else? Any other names that come to mind?

MULLANEY: Nobody else that I can think of that might be pertinent to this subject.

NORBERG: Let me follow this for just a couple of minutes. What sort of things happened in the radio club? What sort of activities were going on?

MULLANEY: I forget how often we got together, I think it was only about once a month. And it was mostly chit-chat about ham radio. But we had some activities concerned with organizing for emergencies and we had some exercises and drills. We'd go out on weekends and play that there was a storm or something and we had to provide the communications. That sort of thing.

NORBERG: This was in 1938 you said?

MULLANEY: Yes.

NORBERG: Was there any discussion of any forthcoming war possibilities, and what would happen to radio at the time?

MULLANEY: That seemed very remote in that year, although I think it started to seem less remote when I started at the university and joined the Signal Corps program, the ROTC, and went into the Signal Corps end of it. It was kind of obvious that they had preparation in mind.

NORBERG: Yes, by September '39 it would certainly be obvious to some.

MULLANEY: Yes, the European situation looked pretty bad then.

NORBERG: Well, did anyone come from the university or from other universities to talk to people at this radio club, either giving the usual type of formal presentation or else helping with the club?

MULLANEY: Boy, I just... I can't think of any examples of anybody from the university who did that. We had regular programs and people were invited to speak on different subjects. But it seemed to me that it was mostly radio hams that had done something outstanding in one field or another, whether it was a new type of antennae or something and would come and talk on it. Whether there was any university connection with some of these people I just don't remember. I was 15 years old at the time and I just don't remember.

NORBERG: You can see that I'm fishing for connections that you may not have remembered at the beginning. What sort of things were you reading at the time?

MULLANEY: Well, in those... If we're talking about 1938, I was still in high school and so forth, I didn't do a lot of reading that I didn't have to do. I was not a great reader as a boy.

NORBERG: How about radio publications?

MULLANEY: Oh yes. Oh yes, that's different. Things like a magazine called *QST* was probably the main one. Anything like that I grabbed. I was not a great history reader, fiction reader, anything like that.

NORBERG: It was *QST* and things of that kind, *Radio News*, *Electronics*, that sort of thing that I was looking for. Okay. Getting back to the University of Minnesota then. You entered the university in 1939. What sort of program did you find? What was the first year like?

MULLANEY: I remember thinking in the first year that this really didn't seem to have much to do with radio, which I was interested in. You know, it was English, engineering English, college algebra, chemistry, which I had to take a very intensive course because I didn't have high school chemistry, mechanical drawing, which I hated with a passion, I was never any good at it. This sort of thing, and I thought, boy, what did I get into here. I'm really not very interested in anything I'm studying. And I wasn't.

NORBERG: When did all of that change then? Assuming it did.

MULLANEY: Some of that didn't change at all, Arthur. When I started to get, in the second year, in those days and probably still today, they started the electrical courses and I could see where things were heading. I could even see why I was taking some of the things I didn't like, courses like, oh there were some I really hated - mechanical engineering courses. We called heating and beating. It was forging, heat treating, and welding. And I thought what the hell has all this got to do with anything. But after I got into engineering and had to deal with cabinets and case work and this sort of thing and what other people were doing, you could see where they wanted you to have at least a smattering of these. I really don't have any complaints, but I didn't have very many good instructors in electrical subjects there.

NORBERG: Even at the advanced level?

MULLANEY: No.

NORBERG: Who was around then?

MULLANEY: I think the best one I can remember that I really got a lot out of and got acquainted with and so forth was a man named Orville Beckland, who later went to Texas Instruments. In fact, I still hear from him at Christmas time. All these years. And he was excellent. And there were a number of others and I don't want to do injustice to those that were good. There was a fellow named Muckenhern that was very good. And there were people that I didn't really have that much, because they were in other... There was a guy that I just saw that died recently near 100 years old, John somebody or another. He was very good, but I didn't have him very much. There were some good people there, but I just didn't happen to hit them. And I seemed to get the mumblers, and the... There were some kind of marginal people there.

NORBERG: Do you remember any of the texts that you used in the communication courses specifically?

MULLANEY: I could find them. The radio book was by Glasgow. Then there was a communications book that was mainly telephones, transmission lines, that sort of thing. That was... I think that was Everett. Bill Everett? Everett anyway. I forget where he was from. Those were two very good texts. They were standard texts. Then when the war started, they threw together a course that was supposed to be in ultra high frequencies. It was a poor course and the material wasn't very good, but the material that we did have was a book that was thrown together in a hurry that was done at MIT. It was called *UHF Techniques* and I think by the staff of MIT. There wasn't much good material of that type and that was the first - let's see, where was the first acquaintance I ever got with... I think that book was the first place I ever saw what in those days were known as trigger circuits, multi-vibrators and things like that. Anything that had any remote connection with computers. Of course, we didn't think of computers, but... The material was not very modern, really. It was only after I got out into the outside world that I started to see that electronics was really a little more advanced than I had been playing with in the lab.

NORBERG: Did you take any of the other science courses besides chemistry while you were at the university?

MULLANEY: I took physics, the regular, standard, classical physics, a quarter of mechanics and a quarter of electricity and so forth, whatever they had. There were some courses that really were, I think were in the physics department. There was an electrical measurement course. And then back in engineering there were I think I took a course in hydraulics. But as far as the basic science background...

NORBERG: Fairly standard program, though.

MULLANEY: I think engineers... Yes. Standard and classical and... These days I think an electronic engineer gets a lot more science and physics with the semiconductor business. But we sure didn't.

NORBERG: Let's turn to the Signal Corps. What did you do as a member of the ROTC?

MULLANEY: I was just in that one year. And I guess my interest was that I had had four years of infantry ROTC in high school and I thought it might be kind of interesting to see what the program was and so forth. I wasn't very interested. The technical end was close to zero and I just went to drills and did it for a year and I dropped it.

NORBERG: I see. What other extra curricular activities did you participate in at the university?

MULLANEY: Very few. By the time I was a sophomore, I was working quite hard. Sometimes as much as 40 hours a week, but usually more like 20.

NORBERG: At what?

MULLANEY: In a broadcast station, radio operator. We had a little station over near Montgomery Wards. It was

called WMIN, a little 250-watter. It was a nice little station. The transmitter and studio was right there, so the one licensed guy did everything including doing the announcing when we opened up early in the morning.

NORBERG: Is this the one on Lake Street in Minneapolis?

MULLANEY: No. The linear descendent of that now is a station called KLBB, still on 1400, the music of your life format. But that has a direct connection with it. The freeway is there now; 94 is right where the building used to be.

NORBERG: I see. I was thinking the Montgomery Ward building on Lake Street, so you're not speaking of that one.

MULLANEY: That's the Sears building. Montgomery Ward is on University.

NORBERG: I see. I have it misplaced then. Fine, thank you. Twenty to forty hours a week. That wouldn't leave you a lot of time then to do other things.

MULLANEY: No, no it didn't. I got into things like once a year we'd have an engineering show and put projects together and, you know, like talking light beams and all that sort of a thing. I got into that sort of thing, but I didn't really... I didn't spend much time on the campus. When I was through with classes, I was off probably to work or something.

NORBERG: My view of the class of '43 is that it was a fairly well populated class with people who became interested in electronics after the war, or had a continuing interest in electronics anyway, such that after the war they turned out to be involved with companies like ERA and so on.

MULLANEY: Oh yes.

NORBERG: Did you strike up any acquaintances among this group while you were going through?

MULLANEY: Oh, yes indeed. Yes. People like Bill Keye and Erv Tomash. Other people that went to ERA, Bob Erickson, Bob Murnane, Ed Nelson...

NORBERG: Did you have any close associations with these people before ERA days?

MULLANEY: Associations at school and in class and so forth, yes. I knew a number of them quite well. Like Erv, Bill Keye, Cliff Helms, but only through class associations. Really nothing else. A couple of them through ham radio. Bill Keye used to be a radio ham and Bob Erickson has been all these years. I still have schedules with him on the radio and that started back then. So there are a number of friendships I have that go way back here. And a number of these guys did turn up at ERA. In fact, when I started ERA in '47, I was surprised that some of my old classmates were there.

NORBERG: I'll come back to them in a minute. I know the answer to this question is going to be fairly obvious to both of us but I'm going to ask it the way I want to anyway. As you were coming up on commencement, what is it you thought you would do?

MULLANEY: I knew what I'd do then, because I had already accepted a job. The recruiting had started for the war industries by that time and a number of companies had come to the campus to interview and I had accepted a job with General Electric in Schenectady.

NORBERG: Why?

MULLANEY: Because I thought I would get some... I guess I thought I would get some good electronic experience there.

NORBERG: Had you other options?

MULLANEY: Yes, there were other options, but there were none that I pursued to the offer stage.

NORBERG: How about just going in the military?

MULLANEY: Yes, I certainly thought of that. And of course, a lot of my classmates had done this. In fact, some of them left earlier and so forth. I was only 20 years old and I felt that I... I guess I felt I wanted to get a little experience first and get out into the industry. And that was a... Deferments were readily available for somebody in technical work and it just was something that if I had gone the other way first I wouldn't have been able to try this way. I just thought that I would start that way.

NORBERG: What General Electric facility were you based in?

MULLANEY: I started at... Let's see, was it at the main plant in Schenectady? No. It was at a little plant near Schenectady in the lab, in an activity called carrier current, the communications on power lines. That was fairly interesting, but I really wanted to get into things like radar and radio and so forth, which I subsequently did. I had a very short stint at the main factory location, the main plant in Schenectady, and I thought that was a terrible place. You know, dust and smoke, and... I was not very much of a Schenectady fan. I went back there a few years ago, too, to see it and it didn't look too much different in a lot of ways.

NORBERG: I almost went to Rensselaer, I know the area well.

MULLANEY: Oh, do you? I was married in Schenectady, actually.

NORBERG: Well, now as I recall in the 1950s, I don't know if this is true of the '40s, but in the 1950s, I also applied at General Electric when I was coming out of school as a physicist in '59, and what I remember about their, is what I'll call their indoctrination program at the time, was that a new hire, a new technical hire, would go around to various

facilities first...

MULLANEY: Yes, it was called being on test. That program was still going, but it was highly modified in those days because when they got you on a program, I started out in the test program, went to the carrier current lab and had a three month stint there, but then when I got assigned to a radar development and test program, they kept me there. If they wanted to keep you there, they just would terminate the test, and I think they gave you a five to ten cent an hour increase and said, "You're off test."

NORBERG: All right. What sorts of projects did you work on there?

MULLANEY: I got on a very large radar program. The radar was to be installed on aircraft carriers. It was the first time I'd ever encountered microwaves and also antennae servosystems. This one moved the antenna on three different axes, so it was a rather complicated servo system. Elevation and azimuth and also slew to take care of the carrier, you know, going from side to side and so forth. So it was a very interesting thing. And it was sort of a semi-development and semi-production, in that when we finished with them the navy inspector came in. One of my jobs was I would follow them around with a screwdriver and a pair of pliers in my pocket and as he would find things wrong I would try to tweak them to his satisfaction. And we'd get the thing through test and then off it would go to a carrier.

NORBERG: How much of the development was done at General Electric versus what might have been done, say, at the MIT radiation lab?

MULLANEY: Now that's very interesting. I was at too low a level to really know. I think that the antenna work, the basic antenna development of the control work, the servo-systems for that and so forth, was done at General Electric and what was then known as the Aeronautical and Marine Department. The microwave stuff, I'm sure that the basic transmitter and tubes and so forth that... I don't know whether that was done at GE or whether that came from someplace else. I just don't know. It was my first experience with microwaves and we didn't know anything about

radiation in those days. I used to shake my key chain in front of the antenna and it would spark; we'd put our hands there and warm our hands up and...

NORBERG: Well, what sort of tasks then did you work on in connection with microwaves? How did you learn about microwaves?

MULLANEY: I didn't learn an awful lot about microwaves, because mostly I was assigned to the antenna control. What I learned about microwaves was watching the other engineers from the radio department who were working on that. They'd come in and put that together and I'd hang around with them or help them or something. But that wasn't my main job.

NORBERG: Who was working there at the time that stands out in your mind?

MULLANEY: I don't remember many names from those days. I remember the people I worked with, a guy named Marks, and a guy by the name of Twyford. I remember the guy that did the design on the servo-system was a fellow named Sid Godet. And I didn't run into that name until a couple of years ago, I saw his name connected with a little company in Florida. There are no people that I was associated with there that I have been in touch with in any way.

NORBERG: I was thinking of big names like Dushman and people like that who were involved with General Electric's developments in vacuum tubes and so on.

MULLANEY: No.

NORBERG: All right. You stayed at General Electric a year, roughly. Is that correct?

MULLANEY: Yes, that's right.

NORBERG: Then what did you do?

MULLANEY: I went into the Navy. I went down to New York. They had an officer procurement office in New York. I was thinking about doing this. After I had decided to go into the industry and saw all my friends going into the service and so forth, I thought maybe I really should do this. But I must confess the trigger that pushed it was one day they said we don't think we can get deferments for you guys who aren't 22 years old. We think there may be a problem. So I thought well, that settles it. So I went down to New York and applied for a commission and that came through. I had just gotten married and I... This all happened very fast in the spring of '44. My commission came through and we left Schenectady. I took a couple of months off. I don't think I had to report until summer. And I went in in '44.

NORBERG: Stationed where?

MULLANEY: Well, first I went to Princeton to indoctrination school and then I went to sonar school in Key West. Then I got the terrible blow, I got ordered to the naval base at Key West, I thought I'd get shipped out someplace. And I actually stayed there for almost two years. I got to like it.

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NORBERG: What sorts of things went on at Key West?

MULLANEY: First, it was called a Naval Operating Base. We took care of a lot of different kinds of ships, mostly small, that came in there. We installed radio, radar, sonar, and then we did maintenance work on them coming in. Occasionally, a very large ship would come in that would have to anchor out, that couldn't come into the harbor there, but mostly we had up to destroyers, I would say. Sometimes a little larger.

NORBERG: What did you learn about the equipment as a result?

MULLANEY: Oh, quite a bit. I started as the base sonar officer, but when I left I was the, through attrition and people getting out of the service and so forth, I wound up with the whole activity under me. And I learned quite a lot about the equipment of that time.

NORBERG: In what sense?

MULLANEY: Well, I learned some of it didn't work very well and I think that was an important thing to learn. I guess I also became more acquainted with circuits that I later found in computers and used myself in designing computers, you know, multi-vibrators and flip-flops and that kind of thing that I really didn't have any acquaintance with at school.

NORBERG: So this is what you were referring to before when you said that you learned more about electronics afterwards.

MULLANEY: I think the concept of a pulse to do something. I didn't really learn, didn't have any application of that in school, but the thought of chasing pulses around and opening gates and letting them through and that kind of thing in the radio, in this radar and sonar equipments, certainly had a direct application in computers.

NORBERG: How did you learn about the circuits at the time? Were there manuals that the Navy had used?

MULLANEY: That's right. It was mainly manuals. There was really no instruction that amounted to anything. In sonar school we had, yes, we had some instruction, but it wasn't very good. So the manuals were pretty good.

NORBERG: Do you remember where the manuals had been produced?

MULLANEY: The manuals were produced by the manufacturers such as, there was a company called Submarine

Signal Company, Westinghouse, there was Western Electric, Raytheon, General Electric, RCA. There were lots of different people involved. And by and large I think they did a good job. Their field engineers: I ran into a lot of field engineers from the various companies that would work on and come out and put in modifications and also instruct technicians and so forth. And I thought most of them were very good, too. I was impressed with them.

NORBERG: Did you stay there the whole time that you were in the Navy?

MULLANEY: Yes, I did. I was just trying to think. I had a very short stint in Miami, but... I found out when I was being detached, and I got out in Jacksonville and I got a look at my file, and I found out that I had gotten orders to the Pacific I think four different times that my supervisor, who lived in Miami, I was in Key West and I for the most part I reported to a guy in Miami who didn't tell me at all that he had had orders squashed because he didn't have a replacement. I could have had a little... I didn't have a car. I didn't want to leave my wife stuck down there with a baby and a car and so forth, so we just didn't acquire anything. I would have rested a little easier, because I kept thinking there's no reason. Why don't they send me out to the Pacific? Everybody was going to the Pacific. So I found four different sets of orders that never got to me.

NORBERG: Now you were released in '46. When in '46?

MULLANEY: I think it was July.

NORBERG: July. What did you do then?

MULLANEY: I came back to St. Paul. My wife was living with my parents. Housing was very difficult to get, so we moved back into the family home. I met an old guy who was a manufacturer's rep, who talked me into going in to work for him for a time. So for a year, from '46-'47, I sold resistors and transformers and all kinds of things, and traveled four or five states. I hated almost every minute of it.

NORBERG: Four of five states I assume were around Minnesota?

MULLANEY: That's right. The Dakotas, Iowa, Minnesota, and I think part of Wisconsin.

NORBERG: How did you come to go to ERA?

MULLANEY: I had a brother-in-law who was working for General Electric in Schenectady and he had heard about ERA. And he, in fact, went to work there. He started there before I did. And he told me it was a pretty good place.

NORBERG: Who's he?

MULLANEY: His name was Joe Kahnke. So that was really the connection there.

NORBERG: Was he here in St. Paul at ERA?

MULLANEY: Yes.

NORBERG: So did you go over and apply for a job or did he speak to someone?

MULLANEY: No, I applied for a job. Ken Busch was the personnel man I recall. And I think I started there in June of '47.

NORBERG: '47. What sort of interview process did you go through?

MULLANEY: I don't think it was much. I think that I had... I certainly had an interview with the personnel man and I believe I had an interview with John Coombs, who was director of development (I think was John's title at the time). But there was very little formality and I didn't spend much time there and I think about a week later they offered me a

job and I accepted immediately.

NORBERG: Yes, I can understand why. Who were you assigned to when you first went there?

MULLANEY: To the Goldberg project with Jack Hill as project engineer.

NORBERG: Now this in '47 this would be Goldberg I or II?

MULLANEY: I don't know what numbers there were on Goldberg.

NORBERG: Then what sorts of things did you have to do?

MULLANEY: Well, first I had to learn something. I found I was pretty green. Incidentally, Jack Hill was the best engineer I ever worked for. Jack Hill was a very versatile guy. Not only... He was basically an electrical, an electronics guy, but he was also one of the best mechanical engineers I ever saw. I learned a lot from him and he was kind of demanding, you had to learn it in a hurry because Jack didn't have a lot of patience sometimes. He was full of vim and vigor and he was all over the place. I got assigned to design a matrix, it was really a... Well, let's see. How would I describe it? A bunch of inputs on the X-axis and a bunch of inputs on the Y-axis, and you detected... They were really a bunch of AND circuits. A whole matrix of AND circuits. And then they were combined in various ways for output. It was a very special purpose kind of thing. Involved an awful lot of tubes and wires. I designed that thing.

NORBERG: Now when you say you designed this, was this part of a larger piece of equipment?

MULLANEY: Yes, it was part of Goldberg. It was one...

NORBERG: Did you learn about the rest of the parts while you were doing this?

MULLANEY: Oh yes. Oh yes.

NORBERG: Can you tell me something about the rest of the parts? Goldberg is unclassified, by the way.

MULLANEY: Is it? Yes, that's what I was getting... I didn't know that, because in those days, you know, we sure... Security was very tight. We didn't tell anybody what we were doing or who we were doing it for. But it was built around a magnetic drum with the information going on the magnetic drum and then one track being precessed against another to compare two or more tracks in different ways. And then you would detect various coincidences in these things like this matrix and when they would hit the combinations they were looking for then you'd get an output. It was that kind of thing. I don't remember the details at all, but there were a lot of elements of computers in them but of course it was strictly wired program, strictly special purpose. The output was on a line printer that had been designed also at ERA. There were a lot of elements in there of things that went into computers like the magnetic drum, tape reader, tape punch, line printer, things of that sort, that were all elements that could be used for more general purpose computers.

NORBERG: To your recollection, were all of those developed at ERA?

MULLANEY: Yes, I think most of them were.

NORBERG: Try to go back to July of 1947, Frank, and can you recall the state of project Goldberg in terms of the development of those devices when you arrived. I'd like to separate now what you knew about in '48 and '49 when these things were being delivered.

MULLANEY: Some of the sections of the machine were working in the lab in prototype and in pieces. There was nothing connected together. For example, I remember Leon Findley and Arnold Hendrickson were working on the magnetic drum. They had a drum with three or four tracks on it. They were developing amplifiers for it. They were

learning how to erase and rewrite and that sort of thing, put on timing tracks. I went to work on the matrix, nobody had been working on that. Bob Erickson was working on something else. Oh, Bob Erickson was working on counters. It had a whole bunch of decimal counters, which we called ring counters in those days. It took a whole chassis full of stuff for one decimal place so he was designing, he and Jack Boekhoff were designing counters. So there were all these pieces that were in various stages. Some of them worked; some of them didn't work. The printer was being done in some other part of the mechanical group and I don't know who did that. I don't remember who did the printer. The same with the tape units. A photoelectric tape reader was being developed there in that lab. So there were pieces, pieces all over the place. And it was obvious that a lot of work had been going on. They'd been working for a year on much of it, but there was still a long way to go.

NORBERG: What sorts of information did you receive and did it come from individuals or did it come from documents that were around?

MULLANEY: Well, there were some documents from the customer that were mostly in block diagram form of... The customer knew just what he wanted done, but they didn't tell us how to do it. So as far as documents go, they were mostly block diagrams. A lot of the information I got was word of mouth and there was very little specific design information. You had to kind of make up things as you went along. There just wasn't a whole lot of information. I wasn't really seeing any reports from other activities that were doing similar work. That started later it seems to me, when there was a lot of information exchanged. So I didn't really know what people were doing. We might have been reinventing the wheel you know in some cases, I just don't know.

NORBERG: Who then did you have direct contact with besides Jack Hill?

MULLANEY: Jack Boekhoff, who died a few years ago; Bob Erickson; Dolan Toth; Arnie Hendrickson; Leon Findley; Bob Perkins, the mechanical engineer on the project...

NORBERG: This is all in '47.

MULLANEY: Yes. George Hardenburgh, Ed Nelson, these people were all on this specific project.

NORBERG: I noticed you didn't mention Cohen and Rubens, which everybody else seems to mention when you talk to them.

MULLANEY: No, they weren't... They were not specifically on this project under Jack Hill. Now, I met Arnie early in the game, but I was not working with him or for him at that time. I met Sid Rubens, but ditto. I'd see Sid in the hall and that would be it. I didn't know them. Sid was very likely working on some problems concerned with the magnetic recording but he wasn't working in that project and he wasn't working with... I just didn't have direct contact with him, see. There was a lot going on. We were kind of compartmented. I didn't know what people were doing.

NORBERG: Did you have any contact with Coombs after the interview?

MULLANEY: Yes, John would... Yes, I did. John would stop in the lab. John did a lot of wandering around just looking over people's shoulders and so forth. I didn't have any contact with him that would... No technical exchange. So I don't really know anything about John technically.

NORBERG: Still staying with '47. Did you have any contact with people like Meader?

MULLANEY: Not in '47, no. I knew who Meader was. He was in... I believe he was living in Washington at that time, but I'm not sure.

NORBERG: Oh, I would have guessed he was here in St. Paul and Norris had not yet come back.

MULLANEY: Okay.

NORBERG: Is that right? Does that...

MULLANEY: Oh, you're undoubtedly right.

NORBERG: Well, I don't want to say undoubtedly. I don't want to accept undoubtedly because that may not be.

MULLANEY: I certainly knew Meader to say hello to. I don't think he knew me right in '47. He knew me later. But I didn't have any contact with him then.

NORBERG: How much contact did you have with the Navy personnel who were on site?

MULLANEY: In '47, not much. Captain Creasor was there and once in a while I'd feel a hurrumph over my shoulder. He was looking in the scope, when I was doing something. That was the kind of contact I had with Captain Creasor. I don't know whether Ed Svendsen was there or not, I don't think so in '47. I did meet some people from the customer in those days like Joe Eachus. But in '47, I was a very low-level engineer and I didn't have a lot of contact with these people.

NORBERG: I can understand that. I seem to recall that Eachus came to visit on July 31st and August 1st of 1947 -- I just read it the other day, that's how I remember the dates so well -- to discuss possible new projects. Did you meet with him?

MULLANEY: No. I would not have been in a discussion like that, but that is probably the first time I was aware of him and probably met him in the lab, but I certainly wouldn't have been on any discussion of that kind.

NORBERG: No. Okay. I didn't think so I just wanted to see how low a level such discussions would move toward. All right. How did you find the atmosphere, then, working with all of these people?

MULLANEY: I loved it. I could hardly wait to get up in the morning and get into the lab. It was such a change from what I'd been doing and I just thought it was great. It was really a nice place to work.

NORBERG: Can you sort out the joy at the difference in the job from the actual job itself?

MULLANEY: No.

NORBERG: That could be a fundamental problem here.

MULLANEY: Not really, I guess. I was happy doing what I was doing and I was learning something every day and it was just fun and I enjoyed it.

NORBERG: Were any new materials coming across your desk like new textbooks, say the new edition of Terman's *Radio Engineering* or *Communication Engineering*, things of that kind?

MULLANEY: In '47, I don't think so. In '47, I can remember bringing that text I referred to that was put together by MIT very hurriedly and a terrible printing job and so forth. I remember bringing that in, because it had a chapter on flip-flops and multivibrators. And if I brought that in, that means to me that there wasn't much good material around. So in '47, I just don't remember much there. A few years later, yes, I remember various pieces of things.

NORBERG: I've seen a library list of what was available at ERA and it's fairly skimpy so your recollection is quite good.

MULLANEY: I suppose there was Terman, Glasgow, and Everett...

NORBERG: I don't even remember those things on the list. What seemed to be there mostly were technical reports from other projects, and I don't mean computer projects, but other Navy activities, specifications for how you would

build a certain kind of equipment and so on. And that leads to a series of questions, I think, about the association with the Navy people. For instance, I think back to Jack Hill, because it's my understanding that most of the specifications that were developed for Goldberg, for any project for that matter in the 1940s, carried with it some very specific Navy requirements about what sort of ruggedness this equipment was to have.

MULLANEY: Oh yes. It was supposed to be mil spec.

NORBERG: Yes. Now did this interfere with the design of the components that you were involved in, or did it help it in any way?

MULLANEY: I think both, Arthur. I think it interfered in some of the mechanical requirements that really weren't necessary in view of the environment it was going to be in. [It would be in] an air-conditioned office type environment when we were building things to shipboard specifications really. Now where it helped, I think, was in the specifications of the conservatism that you had to put into the electrical design and the use of resistors and so forth. For example, I can remember that no resistor could dissipate more than half of its rating or something of that sort. It did give us a discipline that we really needed, in that when we started to put together thousands and thousands of tubes and other components that I think we quickly realized that you had to have this kind of conservatism in order to come out with any kind of reliability figure. And while we had to go beyond the Navy specs in those regards, it seems to me that that's where I got introduced to that kind of thing of derating of components for higher reliability. But some of the mechanical things and the way the components had to be put on the boards and the lugs and the spacing, a lot of that was not necessary and it was very expensive.

NORBERG: How did Hill deal with these questions? Do you recall? Did he discuss them with you people or pass on the specs or what?

MULLANEY: Oh, we were all involved in that kind of thing. Jack had very little patience with things that he didn't think were necessary, but things that he did think were necessary he was a real taskmaster. And he ran a... He

instilled a lot of that kind of discipline. Now the other things we'd do because we had to get by the inspection and the Naval inspectors and so forth but a lot of us had very little patience with some of it.

NORBERG: What sort of interaction did you have with Hill? What I'm looking for here is when you were discussing things with him, what were the discussions like?

MULLANEY: Jack was very involved in everything. He would let you do your work, but he wouldn't let you go off, run off very far. He would come in the lab, see what I was doing, see what the progress was, if he didn't like some direction I was taking, he'd get his hand on the scope or in the breadboard or whatever. And he was very much involved and he knew everything that was going on in that project. But at the same time, he gave you enough room to run. And he'd make suggestions that were very valuable, that kind of thing.

NORBERG: Were there meetings in his office in which overviews might be discussed in terms of your work?

MULLANEY: Yes, but most of it was Jack running around with one-on-one meetings with people. Jack didn't like big meetings.

NORBERG: So he would stand at your workplace or something like that.

MULLANEY: Yes, right.

NORBERG: How did things progress then in 1947? How did you move from one project to another?

MULLANEY: Well, the way I moved off of Goldberg was that a higher priority project came along called Demon I. They wanted a piece of equipment. A problem came up in a hurry and they had to get something in a hurry and they gave us three months to build Demon I. So Jack Hill was assigned to that. By this time, Goldberg was fairly well along and I think Jack Beckhoff took it over, but I'm not sure. And maybe Jack stayed on as supervisor of it, I'm not

sure on that either. But we started a project called Demon I.

I remember one summer, that must have been the summer of '48, that we just worked like crazy trying to get that thing put together. That used Goldberg type components with some changes. We stole as much as we could from Goldberg in design and then it had some things that were very specifically for Demon. But the magnetic drum techniques and much of the electronic, the chassis and some of the standard circuitry we took from Goldberg. And I think we did get a machine out in very close to the time by working overtime. By this time we were living down in Farmington. My wife had inherited a house down there. We couldn't get anything in town. This was 25 miles away. And I remember driving home tired one night about 10 or 11:00 and I ran off the road going to Farmington. It was a long summer; it was very long. I didn't get paid any overtime, either. When you're off the clock, you get paid no overtime. So we were working 60-65 hours for...

NORBERG: I was just listening to the feedback here, and I'm wondering what in the world it is rather than... and so I lost my train of thought for a moment. But in any case, you say that you took as much as you could from Goldberg. Did you participate in the discussion of the specs that were going to be necessary for Demon I?

MULLANEY: Now by this time, I was in more of the discussions, yes, because I was one of the principal engineers on Demon. The customer, in this case I think it was Joe Eachus still, and Joe would come out and I would be in those discussions where we'd sit down and talk about things.

NORBERG: What was Eachus like?

MULLANEY: Very sharp. Knew what he wanted to do, knew quite a bit about...although I'm sure he was not trained in electronics per se, I don't know what, he was probably a mathematician, wasn't he? He still knew what the score was and he knew what was involved and he was very quick at picking things up. Very sharp guy. They were very lucky to have him. In fact, that activity had some very, very sharp people that changed my attitude on civil service a little bit.

NORBERG: I'll come back to Eachus in a minute.

TAPE 2/SIDE 1

NORBERG: Frank, do you remember anything specific about those meetings with Eachus or any of the other Navy personnel on Demon say, sticking with that one, in terms of references that were made during the meeting to what's going on elsewhere.

MULLANEY: No, I don't really. In fact, they were probably pretty isolated. I'm not sure they really knew what was going on elsewhere. Maybe they did, but I didn't.

NORBERG: Then in working on Demon I, what did you do that was different from Goldberg? You mentioned having taken much of the circuitry out of Goldberg.

MULLANEY: Well, it was a different... It solved the problem in a different way or solved a different problem. I'm not sure, see. The logic was different from Goldberg. As far as anything in circuit design, we probably didn't do anything very different from Goldberg. I think we learned a few things in Goldberg of things we didn't want to do in Demon, and it got the usual improvements of something that you're doing for the second time. But by and large, it was the same kind of technology as Goldberg.

NORBERG: Would you say then that much of the activity in the years that you were at ERA before it was sold to Remington Rand were problem driven as opposed to technology driven?

MULLANEY: Absolutely.

NORBERG: The problem as specified by the customer, has become quite customary since.

MULLANEY: Yes. And they would tell us as little about that as they could and still get done what they wanted to do. They would take the problem, break it down, and tell us logically what they wanted to do. Now as the work went along, occasionally we might suggest a different way of accomplishing the logic, but we would never really get into the basic problem, as far as I recall. Now, even at the level that we were working at I think Demon was labeled top secret at that time, but there was certainly something beyond that -- that we didn't get into in a compartmental type of clearance needed to really go into the basic problem.

NORBERG: What I was trying to get at though is that you were never really treating a generic situation then. You weren't trying to design equipment to do a range of problems.

MULLANEY: Not in those days, no. If we're talking '47-'48, no.

NORBERG: When did that begin?

MULLANEY: My first exposure to something much more general was Task 13, which grew into the 1101. Arnold Cohen was working on the logic of that with the customer. And as I recall, I was assigned to that and I was sent to learn the logic from Arnold so that I could design the control system for that machine. Now that's the first occasion that I worked with Arnie. He was working on the break down of the basic command codes, the basic command names. The machine instructions we'd call them today, came mostly from the customer but with suggestions I'm sure by Arnold and others for changing this or that. But what Arnold was doing at that time was taking each instruction and breaking it down into the micro instructions or the steps needed to do it. And then I took it from there and put that into circuitry. That was my first occasion working for Arnold. I was still working for Jack Hill but I had a lot of contact with Arnold Cohen.

NORBERG: Now, do you remember when this was? When you began working with Cohen?

MULLANEY: It was after we delivered Demon and my impression was that that would be the end of '48 or the first part of '49, I'm not sure.

NORBERG: That late?

MULLANEY: Yes.

NORBERG: Because Task 13, as I recall, was given in '47.

MULLANEY: Yes, but all these things were going on, the development of the logic and the break down of these steps and... You had to make up a lot of the stuff, you couldn't pick up a book and find this in there. And there was a lab already started for Task 13 at that time that Jack Hill... They were developing standard circuitry for the flip-flops and amplifiers, and developing the pulse transformers. The component work was going on while we were still doing Demon. So I didn't get assigned to it until after we finished Demon up. And I spent quite a bit of time in Washington nursing that machine after we delivered it, too. So there was a fair amount of work done when I got assigned to Task 13.

NORBERG: But if Demon I was delivered in just a few months from the time the problem was given to ERA, that should have put it more toward the middle of '48, shouldn't it, rather than '49?

MULLANEY: I think we delivered Demon in October of '48. And the reason I remember that, if I do remember it right and you know that... I drove out to Washington with my wife and we were staying with a brother-in-law in Arlington. I remember coming out one morning to drive to Nebraska Avenue, to the customer, and there was frost on the window. And I thought, boy, the middle of October and there's frost in Washington? I had to scrape it off, so I'm pretty sure of the time period there. We worked on Demon all that summer and we didn't hit the three months on the nose.

NORBERG: What did you do in Washington?

MULLANEY: Put the machine together and tried to keep it working.

NORBERG: How successful were you in keeping it working?

MULLANEY: Reasonably. We had one really bad problem, where we got a load of bad resistors that had been stored in the Navy facility or someplace where the Navy got them for us. They were mil spec and everything, but they changed values like about by half and this really plagued us. And one night or maybe a couple of nights, but I can remember staying up late. Jack Hill came out or was out, I'm not sure which, and we set up a production line where we took out all these chassis, set up tables, and one guy would sit down and rip these resistors off, the next guy would put a couple more on and so forth. We had a production line going and we did a lot of remanufacturing there on the spot. We had that kind of thing continually, but it was kind of a...

NORBERG: On the spot meaning in Washington?

MULLANEY: Yes.

NORBERG: So Hill was there as well?

MULLANEY: Yes.

NORBERG: Was this customary to go as a group?

MULLANEY: Yes. The whole group, much of the project group would go out and install the equipment and a number of us would stay then. I think I was in Washington for six weeks on that stint.

NORBERG: Did you interact with the Navy personnel who were going to use the equipment?

MULLANEY: Oh yes.

NORBERG: All right. In '48, then when you came back, was it at that time that you were assigned to Atlas?

MULLANEY: I think so.

NORBERG: Let me pick up one other thing if it's possible, Frank, and that is do you remember the task numbers that you worked on earlier than 13?

MULLANEY: I should. It seems to me that Goldberg was 9. (Pause.) Boy, you caught me flat-footed. I thought I...

NORBERG: That helps to isolate the problem.

MULLANEY: I thought I would never forget those things. Demon I think had a number higher than 13.

NORBERG: I'm not going to help you.

MULLANEY: Demon was 15 maybe? I don't know.

NORBERG: You see what happens is people keep talking about given tasks and so you remember those very clearly like 13 with Atlas, because it was a very important development. But in fact, it turns out that there was a whole range of tasks, as you well know. But I can identify which part of the project you were on by your telling me which task that might have been associated with it.

MULLANEY: Well sometimes, though, a task number would be assigned in the very early stage of logical design,

and sometimes the chronology isn't quite apparent from the task numbers because they would be in different stages and so forth.

NORBERG: Yes, but then I can break it down in looking at the records I can find it.

MULLANEY: I'm pretty sure Goldberg was Task 9. I don't remember Demon.

NORBERG: Do you remember having to write reports that would be submitted to Jack Hill on either the Goldberg or the Demon?

MULLANEY: Oh yes. Oh yes.

NORBERG: What would those reports constitute?

MULLANEY: Mostly they were progress reports that had to be submitted to the Navy each month. And the project engineer would be the one responsible for doing the overall report, but often he'd have the person working on a particular section write up what you did on the control section or whatever else you were working on. There were other reports, I don't remember exactly what date those started, but we had some things that we called technical memoranda. If you came across something you thought would be of interest to another project, you'd write it up and it would get sent to the engineering distribution and so forth. And any engineer could institute something like that and I'm sure his project supervisor or engineer would decide whether it should be done. But I can remember doing some of those. But the regular ones were to the customer.

NORBERG: That's interesting. I don't recall seeing any of those. Either I didn't understand what they were or else I haven't...

MULLANEY: I think I have some.

NORBERG: What I have seen though are the reports to the customer. I've seen technical memoranda in the Px series where they would distribute it quite broadly, things like the report on selective alteration which Cohen and Keye did which was distributed around the nation.

MULLANEY: No, these were strictly internal and they were mimeographed and stapled together, you know, that kind of thing.

NORBERG: I see. I have to admit I haven't seen any of those.

MULLANEY: Well, I'll see if I can... Would you like to? I'll find some.

NORBERG: Did you give them to Bruce by any chance?

MULLANEY: I thought I may have given him one or two of those.

NORBERG: Well, then if he has I can check back at the office to see what they're like and make sure that I understand what we're talking about. The other reports that I have seen, of course, are published documents but that's easy to get. Occasionally there will be a memorandum about something where a meeting has taken place and somebody would write a memorandum to the files. Then you learn about information being transferred around the plant. But that's obviously not what you're talking about. All right. Getting back to Hill and asking for these reports. Did he ever interact with you about what was in the reports, "This is not enough. This is going in the wrong direction. Suppose we try this instead of that..."

MULLANEY: It seems to me that that would not have been in connection with the reports, that would have come about chit-chat in the lab and so forth. The report was mainly to tell the customer what we were doing. As a result, the conversation was probably more about the wordage that was used to tell the customer what we were doing or

weren't doing, rather than any change in direction or anything or that sort.

NORBERG: In addition to the technical memoranda that would have been distributed, do you remember other more general meetings discussing technology, discussing techniques, and so on?

MULLANEY: Yes. One kind of thing: Arnold Cohen had a guy -- I think his name was Pete Bearman, a mathematician from the university -- come to give us some seminars on or lectures on numerical methods. When we got into Task 13 and none of us really knew anything about computing and most of us were engineers, hardware engineers rather than mathematicians or logicians or anything like that, and we didn't really understand how you broke down the problem, how a problem that... For example, how you could solve an integral with all this arithmetic. Here all we could do was arithmetic, fast, multiply and divide and compare and so forth, but what we didn't understand is how could you solve a problem in integral calculus like that. Well, Pete Bearman was a numerical methods guy, and he showed us various numerical methods and approximations and so forth as to what you could do. I remember that kind of thing. When transistors first were announced in '48 or thereabouts, we had some sessions, somebody or other telling us about transistors. There were these things that were going on trying to get us up to date. By this time also it seems to me that reports on the ENIAC were around so we could see what kind of circuitry they had and maybe other machines that were being built. The information thing was starting to pick up tremendously by that time.

NORBERG: How about the reports of trips to various places that people had made doing the survey under Task Order I?

MULLANEY: Almost everything was classified. And if it was classified, then it didn't really get distributed outside of the group working on it, so that tended to keep down the communication.

NORBERG: I see. But when the report on high-speed computing devices was finished, that is the report that subsequently became *High-Speed Computing Devices*, that was submitted to the Navy, as I recall, at the end of '48

and at the time Mina Rees got a hold of it, she decided that it would be useful to publish it. And so in '49 this book was revised and more footnotes were put in and so on and a structure to the report was provided. But I would have assumed that that report was circulated within ERA at least.

MULLANEY: By the time I saw it, it seems to me it was a book. And by the time I saw it it was also obsolete. Things were moving very fast, and for example, some of the circuitry that it described was more appropriate to Goldberg when we were way beyond that and we were working on the circuitry for Atlas. That kind of thing. So I did not ever get much good out of that book. Probably because I saw it too late.

NORBERG: The presentations that you mentioned by Bearman and others all were outsiders. How about insiders giving talks?

MULLANEY: Yes, I can remember Dolan Toth I think gave some of the transistor talks. Dolan was one of the guys who first got his hands on some of the transistors and tried to build computer circuitry on them. And he gave us some talks on that. And I'm sure there were other things of that sort that I just don't remember right now.

NORBERG: I've come across listings of a whole series during '47, but I haven't seen any for '48 and '49, so I don't know how long they continued. I would guess that maybe the tail end of that was when you had just arrived so there might not be very many. I wanted to make sure of that. Let's go back to that statement you just made, though, about the book was obsolete by the time you saw it and that the circuitry developed for Atlas was substantially different and improved over what had been done for Goldberg and Demon. What part did you play in the development of the circuitry for Atlas?

MULLANEY: I would say a substantial but not principal role.

NORBERG: How would you distinguish those two?

MULLANEY: By the time I got into Atlas, the first run had been made at a standard circuitry. And I believe that George Hardenburgh had designed that -the flip-flops and some of the pulse amplifiers. This wasn't completely satisfactory, it didn't come up to Jack Hill's specifications and I was involved in the redesigning of some of that circuitry. Of course, it's much easier to improve somebody's circuitry than to be the guy that did it in the first place, so...

NORBERG: How did the circuitry differ from what was, say, in Demon?

MULLANEY: It was very much faster. By that time, we had some new tubes out, too, that were more appropriate.

NORBERG: Such as?

MULLANEY: 12AU7 that was a twin triode we used in flip-flops. That was not available when we started Goldberg. Goldberg had thousands of 6J6s in it and that had a very bad heater/cathode, short circuit problem, that would have been impossible to use in it with any reliability. The pulse techniques had gotten much improved and refined. It seems to me that in Goldberg we didn't use any pulse transformers, no real short pulses in pulse transformers. It was just much faster and improved... I don't know whether it could have been done in Goldberg times or not. I don't think so. I think some of the tools -- the components and tubes -- were not available. I designed the control system and the switch to decode the machine instruction and to break it down into steps. I designed that part of the system. And a lot of that I had to make up; I had nothing to go on in the way of material. I found out later other people had been doing. But we were still fairly isolated.

NORBERG: When you say other people, what other people do you mean?

MULLANEY: Well, there were other people building computers, Whirlwind for example. We were getting some Whirlwind materials but by and large I didn't get it until it was too late to help me very much. Whirlwind's organization was a pretty much like Atlas. And I'm not sure whether, I'm not sure how much connection there was at

the logic level. They were von Neumann type logic and there was certainly connection at that level, but I don't know how much detailed connection there was. In fact, I don't know how much Eachus learned from that. See Atlas came, I think, largely from Eachus and his associates with modifications and so forth by people such as Arnie Cohen. And I don't know how much contact Arnold had with MIT.

NORBERG: Well, why do you say that, Frank? Is that something you learned later on or did you know that at the time?

MULLANEY: Which now?

NORBERG: That there was a good deal of similarity between Whirlwind and Atlas.

MULLANEY: Well, as soon as I started to see MIT reports the similarity was obvious. But we were pretty far along. We were probably as far along as, or maybe even farther than Whirlwind was at that time. We did start to have then when we saw that there was a lot of similarity, there were a lot of meetings.

I don't want to play up this isolation thing too much. We did get together with them. We did visit. In fact, it was in those times someplace we cranked up a committee, an industry wide committee, to talk about vacuum tube design for computers to try to get tubes designed specifically for computers.

NORBERG: Who's we?

MULLANEY: ERA, MIT, Burroughs and others. I was on that committee and we used to meet in Newark and talk about these things. I think that may have been in the early '50s, though.

NORBERG: Let's drop back a minute, I want to pursue this. As you were designing this decoding switch, who else were you talking to within ERA trying to work out your ideas?

MULLANEY: Certainly Jack Hill. In my mind, Jack Hill, as far as the hardware goes in ERA in those days, the computer-type hardware, Jack Hill was the dominant guy. Other people... You know, it may be like that I was just seeing that part because I was working for Jack but that's my impression. I would talk to various other people, you know, consult them about a particular problem, like George Hardenburgh. George Hardenburgh was a very talented engineer, but his input-output system was hard to get at. He was also a little zany. Somebody would have something on the scope and would go out to coffee and he'd change the connections around on the scope so when they came in their pulses were going upside down or sideways and someone would sit down. George had a lot of fun with his work, but he was very talented. I don't remember who else now on that particular design. There I did look at the MIT reports and they didn't help me a great deal.

NORBERG: Because you had already settled on a design or because they didn't have the sort of information that you would have needed?

MULLANEY: Because I was already doing what I learned that they were doing from the reports. And our circuitry was somewhat different and I was working somewhat with our standard circuitry with some modifications and trying to design some output circuitry for it and find the right kind of tubes and so forth. And I think there was really mainly on that particular thing I think it was mainly Jack Hill and I did it. Jack would come up with some suggestions, I'd try them, they'd either work out, or wouldn't work, and I'd try something else and then finally settle on something.

NORBERG: How many different sort of...

MULLANEY: I've left out the name of one guy that I worked with on this kind of thing earlier was Howard Shekels. I didn't mention his name. There were probably a lot of other people I didn't mention. But I learned a fair amount from him. Howard was an engineer who was probably one step ahead of me in experience at that time and I learned quite a bit from him.

NORBERG: When you say one step ahead of you in experience what does that mean?

MULLANEY: Well, I meant that he had been working on that kind of stuff probably a half a year longer than I had or something.

NORBERG: How many different kinds of circuitry were there in Atlas that you were associated with it? You know, I think about the control system, the decoding, read/write the circuits for the heads, pulse techniques and so on. How many different kinds did you work on?

MULLANEY: Well, being involved on the control system, I worked on almost everything, except I did not work on the magnetic read/write circuitry. But I got involved in just about everything else. The input-output was very crude. We had a tape reader, a photoelectric tape reader, that I talked about when we were talking about Goldberg. I talked about that, but now that I think about it, I don't think that was Goldberg, I think that was developed for Atlas. We didn't have a photoelectric tape reader on Goldberg. We had a mechanical tape reader. So we had tape in and out and we had a typewriter on Atlas. And that was it. But we had a pretty sophisticated control panel with lots... It looked much more impressive as a computer than today's computers, lots of neon lights. I don't know how else to answer what kind of circuitry.

NORBERG: While you were working on Atlas in 1949, what was the tenor of ERA like? Was it opening up a bit more, was there more contact among the people who worked there?

MULLANEY: I think so. Yes. By this time, people had moved around from project to project more, so there was less isolation because they had worked on other projects and knew people on other projects. There was a good deal of wandering down the hall and into the other guy's land.

NORBERG: Were you ever associated with any of the commercial projects?

MULLANEY: Yes. When Atlas became the 1101, I was the project engineer.

NORBERG: I was thinking of the earlier ones for the aviation community.

MULLANEY: No, no, no.

NORBERG: None of them. Okay. Were you by this time in 1949 becoming associated with people like Bill Norris? People who were at the management side of things.

MULLANEY: Yes. I was finding myself in more and more meetings in his office, for example: with Captain Creasor and Joe Eachus, when we were having problems and things weren't moving fast enough. I'd get called in and called on the carpet. I was getting into that kind of thing.

NORBERG: Why? Why you? Why not Jack Hill?

MULLANEY: Well, both of us. At some point, and I don't know exactly...

TAPE 2/SIDE 2

MULLANEY: ... That sort of was a common pattern. A guy would be project engineer and then they'd want to load him up with some new project that had similarity and he would get that too. Then somebody else would be designated project engineer and he'd be project supervisor.

NORBERG: Do you remember anybody from the University of Minnesota coming around?

MULLANEY: At some point, I remember we used to have guys come over for summer work. And I think that may have been a little later in the '50s, like Sid Larson. We probably had other people, too. Oh, I can see this guy... Leroy

Anderson and others. What period are you talking about right now, Arthur?

NORBERG: Still in '47, 8, 9, '50.

MULLANEY: No. I don't remember any people from the university. The only specific one was this Pete Bearman that I mentioned earlier.

NORBERG: Yes. All right. During the time you were on Atlas, did you become involved with other projects?

MULLANEY: I don't think so.

NORBERG: Did you have any part in either the NBS discussions in '48 or the IBM discussions in '49?

MULLANEY: I don't think any real part, no. I was aware of [them] and I don't think I sat in on anything.

NORBERG: When you say you were aware of, what were you aware of?

MULLANEY: I guess that such discussions were going on. I don't think I really knew anything about it.

NORBERG: Do you remember when the contract was signed with IBM?

MULLANEY: No.

NORBERG: Do you remember any reaction to it?

MULLANEY: I remember being very interested that we had such a thing, but other than that I don't really...

NORBERG: You don't recall any unsettled feelings on the part of your colleagues about the IBM agreement?

MULLANEY: No, I don't.

NORBERG: When Atlas was approaching the production stage, I'm speaking of Serial I now, approaching the production stage, how much involvement did you have with the production level?

MULLANEY: Quite a lot because it was really all development. Production was rather crude at ERA. While we had assembly shops and things of that sort, I can remember many times running down to the assembly shop with a red pencil and marking up a diagram and changing things right on the spot. That was the kind of thing we were doing.

NORBERG: Would such a machine be assembled at ERA and tested before delivery to the customer?

MULLANEY: Yes, absolutely.

NORBERG: And then disassembled and shipped?

MULLANEY: Yes.

NORBERG: What sort of diagnostic tests were run then?

MULLANEY: The various engineers in charge of the different sections would write programs to test that section. None of us were programmers, none of us had done any programming previously. I wrote some programs to check all the, for example, to check all the commands, to make sure every command did the steps it was supposed to and so forth. And what we learned early in the game was that some of these things were sensitive to more than just... That they were really much more involved than we knew. We were just getting acquainted with this kind of big machinery where it would work in one instance and maybe with a different combination of numbers it wouldn't work. And this

was a great revelation to us.

NORBERG: What did you do about it?

MULLANEY: Well, we developed more sophisticated techniques. At that time, the principal technique was to vary voltages and to make sure you had enough margin. We varied bias voltages; we'd vary other parameters. I think that one of Jack Hill's great contributions to the maintenance was to reduce the heater voltages on all the tubes and that would... You'd find the weak emission ones in a hurry, especially as they developed a thing known in those days as sleeping sickness. We would reduce the filament voltage from 6.3 down to maybe 5 volts, and the thing would work at 5 volts. We could be reasonably sure then that it would work for quite a while when we brought the heater voltage back up. That got to be our principal single maintenance technique.

NORBERG: Now this was done systematically as well? That is you would reduce the voltages in a given section to 5 and then you would switch to the next section and go on in a cycle?

MULLANEY: We'd have different levels, too. We wouldn't reduce it as much, say, every day, but then we'd have a house cleaning, where we would really clean it out by reducing it to 5 volts or 4.8 or whatever. It seems to me we could vary it any amount we wanted to. So we came up with different levels at different times and I think those were written up as standard procedures.

NORBERG: When you say written as standard procedures, I haven't seen any of those. Was this done often?

MULLANEY: Hell, I don't know! This would certainly have been communicated to the customer in progress reports. It certainly should have been put in the manuals.

NORBERG: That's an interesting notion, because in looking through the various records, what seems to survive are not the manuals but the initial characteristics. For example, the two volumes of Atlas characteristics are still around,

but I don't believe I've ever seen any Atlas manuals that would have been produced for the customer.

MULLANEY: That is very interesting and I think I know the reason for it. The characteristics, every engineer working on the project would have had a set of those, so there were more of these around. Now the manual didn't actually get out until after the equipment was delivered, had been installed, the crew had come back from Washington, and by this time the people were off on another project and probably most of us never did see the manuals. This was being worked on by the publications group and although they would come and talk to us about various things in circuitry when they were writing the manuals, we didn't write, the engineers on the project did not write the manuals, and I may never have seen the manuals.

NORBERG: Could you take a guess as to how many copies of such a manual would have been produced?

MULLANEY: No. I don't have any idea.

NORBERG: That's something I'm going to have to look for, because I have not seen one.

MULLANEY: Most of them probably wound up with the customer.

NORBERG: That's become a source of difficulty of finding the documents, not because they're classified because for the cases of '61 and '69, particularly the Technitrol and then the Honeywell-Sperry suit, the materials were mostly declassified. That's why I could say to you that Demon and Goldberg and so on were declassified and so it's easy to talk about, because those documents were declassified for the court cases. But manuals were not submitted in evidence. What was submitted in evidence, because they were looking for firsts were things like characteristics and so on. So it's not there. Now I asked the question, though -- you present me with a little bit of a surprise -- because I asked the question for a different reason, actually, and that is thinking back to when I was looking for information on the electronics industry in the early years, say the 1920s, there the manufacturing procedures for tubes became standardized as well. In smaller companies looking for those procedural documents was very difficult. You couldn't

uncover them. You'd have to find somebody who was on the production line who might have saved them. And for things like Federal Telegraph Company, which were influential on the West Coast, I was looking for such documents and found them in Charlie Litton's papers. He had saved those smudgy things that had been used on the production line telling how to make Housekeeper seals, how to do other sorts of things in sealing metal to glass and so on. And I was looking for the same thing here when you were saying standard procedures and I was about to ask you what does a standard procedure mean when you only have one item being produced?

MULLANEY: I guess I mean more of what was a less formal thing than you're thinking of when you're thinking standard procedures. Maybe more an SOP, standard operating... things that we did. And I think we probably didn't even use the term standard procedure. It's only from looking at it from 40 years that it really... We did develop some things that to us at that time we did regularly. And I don't remember in what form they were written up at all.

NORBERG: Would they be passed on to other people in ERA for their activity in putting the machine together?

MULLANEY: Oh yes. I think it's very likely some of those things came out in a technical memorandum series, too. They certainly would have been passed on to the customer. The customer had maintenance people that we trained, too, and we would have passed it on that way to the customer.

NORBERG: Were a number of people hired for work specifically on Atlas do you remember? I'm thinking of the production really not the design.

MULLANEY: It seems to me most of the people had been working at ERA and... Let's see, is that true? Sometimes I get very confused between 1101 and 1103, too, as to which people worked on which.

NORBERG: But in fact we're still only talking about Atlas.

MULLANEY: Yes, I know. You mean you're not even talking about 1101?

NORBERG: Not yet.

MULLANEY: Because I think of them as one.

NORBERG: All right.

MULLANEY: Because they really were the same thing.

NORBERG: They were and they weren't. It depends on the perspective.

MULLANEY: That's right, that's right. But from somebody working on the hardware, it was the same thing. So from looking at it from 40 years off, I don't remember who worked on what. But I think, as I recall, people at the Atlas stage were for the most part people that had worked on something else at ERA.

NORBERG: The reason I asked that question, Frank, is I've looked at the annual reports, obviously, of the company, of ERA, and it is noted there that the peak work force in ERA was 1949, let's say 650 employees. In 1950, that number went down and of course in '51 it went down a little further, but not much. And I'm wondering why these employees were brought on. Were they brought on to produce things like Atlas? Let me ask it this way: were a number of machines or systems being built all at the same time in '49 that would have required an increase in the work force?¹

MULLANEY: I don't remember how many Atlas's were built, but there weren't many.

NORBERG: Just two.

¹The peak year was for October 1947 to October 1948: 652, not 1949 as stated. In 1949, the work force dropped to 490 and rose in 1950 to 528 (Data from ERA Annual Reports, Cohen Papers, CBI.)

MULLANEY: So I think the answer to the question, if you're sticking to Atlas, is that there wouldn't be a lot of people put on just to do that.

NORBERG: But there was another Goldberg being built at the same time. There was a second Demon in process at the same time. So there are possibilities. But okay, you don't recall, and that's all right. Do you recall when the first indications arose in either your mind or in other people's minds about going commercial with Atlas?

MULLANEY: I think at some point along the line it dawned on all of us and probably at different times, probably earlier with people like Arnie Cohen, and later with me, who wasn't that familiar with computers, that it dawned on all of us that we had, we really had a computer that would be useful for things other than what our customer was going to use it for, if it had a few changes and what not. And at that time, let's see, was IBM making noises about a 701 or... I forget what they had out. They probably had the 650. I don't know where the idea came from, but it seemed to be more or less, it looked to me like it arose in different places at different times or was sort of spontaneous. I don't actually remember getting together to talk to anybody about it, though. Now we must have and probably there were things going on at higher levels that I was still not involved in, maybe with Norris and possibly Arnold Cohen or whatever in discussing this, but I just don't remember.

NORBERG: Do you remember when you began working on 1101 as an independent entity?

MULLANEY: I think it was while we were still involved in Task 13, in Atlas. And I do remember discussions about starting a computing center in Arlington.

NORBERG: What would that have entailed?

MULLANEY: It would have entailed an 1101. In fact I think the first 1101 or maybe the second went to Arlington to be involved in the computing center.

NORBERG: To do what?

MULLANEY: To take on people's computing. You know software was nonexistent in those days. If you wanted to put a problem on a computer you had to do the programming in machine language and so forth. So the thought of trying to run a computation center -- we didn't really know how far out it was but it was reasonably successful because I think the people running it learned a lot. You learned a lot about what you had to have to serve a customer and so forth. So I think that was very much involved. We were going to be in commercial computing and we were going to set up a computation center. And where else did the... I don't even remember who got the first, who was the first customer for a commercial 1101. But we knew we had... The principal differences as I recall it, or maybe you don't want to get into that...

NORBERG: Go ahead.

MULLANEY: The input-output was almost nonexistent. We had a typewriter on it and we had tape out, magnetic, I mean paper tape output.

NORBERG: This is the Atlas?

MULLANEY: Yes, the Atlas. So we knew we had to have something a little more general. But I don't think it ever got it. And this was one of the faults that I think is still written up in the 1101 and it also got propagated to the future 1100 series and that is ERA wasn't noted for very sophisticated input-output. The reason was where the thing came from in the first place. We had to take out a classified command or two. I forget what else. Very little else was done to that Atlas. Atlas was 1101 in my mind completely and I don't remember where the... I don't remember how many they sold. It seems to me one wound up in Italy, but I'm not sure how... I just don't know.

NORBERG: That's all right. But this notion of the computing center at Arlington and the ability to do work for other organizations, is it possible that that could have given rise to the notion of a commercial machine?

MULLANEY: That's possible.

NORBERG: You don't know that, though.

MULLANEY: No. My tendency would be to think that it was the other way around, that...

NORBERG: On what evidence would you select the other way around?

MULLANEY: Because to make the decision to put one in Arlington, there would have had to have been a declassified version, hence an 1101. It seems to me that the decision would have been made at that time to build other 1101s.

NORBERG: Well, I guess it wouldn't seem quite so obvious to me, because I would think that if one believed that there was only a very small market for computing business now, not computing machine business, but computing business, then to build a machine to put into Arlington to do work for either the government or other organizations around Washington, D.C., would not require a decision to go commercial, it would only require a decision to become declassified.

MULLANEY: Yes, but... That's true. But I think we regarded even that machine going into the computing center at Arlington "commercial."

NORBERG: Do you remember who began to push the idea once it seemed to become common?

MULLANEY: No, I don't.

NORBERG: Who did you interact with in Arlington? We're talking now between '47 and '51?

MULLANEY: I didn't have much interaction with Arlington. They were working on, for the most part, as I recall, they were working on projects that were paper-type research things. And I just didn't... I would meet some of the people occasionally as I would be out there or they would be in St. Paul, but I didn't really have any contact.

NORBERG: So you had no interaction with Engstrom and Tompkins and those people.

MULLANEY: Not with Tompkins, but I got to know Engstrom reasonably well, because when I would deliver equipments out there, for example, I would see Engstrom. In fact, Engstrom was a very sociable guy and sometimes he would have a dinner for the crew and things of that sort. I didn't have any technical contact with Engstrom. I don't know how much technical work that Howard did at that time, either. I think he was a little aloof from that by that time, too.

NORBERG: By which time?

MULLANEY: By the time I was delivering machines out there.

NORBERG: All right. How about with people like Erv Tomash?

MULLANEY: Of course I knew Erv, because we went to school together. I knew Erv was in Arlington. I didn't have any contact with Erv on company business while he was in Arlington, but then he moved to St. Paul and went to work briefly as an engineer on either Task 13 or 1101. I'm not sure which. I think... No, I'm wrong. That may have been Task 29, which grew into 1103. I don't think Erv came until then. At some point, at least, I remember he went to work briefly as an engineer, but I think that was Task 29.

NORBERG: When was the first 1101 actually produced? Was it before Remington Rand acquired ERA?

MULLANEY: I believe so. And I would say... I'm guessing, Arthur, I would think '51.

NORBERG: '51. I can check that easily in my notes back at the office. I asked that question because it seemed to me that Erwin was working on generating customers for 1101.

MULLANEY: He might well have been. I don't recall the circumstances as to how he happened to really get back into hardware engineering. I think maybe he had wanted to do that because he hadn't been involved. I think it was his choice to come back to get into hands-on engineering for the time. But I don't really know, because I didn't have contact with him, I don't know what he was doing prior to that.

NORBERG: Who else came to the company -- and I realize I've talking a lot of your time this morning, Frank, I'll finish very soon. Who else came to the company in those years, '50, '51 and so on, that made an impression on you?

MULLANEY: Well, at some point in the early '50s and I can't pin it down exactly, a lot of people came to work including... Well, I think by this time we were getting into Task 29. I'm thinking of people like Seymour Cray and Jim Thornton and Tom Rowan and Chuck Pence.

NORBERG: Those are all names that come on in '51.

MULLANEY: '51?

NORBERG: It sounds like ERA is gearing up for something, doesn't it?

MULLANEY: Oh yes. Really 1101 was not much of a commercial machine. We used to say that we thought it was the first computer offered commercially, but I don't really know how many of them. There were only... You probably know how many were built, I don't know how many were built. But by this time we were gearing up for what became the 1103. We were doing Task 29 which was Atlas II. And all these people that I mentioned... I was first project

engineer and then project supervisor on Task 29 and all these people came to work for me. Most of them were right out of school. And some of them, in a hurry I could tell... Seymour had only been there a couple of weeks before I knew we had something very unusual there. Bob Kisch came too. Bob Kisch had been at ERA, but Bob Kisch came to work on the project about that time, too.

NORBERG: There also seemed to have been an expansion of activities at the time in terms of R&D. It's in that period that Transtec and Magtec get started as research projects, the attempt to use transistors or magnetic switching techniques and the like. And all of those things sort of presage a new approach in ERA. Was that under general discussion among project engineers and supervisors at the time?

MULLANEY: By that time, I think we knew we were in the computer business. And there were all kinds of possibilities that were coming along. Transistors were certainly in the offing, but what was more immediate was that the various magnetic circuits -- I forget the name of some of the projects, too -- but they actually built some machines with magnetic logic. Wang and Woo had come out with their magnetic circuitry, An Wang and his associate, and there were just a lot of things going on. We knew we were in the computer business and I think that we were all enthusiastic about getting into it in a more commercial way. That while the life's blood of the company was still the Defense Department contracts, we wanted to branch out into the commercial. So there was quite a... It seems to me business must have been pretty good. I'm surprised that the peak employment was in '49, but I... No, I just... Because my impression is that there was so much going on in the '50s that I... But maybe it didn't get that much...

NORBERG: Well, what I think is the case, and the maximum number of alternate projects for aviation, various tasks that were being done outside of the computing business that ERA might have been concentrating on reached its peak in '49 and that began to slack off.

MULLANEY: You see, since I wasn't involved in those areas I wouldn't have been as aware of it. That's right.

NORBERG: Well that, as you probably remember, gave rise to a cash-flow crunch, because there wasn't enough

coming in from what was the cash cow the aviation side. And as a result, ERA then gets into a bind, which of course Parker and Norris were trying to deal with. That's a good stopping point I think for now, today, Frank. And we can pick up with the sale and maybe a couple of other things on Atlas and 1101 and then move quickly into 1103 and the interaction with other parts of the Remington Rand company.

DATE: 11 June 1986

TAPE 3/SIDE 1

NORBERG: I would like to begin today by asking you just a couple of more questions about the transition from Atlas to 1101. The reason for that is two-fold. First of all, last time when we were discussing it, there was some lack of clarity about which machine really was...

MULLANEY: That's right. And I think I answered a couple of questions that probably referred to the Atlas II or 1103.

NORBERG: That's fine. And you commented on that at the time. But the thing that comes through most forcefully in the answers that you gave is that the 1101 was essentially the same as Atlas with a couple of instructions taken out.

MULLANEY: Yes, that's it. There were very, very few changes.

NORBERG: Now what does it mean in that period of 1950 to take a couple of instructions out? Does this mean that there are substantial differences in the basic circuitry or is it just the program, the machine language program which changes?

MULLANEY: The instruction, and there may have only been one instruction taken out, there was one instruction which the customer regarded as classified, because the use of the machine could have been inferred from this

instruction. We took it out. There was just... It was just removed, you know. That probably meant either just disconnecting some wires or...

NORBERG: It did involve some sort of hardware change then.

MULLANEY: Oh yes, but very, very minimal. It was taking one machine instruction out of the repertoire.

NORBERG: Second question has to do with your article on the 1101 that was published in 1951. At the end of it, you have a series of comments about what would be done differently if you were designing a new machine, different machine and so on. First of all, would you comment on those differences? How were those differences identified at that time?

MULLANEY: I think looking at this I see what happened is that the technology changed between the time that we designed Atlas I and the time I wrote this. Things had moved along. Referring to the specific comments, for example, in the 1101, there was no rapid access memory. All we had was the drum. So to design a new machine you would put in in these days an electrostatic or maybe even a core storage... I think was what I had in mind there. Also, diodes got much better, much more reliable, so much of the gating and so forth would have been done with diodes rather than with tubes. Central exchange register: I think number three is saying that tube count could be reduced by making greater use of a central exchange register thereby requiring fewer transmission gates. We had a lot of different registers with many paths between them and I guess I felt at that time by funneling them all through one register you could cut down the number of paths and so forth. A few circuits that would be replaced: that's just a comment on the circuit design. I guess those are the comments. Technology had moved along, it was a few years, and we'd learned to do some things better.

NORBERG: Did these things then, secondly, get built into the 1102 or not until the 1103?

MULLANEY: Well, they got into the 1103. The 1102 was essentially, as I recall, the 1102 was an 1101 built out of

1103 circuitry. So some of those things, the hardware things would have been incorporated. There was no rapid access memory. The machine was not redesigned but some of the circuit changes that would have made a more reliable circuitry did get put in. The hardware was changed.

NORBERG: For the 1102?

MULLANEY: Yes.

NORBERG: And then the 1103 was a new design.

MULLANEY: The 1103 was a completely different machine. There was no compatibility of any kind between Atlas I and Atlas II or 1101 and 1103.

NORBERG: All right. Were you in on the design of Atlas II?

MULLANEY: Yes.

NORBERG: And can you say anything about the differences between Atlas II and either Atlas I or 1101, I don't really care which?

MULLANEY: Atlas II was a two-address machine as opposed to the one-address in 1101. It had a fast memory. First electrostatic, and then that was replaced by core in the 1103. But the first Atlas II's were electrostatic storage.

NORBERG: Do you remember why electrostatic storage was chosen at that time?

MULLANEY: Yes, because it was a little bit ahead of cores in the chronology of the technology. But it got taken over very fast as soon as cores really came along, when we really could get uniform cores at reasonable prices, and

so forth. It was so superior that there was no contest at all. So electrostatic -- that was a very transient thing on the scene.

NORBERG: Were you in on the sale of these machines?

MULLANEY: Indirectly, but not directly. I was not in sales. However, in the course of selling one, I would almost invariably have contact with the customer, either in St. Paul or at the customer's site.

NORBERG: Was there any training of customer's personnel involved that you might have participated in?

MULLANEY: Yes. The original customer for the Atlas II... Now are we differentiating here at this point between the Atlas II's delivered to the original customer and the 1103s or...

NORBERG: The only distinction that I would be searching for is if there were differences in the treatment, if the Atlas I was quite different than Atlas II.

MULLANEY: No, I mean are we talking about Atlas II or are we talking about 1103?

NORBERG: That's a bigger distinction. Let's try both of them, if we can.

MULLANEY: Okay. I recall Atlas II some of the customer's personnel lived in St. Paul for a considerable period of time, so we were with them every day. They were in the lab watching us work; they were helping us test the machines and so forth to get acquainted with them. Now by the time we were selling 1103s, I was another step removed from the hardware, because although the projects were under my direction, they were not directly. Somebody else was doing that. Noel Stone I believe. And my contact with the customer would be much more, well, a lunch or a meeting or something like that, rather than day to day technical contact.

NORBERG: Who was doing maintenance on these machines?

MULLANEY: In the case of the Atlas II, the customer had his own maintenance group and they would be trained in St. Paul, as well as on their site. I believe that in the 1103 the company had a -- I know they did, yes, -- the company had a customer service group so it was getting more formal, more organized and so forth.

NORBERG: I'm going to switch the topic for a moment and come back to what happened after 1103 in just a few moments. The last time, just as we were finishing, I mentioned that the next series of questions would be on the sale of ERA to Remington Rand. Do you remember your reactions when you learned about the sale?

MULLANEY: Yes. Displeasure. Mild dismay. None of us had a very... we didn't know much about Remington Rand, none of us had a very high opinion of Remington Rand as far as the kind of technology we were in. And much of it was because we just didn't know. Several of the ERA people had gone to work for Remington Rand before this time, like Don Ammerman and, oh, I forget who else. Lou Chaloux, maybe Cliff Helms. And aside from those people, we didn't really know anybody there. We just weren't very happy about it. We thought that ERA could have been financed, could have made it alone, and so forth, you know. Although, I must say I didn't really know anything about the financial condition or why they had to do it or why they wanted to do it.

NORBERG: So you were not sufficiently high up at that time to be part of the group that was discussing the options before it.

MULLANEY: That's right. This was what, '52?

NORBERG: That's right.

MULLANEY: Yes. No, I was not in '52.

NORBERG: Do you remember talking about this with the others in the company?

MULLANEY: Oh yes. There was a lot of talk about it.

NORBERG: Was this a general feeling do you think?

MULLANEY: I think it was. I recall one meeting that Arnie Cohen maybe told you about. Somebody came out from Remington Rand to sort of a get-acquainted meeting and to try and make people feel better and so forth. And he was asking a lot of questions that weren't going over too well, that seemed to be, I don't know, critical or whatever. And Arnie said, "Well now, we've answered a lot of your questions about ERA and so forth, suppose you tell us a little about Remington Rand. We know they make shavers and typewriters, but what else do you do?" This didn't go over too well, I remember, but we all applauded that, because I think we all felt that way. This was the general... They were getting into somewhat of an antagonistic situation.

NORBERG: What was your next interaction with Remington Rand?

MULLANEY: Let's see. Oh boy, that's a long time. At some point, we had to get together with the Philadelphia people, the UNIVAC people and there was another thing that didn't fit very well.

NORBERG: Why not?

MULLANEY: They were different. They were extremely competent. We didn't always think so. Our approach was different. They were more -- well, some people might not agree with me on this -- I think they had a more intellectual and analytical approach. They were also very innovative, but I think we built better hardware. Consequently, we looked at ourselves as the practical people that could make things work and we looked at them as these eastern fellows that thought they were pretty hot stuff. And it just didn't work very well.

NORBERG: I see. You didn't see any opportunity to take some of that intellectual competence from them and, say, build it into your systems.

MULLANEY: I guess they didn't, because we didn't like the way they built circuitry and so forth. I think they were probably better at ideas and logic. Although, I must say that some of their things like their tape units were way ahead of the... They had a lot of foresight in their magnetic tape equipment, which they designed from scratch and so forth. We just didn't appreciate them then. I think that we were too parochial to do so, but we didn't. And we didn't really give them a chance. Personalities were part of the problem. Pres Eckert, in my opinion, had a very, has a very abrasive personality. And that didn't go over. He would come out and appear to be lecturing us and so forth.

NORBERG: He does that at the dinner table.

MULLANEY: I was on a committee, an engineering committee, that met back and forth to discuss common engineering problems and Pres dominated that to the point where I had all I could do to sit at the table and listen to him and so forth.

NORBERG: What sort of problems were being discussed by that group?

MULLANEY: Oh, tube life, diodes, design criteria, derating of components, reliability, tests, life tests, that sort of thing.

NORBERG: Do you remember what the committee was called?

MULLANEY: No, I don't, except engineering committee, joint engineering committee or something of that sort.

NORBERG: There was such a committee, that may well be right. I was leading in a slightly different direction, so let me try to pull it back to that. Beside Eckert on this committee, who else did you deal with in either Philadelphia or

Norwalk or both? You personally now, not ERA.

MULLANEY: Okay. I had very little contact with Norwalk. In Philadelphia it was mainly Pres Eckert, Jim Weiner, Fraser Welch, and to a lesser extent probably Herman Lukoff. I'm dredging these names up that I haven't thought of for years and years, so there might well have been others. Those are the people that come to mind.

NORBERG: Now, beside the engineering committee, were you doing other projects with them or discussing other products perhaps?

MULLANEY: No.

NORBERG: It was just on this committee that you interacted with these people. Okay. What did you perceive about the new management, the Remington Rand management, from your position in St. Paul?

MULLANEY: I or we didn't have a very high regard for it from what we saw.

NORBERG: Did you have any contact with them?

MULLANEY: Very slight. I met Marcel Rand; I'd met Jim Rand, the old man. He did not stay in the operation very long. I had been up to Norwalk a time or two. It just didn't.... Oh, who was the general, Leslie Groves was generally perceived as being... I mean I'm not going to put that on tape.

NORBERG: He was incompetent in this job. I'll put it on tape.

MULLANEY: He was not the right man for the job. So we didn't think much of the management.

NORBERG: Do you think this had a negative effect on the ERA division?

MULLANEY: Well, yes, I think it did, but I guess you'd have to say compared to what because I don't know what else they might have done. Maybe that was the only way to finance the operation.

NORBERG: Well, compare it with the Eckert-Mauchly division.

MULLANEY: Oh.

NORBERG: There were two divisions within the same company.

MULLANEY: They may have had the same problems with the management.

NORBERG: They might very well have. One might make a comparison, I think, between products, the different sorts of machines that were being at each location.

MULLANEY: I still say that even from the distance of 35 years or whatever, that we built better hardware in St. Paul. UNIVAC I hardware, although some of the design was way ahead of its time, and it was very innovative, and they talked a great, great job of life tests and derating and so forth, it just didn't work as well as ERA hardware.

NORBERG: Did you ever have to bail them out?

MULLANEY: I don't think they would have allowed that.

NORBERG: But that's not the question I asked, Frank. I asked did you, not whether they would allow it or not.

MULLANEY: Not to my knowledge, no, because we were not well enough acquainted with their hardware to really be able to bail them out.

NORBERG: I see. There's one story that I know about, which I think is fairly commonly known. That is, when one of the UNIVAC machines -- and I must admit I've forgotten now whether it was I or II -- was sent to Louisville, the General Electric facility down there, that Bill Drake was sent down to get the thing operating. They were having all sorts of problems. And what he found was that half the peripheral equipment hadn't been delivered. Input/output was still back in Philadelphia spread out on a table, apparently, not even assembled.

MULLANEY: Oh, that kind of bailing. I thought you meant the actual going in and changing equipment or something.

NORBERG: Yes, I guess I misled you on that.

MULLANEY: That was more of a management thing than a... I remember when Bill went to Louisville. See, I was not in on that end of it. I was still doing military stuff. I was almost completely in military work. So these things, although I'd hear about them and knew about them, I really wasn't involved in them.

NORBERG: Well, what sort of projects were you doing at that time?

MULLANEY: Well, let's see. There were several projects that involved the 1103, Atlas II. There were various flavors with electrostatic storage, with core storage. There was a classified machine called Bogart built out of magnetic components. All of the things for that particular customer were under me as well as... We were... Well, we were getting into a big job that was under George Hanson for a TACS (Tactical Air Control System). I don't think we'd gotten into NTDS yet, depending upon what kind of time period we're talking about, or the missile jobs.

NORBERG: They come in about '55.

MULLANEY: Yes, okay.

NORBERG: I think that's when it came in.

MULLANEY: But that is the kind of thing I was in.

NORBERG: Were you also in, let me say in charge and you can correct it if it's wrong, the NTDS project and Athena and all of those?

MULLANEY: Yes.

NORBERG: NTDS has been declassified, but I don't know about Athena.

MULLANEY: I have no idea.

NORBERG: Some of that missile work is still in use. But NTDS, as I recall it, came from Navy specifications again, so it would be somewhat like ATLAS I.

MULLANEY: Yes, it did, except that in this case I think it had much more input from the ERA, namely Seymour Cray input.

NORBERG: I see. Can you tell me something about that because I don't know much about it?

MULLANEY: I can't really give you any details about that, but by this time Seymour was kind of getting into stride. Seymour had a lot of do with the design of the NTDS computer, working with the customer. It was the first big computer that we built at ERA with transistor circuitry, as I recall. And it lasted quite a while, they built that and variations of it for many years.

NORBERG: There's a short history of it that was recently published by a young Navy historian. It was informative from the user's side, not from the technology side.

MULLANEY: In fact, I think that -- not that the hardware would still be going -- but that program was in being a couple of years ago. I visited Malcolm Macaulay out on the West Coast, who's working for Hughes, and he showed me a pin. He had worked on NTDS in St. Paul. When he went to work there, because he was a pioneer, he got a pin something like "Pioneer NTDS" or something of that sort. It was still going at that time.

NORBERG: Amazing. What were your duties in the ERA division in this period from '52 to '55?

MULLANEY: There were various titles, but I was either a department manager or... either a project supervisor, department manager, or division director on the same kind of projects. And as the groupings would change or there'd be more of them or we'd change the number of people reporting or the number of levels or so, these titles would change. But essentially the job was the same except that it grew during those periods. And mainly it was NSA type jobs, but then as the missile things and the other things, as we got those jobs, those were also in that.

NORBERG: And at the same time the 1103 was under you?

MULLANEY: Yes, it was under me because of its origin. Even though we considered the 1103 a commercial job but it came out of the Atlas II developments and we set up... It seems to me that Noel Stone was the supervisor on that in changing that the transition from Atlas II to 1103.

NORBERG: Who else besides Noel Stone was working for you then?

MULLANEY: Oh boy. Seymour Cray, Bob Kisch, Pete Zimmer, Jim Thornton, Tom Powan, Chuck Pence, George Hanson...

NORBERG: These are people who continued with you for some time in that '50s period and indeed afterwards.

MULLANEY: And most of them beyond, that's right. Bob Murnane, Arnie Hendrickson...

NORBERG: Can you make an assessment of these people from a technical point of view? I'm interested mostly in comparisons among them. Hardenburgh was good at this, Henrickson was good at that and so on, not the sort of gossipy.

MULLANEY: For the most part, I would say if there was any one thing that characterized the group is that they were practical hands-on-get-the-equipment-to-work engineers. The most innovative, analytical, inventive and so forth guy was, of course, Seymour. And that was true then and it was true for a long time.

NORBERG: How did his capability first evidence itself?

MULLANEY: He came into the project, I think it was Task 29, it was the Atlas II job, and he came in when we were quite a ways along and he hadn't been there more than a week or two and we had a prototype going, electrostatic storage. I saw a bunch of chassis out on the table and by gosh they were changing a component in all of these things. I said to Tom Rowan, who was in charge of it, I said, "What are you doing?" And he said, "Well, Seymour thought this ought to be changed." Seymour wasn't really working on that, but Seymour thought this ought to be changed. They had already recognized him as somebody that they should listen to and he'd only been there a couple of weeks. That's sort of typical. He got into everything, but his main job was to design the program control system for that machine.

NORBERG: For Atlas II?

MULLANEY: For Atlas II, yes, when he first came in.

NORBERG: Okay. I interrupted you. Go ahead with the others.

MULLANEY: Oh, okay, where were we. These guys were very good practical engineers. I guess this is what I recall the most about them. Inventive... I think we were a little short on far-out inventiveness. We had, maybe, a shorter term inventiveness. You did what you had to do to get something going, which involved some amount of innovation and so forth. But as far as the new ideas that really were recognized as such and so forth, we didn't do a lot of that, I don't think. We just built stuff that worked better than a lot of other stuff in the country.

NORBERG: Was there any discussion about that, do you remember?

MULLANEY: I'm not sure to what extent we really recognized that. It's only when you look back on it, I think, that you recognize that.

NORBERG: Did anyone else shine like Seymour?

MULLANEY: No.

NORBERG: Did anyone else shine later, '60, '65?

MULLANEY: Well, yes, to lesser degrees. Jim Thornton was a very good machine designer. Now if you're getting into the '65 area, Chuck Casale, when he was young, a new engineer, worked with Seymour, was very good and I think... He got out of that later, I think he could have been very good, too. I'm probably leaving some people out, too. Bob Kisch was very good in some areas.

NORBERG: Which ones?

MULLANEY: Memory, as I recall. In the early days of magnetic drums. I'm probably leaving out some very good

people.

NORBERG: That's all right. You don't need to worry about that. You can put them in later, if you remember them at a later time. Was there discussion within the ERA division of Remington Rand about Remington Rand itself in terms of what it was or was not doing to promote the activities of the ERA division.

MULLANEY: Yes. We felt we weren't being given the support and that is the... I'm sure that means we weren't being given the money. So to really exploit what we thought we had, to go particularly after the 1103 as a commercial project, we were not at all satisfied with that.

NORBERG: What about sales?

MULLANEY: I didn't know an awful lot about sales. I knew John Parker, let's see, he had probably moved to New York by that time and was heading up sales.

I don't whether Erwin Tomash was with him, I don't know whether Bill Drake was with him, but probably. The sales people that came from Remington Rand, who sold Remington Rand equipment, we really didn't have very much regard for. They weren't... they weren't computer salesmen. They were salesmen salesmen all right, some of them, but they didn't know the equipment...

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MULLANEY: Well there were a couple like Marv Swenson that most of us had a high regard for. Marv was still around in the business, but there weren't many.

NORBERG: Was there discussion about the competition? Maybe I should ask that question differently. What companies did you see as the competition?

MULLANEY: IBM.

NORBERG: Why?

MULLANEY: Because they were very aggressive. They were very good at sales. They were forging ahead and we were not at a time when I think we were at least as well qualified technically and maybe more so to take advantage of that market, but they didn't do it.

NORBERG: Were there comparisons made between the 1103 and some of their equipment?

MULLANEY: Yes. And it seems to me that... oh boy, 701? I'm grasping, but I think that was the machine that was the competition.

NORBERG: I think that's right. The 704 comes a little later, and the 650, of course, wasn't delivered until '54.

MULLANEY: Let's see, what was the 704? Oh, the 704 was more like a 1604.

NORBERG: Was there other competition around?

MULLANEY: Yes, there were companies like, oh there was one on the West Coast. I think it was Computer Research or something like that that became part of Burroughs. There was Burroughs itself. There was... Let's see, who else was building big machines? There weren't many people building what we regarded as large machines. There were other people building smaller machines, like NCR. I don't think there was much competition.

NORBERG: Was there any projection going on about how many machines could be sold, things like the 1103, that you might have participated in?

MULLANEY: I don't think so, because I wasn't that closely in touch with the market. That probably would have been the sales people.

NORBERG: Who would be Parker and Tomash and others. All right that's become a bit of a difficulty for me to find the right people to talk to about that. Parker doesn't really remember a lot from that period, especially when he was getting disenchanted with it. He's just sort of wiped it out.

MULLANEY: How about Erv?

NORBERG: Yes, Erwin was quite good about it but tends to be confined to a particular geographic area, because he was selling out in southern California for the most part. He didn't like New York, and didn't stay there.

MULLANEY: Maybe your answer is that it wasn't done in an organized way.

NORBERG: Well, that certainly is possible. I haven't found any documents to substantiate it. I noticed this morning that Norris has not come into the conversation. You must have had some interaction with him.

MULLANEY: Oh yes, probably a lot.

NORBERG: But it doesn't stand out.

MULLANEY: Not with respect to the questions you asked me.

NORBERG: What questions would I have to ask to get it to stand out?

MULLANEY: Well, let's see now. Certainly he was running the whole thing. He was running the whole UNIVAC division.

NORBERG: He was running the UNIVAC division. Now, the UNIVAC division doesn't start until later.

MULLANEY: He was running, then, in this earlier period he was running St. Paul. Okay. And certainly I had contact with him, but not a great deal. Maybe an occasional lunch at the Criterion to talk about a particular customer or progress on a job or something of that sort.

NORBERG: Was all reporting done, then, through written documents?

MULLANEY: Well, there were certainly still the progress reports for the customer. These were still the main reporting tool.

NORBERG: For military projects.

MULLANEY: Yes.

NORBERG: But not for commercial.

MULLANEY: No. And I don't recall... I can't tell you that.

NORBERG: Okay. I've seen a substantial amount of sales statistics in terms of the number of machines sold by the company, so it would be all the machines that were being produced at the same time, including desk calculators and so on. And these came out monthly, but I don't see any reporting going from St. Paul about those same statistics.

MULLANEY: Well, that's interesting.

NORBERG: It is. I also don't see very much of the interaction between Norris and Eckert. Did you ever observe the

two of them together?

MULLANEY: Before the UNIVAC division days?

NORBERG: Well, we may have to shift into the UNIVAC division days, because it may just have been too soon...

MULLANEY: Because it's kind of fuzzy in my mind.

NORBERG: Well, why don't we address that in a different way, because one of the key dividing points in there would be when Sperry purchases Remington Rand, and it becomes Sperry-Rand.

MULLANEY: Oh, of course.

NORBERG: Now what do you remember about that merger? Do you have the same feelings about that that you did about ERA going into Remington Rand?

MULLANEY: We had a little bit higher regard for the Sperry people, because we felt that they were more our kind of guys, I guess. We were... We had a very narrow outlook as to what people we were willing to accept and when old man Vickers came along, and he was kind of an old shoe type engineer, I think we warmed up to him and the situation more than we did to what we regarded as "these eastern businessmen".

NORBERG: Well, what did you know about the reputation of Sperry at the time?

MULLANEY: We knew that they had a good reputation in the military equipment field: gyroscopes, whatever else they were in, aircraft radio, I forget, that sort of thing. And this kind of appealed to us and I think we thought that that would be a plus in our relationship.

NORBERG: Did you have high hopes then for this new UNIVAC division?

MULLANEY: Yes, I think we did. It looked better to us, that sort of background, with the management having that background looked better to us than the typewriter/shaver background. I think that's the way I felt about it.

NORBERG: And did that bear itself out?

MULLANEY: I don't think so. In the first place, Harry Vickers was about at retirement at that time, and we were still dealing with the Remington Rand people from Norwalk. I don't think it made that much difference, to me anyway.

NORBERG: So back to the management now and Norris, where you wanted me to distinguish before between the St. Paul operations and the UNIVAC division. When he became head of the UNIVAC division, do you remember what the feeling was around St. Paul?

MULLANEY: We were pleased, because it looked like that at least put St. Paul in a position to be heard in the top levels of management. I think we thought it recognized the contribution of the St. Paul group, and of Norris. I mean we certainly preferred it that way than to the other way around.

NORBERG: But within a year's time, many people were disenchanted. What happened?

MULLANEY: I guess maybe we had high hopes for the kind of support we'd get to further some of these projects and we didn't get it. I guess that's the main thing, maybe high hopes and then nothing really was different.

NORBERG: I remember reading a memorandum from I believe it was around the 1st of April, 1957. It came from Marcel Rand, as I recall. And it had to do with an increase in management's understanding of the importance of the military operations in St. Paul, and so they were separating out the military operations from commercial operations.

Now if you had been, let me say, essentially in charge of military operations here in St. Paul, that, to my way of thinking at least, would have put you in a much stronger position with respect to the company.

MULLANEY: I don't think that's the way we read that particular memo, Arthur.

NORBERG: Okay.

MULLANEY: It seems to me at that time what we read was is that Norris' job was being cut way back, and that he was being sent back to the boonies. As I recall at that time he also lost the marketing end of it, which up to that time he had been in charge of. So we looked at that as being a backwards step and it was just window dressing to say that this was emphasizing the military.

NORBERG: What were the consequences of the action beside Norris being pushed aside or demoted or whatever?

MULLANEY: The formation of Control Data.

NORBERG: Well, that's one consequence, but how about consequences inside the company?

MULLANEY: I would say increasing dissatisfaction. Had Thornton Fry entered the picture by that time? That was a big problem.

NORBERG: Why?

MULLANEY: Because we felt that Thornton Fry was hired to police us. He was not well accepted. We regarded Marcel Rand as being a light-weight and Thornton Fry as being a hatchet man. Thornton Fry came out to St. Paul and met with various groups and he had a very pompous personality. He lectured us, in effect, and so forth. He was not well accepted. He just didn't go over at all. He was always nice to me, but I really didn't like him.

NORBERG: And he had authority over the division as I recall?

MULLANEY: Yes, indeed he did. Norris reported to him.

NORBERG: Norris reported to him from St. Paul and Eckert from Philadelphia as I remember, and then there was some shifting around after that. What was Fry lecturing you people about?

MULLANEY: I think mainly probably on the theme of cooperation. I think we were still... and I'm sure he perceived it immediately -- Thornton Fry was not a stupid man, he was a very, very bright man -- and I think he saw that he had mavericks in St. Paul, he had mavericks in Philadelphia, and the thing was not playing. I think he was making an attempt to get it to play together.

NORBERG: I don't know whether you can answer this question or not, why not separate the products in such a way that there really isn't competition between the two? Was that not possible because of the personalities?

MULLANEY: I don't know. Maybe it was a question of resources, too. Maybe they couldn't afford to push the UNIVAC I as a commercial product and at the same time push the 1103, which had been renamed the Univac Scientific.

NORBERG: It seems to me eminently reasonable to separate out the military projects from the non-military projects.

MULLANEY: Oh yes, that's true. But with the Univac Scientific, which we were trying to sell, or they were trying to sell as a commercial product, it's true it was going mainly to military activities, but not completely. I'm not sure why the... We just didn't like anything about it, Arthur. That's all there was to it.

NORBERG: All right I'll stop that line of questioning. Was there ever any discussion that you recall about people

moving elsewhere, people moving to Philadelphia, people moving to St. Paul and so on?

MULLANEY: There was not much of an attempt to do that I recall.

NORBERG: In retrospect, would you say that that was a bad policy not to have done that, not to try to merge the two operations?

MULLANEY: Cross-pollinate or whatever? I don't know. They were so different and the people, they had collected a different kind of... We were different and I don't know whether it would have worked or not, I just don't know.

NORBERG: That's why I asked you...

MULLANEY: It was also hard to move people. Most of the people I knew would have been very reluctant to move to Philadelphia, for example. I just don't know whether it would have worked.

NORBERG: In the formation in the early years of Control Data then, what did you people feel you had learned from the UNIVAC experience that you either made sure you emphasized or made sure you didn't let happen in the new firm?

MULLANEY: Well, we felt we had learned how to build equipment that worked. I guess that was the main thing, and when we started Control Data we really didn't plan to build a computer and sell it as such. We felt we had learned to work with some of the military customers, we were going to try to get some of that business, but we didn't have any contracts. The main thing was we wanted to get the hell away. And we didn't really have a very clear idea of what we were going to do, contrary to what some people thought, including Sperry-Rand.

NORBERG: Who was the we? Who was the initial we? I understand that it was at least in two steps.

MULLANEY: It was Arnold Ryden and Byron Smith in my opinion. And it was hard, you know, it was hard... Again, you know, the elephant and the blind man. But that's... I think it was probably Arnold Ryden was the initial, but he was not... Apart from being the guy that got it going, he did not take much part in any kind of discussions about what we were going to do or anything of that sort. I think he was pretty much aloof from that sort of thing.

NORBERG: When did people start leaving the Univac division in St. Paul? And I don't mean just to form Control Data. I'm thinking of new companies that were established and I'm also thinking of people who just simply left and took another job?

MULLANEY: Well, Jack Hill left at some time in that era and when I asked Jack why he left he said he was tired of vast projects that took years and he wanted to work on some smaller shorter term things where you really saw something happen faster and so forth. I don't know what his other real reasons were. But he left. John Riede left, mechanical engineer. I'm sure there were others that left prior to that time. Some of the guys had already gone to Remington Rand as I mentioned before, but that was much earlier. I forget when John Coombs left, but that was quite early in the game, too. John went to IBM. So people had been trickling out over a period in time, but the big exodus was after the formation of Control Data.

NORBERG: When did Midwest Technical come in there?

MULLANEY: After Ryden left Control Data.

NORBERG: It's after that?

MULLANEY: As far as I know.

NORBERG: Okay, I'm not clear on the date. Because what I was trying to separate out in my mind there was whether Drake was with Midwest Technical at the time that he was helping to finance the new Control Data?

MULLANEY: No, no, no.

NORBERG: He was not.

MULLANEY: No. That was... Drake left Control Data very shortly after Ryden did or at the same time, I'm not sure, because he and Ryden were quite close, and Midwest Tech was after that.

NORBERG: If Ryden and Bryon Smith are the first we, how did you become involved with that group?

MULLANEY: They asked me to have dinner with them one night at the Minneapolis Athletic Club. And they told me that they were thinking about how nice it would be to start a company and get it publicly financed. Ryden said he knew where he could get \$200,000 in one chunk, and that sounded like big money to us then, and that we could raise money from other sources and start a company and was I interested. They did not at that time say that Norris was interested, so I don't know whether Norris had or had not been approached at that time. Since I knew this would get back to Norris, and I was working for Norris at the time, I told Norris after this meeting that I had been approached but that I had told them that I wasn't interested at this time and to go ahead and to plan this without me. And he was very noncommittal as he can be, and he says, "Okay, thanks for telling me about that." He did not say to me either that he had been in touch with them or that he was or was not interested. Then that sat for some months, several or a couple or I forget what, not too many months, and Norris called me one day. By this time I was reporting to Bob MacDonald, I think. Norris had reorganized the division, and he said to me, "I'd like to have lunch with you at the Criterion." So we went down to the Criterion and he said that he had given it a try, he had given it a fair try, and boy, he was ready to hang it up and was I interested in the thing I had mentioned a couple of months ago. So I said yes, I was interested. And we talked about it.

NORBERG: You were because Norris now was interested or you had thought it over in the mean time?

MULLANEY: Probably a combination. I would guess that maybe... I guess maybe the unhappiness had continued and also I felt that maybe there was enough, enough steam had built up to make this a feasible thing to do. So certainly Norris' being interested had a lot to do with my interest.

NORBERG: Did Norris tell you about anyone else who was going to be interested?

MULLANEY: I don't recall. I don't think so, but I'm not sure of that.

NORBERG: Because Norris... When did you resign from UNIVAC?

MULLANEY: I just happened to have brought a scrapbook that my wife kept that will help some of those things.
July 26, 1957.

NORBERG: All right, as I recall, that's the same date that Norris resigned?

MULLANEY: Right. That's the same announcement.

NORBERG: All right. Fine. But people like Seymour didn't leave until September?

MULLANEY: Yes, that's correct.

NORBERG: So does that suggest that Seymour and several others like Thornton were not involved in the original discussion?

MULLANEY: Probably not involved in the original discussion, although I'm sure when any word got around... So many people came to me at that time expressing interest, people that we weren't prepared to feed, we really had a hell of a time fending people off. Contrary to what Sperry thought in their law suit that we were going out soliciting

people, we were fighting people off. I immediately started, as soon as I resigned, a file of applications and when somebody would say they were interested, I'd say well, okay, we don't have anything to do, but let me get you on record and then we'll keep it on file. So we had a whole cabinet full shortly...

NORBERG: Was there a certain group that you thought would be a necessary nucleus for this new company?

MULLANEY: Oh yes. Oh yes.

NORBERG: Can you tell about those?

MULLANEY: I might have a different list from what somebody else might have. The people I thought we needed were Seymour, Zimmer, Kisch, Thornton, Bob Perkins. There were other people I was happy to have, but I didn't think were that essential.

NORBERG: Do you think these people were actively recruited?

MULLANEY: No. I think it was... I think it was spontaneous combustion, really. The interest, when people found out that this was being planned... You have, you just have no idea that people were so... For the most part, the idea of getting into a brand new company appealed to them very, very much and there was no recruiting. In fact, after this resignation, they asked me to stay. Thornton Fry asked me to stay around a couple of weeks, and MacDonald wanted a report on something that they were thinking of going into and so forth. And Fry said, "Will you tell me that there won't be any recruiting while you're around here?" I said, "No, there won't be any recruiting," and people kept stopping me in the hall.

NORBERG: Well, let's go back to 1957, the middle of 1957. What is it you saw as the prospects in the industry that were not being fulfilled by either UNIVAC or the industry at large at the time, that you people thought you could fulfill?

MULLANEY: We felt I think that our hands were being tied. We felt that we were being saddled to a management that didn't understand the business. We didn't like the edicts from on high that didn't seem to have, in our view, much relationship to anything sensible. We didn't like being part of a big company. That was the main thing. And of course it got ironic later as things grew, but the main thing was we just didn't like being part of a big company and a lot of the things that went with that. I don't think we really saw ourselves as doing anything fantastic. I think we saw ourselves as doing what we liked to do and had done successfully building special equipments and satisfying some customers with it.

NORBERG: I see, rather than trying to approach a broader market.

MULLANEY: That's right.

NORBERG: When did that all change or did it just sort of creep up on you rather than change?

MULLANEY: It changed because we couldn't get any jobs. The concepts changed. In 1958, early '58, we were in a pretty deep recession as I recall and there weren't a lot of government contracts being let. We had some people working. We had enough money to keep it going at a low level. Really, the idea came from Seymour. Seymour was tinkering in the lab. We set up a little lab. We came in at night and we put together the benches because they were cheaper that way and so forth. We didn't even have a quarter inch drill -- Perkins brought his drill in so we could get these things put together and so forth. By that time Seymour was with the company and he was working on some new transistor circuitry. The idea being anything we were going to build was going to be digital, we'd need computer circuitry and he might as well go ahead and design some standard circuits. Well, in addition to doing this, he designed a very good circuit that used some very ordinary transistors that we could get cheap. At the same time, he was working on the logic of a new machine.

NORBERG: Just for the hell of it?

MULLANEY: Just because that's what he does, you know. He had all the Boolean equations and so he came to us and said, "Look, we don't have any jobs anyway, why don't we build a computer?" And I believe maybe he had even built a prototype of a little machine, a little one-character wide machine called Little Character at that time, built out of this circuitry to show the feasibility of the circuitry. So we agreed that that was a good thing to do, that this might sell. Shortly after that I think we got the Bureau of Ships interested and I don't know at what time, but we did get a contract for this machine eventually. But before that time, we had cut salaries and that kind of thing to conserve the cash.

NORBERG: And this machine was the first 1604 that was constructed?

MULLANEY: Yes, right.

NORBERG: Do you remember how many 1604s were manufactured?

MULLANEY: No, I don't. Quite a number of them.

NORBERG: I think I'm going to stop if right there, Frank, because... (Pause)

MULLANEY: Somehow it wasn't... You know, as I look back on it, that management [Sperry-Rand] couldn't do anything that we liked and I'm not sure why.

NORBERG: Even building a new plant didn't provide the kind of encouragement?

MULLANEY: No, no.

NORBERG: That is strange.

MULLANEY: All my projects were in the old plants and the plants around there so that new plant didn't mean anything to me. But it should have been sort of an encouragement to us, but I don't recall that it was.

NORBERG: Do you remember the other companies that were founded by people who left? Like Ramsey Engineering, and those firms. Did that somehow encourage the possibility...

END OF INTERVIEW