UNIVAC CONFERENCE

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Organized by the Charles Babbage Institute, the Smithsonian Institution, and Unisys Corporation

Conducted

17- 18 May 1990

Smithsonian Institution

Washington, D.C.

Charles Babbage Institute
Center for the History of Information Processing
University of Minnesota, Minneapolis

UNIVAC Conference
17-18 May 1990

PARTICIPANTS

Armand E. Adams
Dorothy P. Armstrong
Lancelot W. Armstrong
Jean Bartik
Lee S. Carter
M. Paul Chinitz
George Danehower
Eugene L. Delves
Donald B. Dixon
Carl Hammer
Frances Elizabeth Holberton
Morgan W. Huff
Florence K. Koons
Donald W. Marquardt
H. W. Matter
Jean E. Sammet
Joseph E. Sberro
Cecil M. Shuler
John K. Swearingen
Albert Tonik
Louis D. Wilson
Frances B. Woltman
Richard D. Woltman

Session 1 -- UNIVAC Customers and Sales
Moderators: Bernard A. Galler, Robert F. Rosin

Session 2 -- UNIVAC Technical Issues
Moderators: Henry S. Tropp, Robert F. Rosin
Questions & Answers Moderator, Paul Ceruzzi

Session 3 -- The Data Processing Marketplace, 1950-1956
Moderators: Michael S. Mahoney, Arthur L. Norberg
Questions & Answers Moderator, Arthur L. Norberg

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The introduction of the UNIVAC computer is among those subjects in the history of computing that has received wide attention. The issues and sequence of events leading to the development of the UNIVAC have been covered in such writings as Nancy Stern's *From ENIAC to UNIVAC* and Herman Lukoff's *From Dits to Bits*, and was the subject of the 1981 AFIPS Pioneer Day. However, less attention has been devoted to the place of the UNIVAC from approximately 1952 to 1956, after its initial development. A two-day oral history conference was convened in May 1990 to examine the role and effect of the UNIVAC on computing and the computer industry in the mid-1950s.

The meeting involved over twenty-five engineers, programmers, marketing representatives, and salesmen who were involved with the UNIVAC, as well as customers who had worked with the machine. Many of these persons were key to the development and use of the computer, although this was the first time that most had been part of the historical analysis of the UNIVAC. Of particular note was the attendance of individuals from General Electric and Arthur Andersen. Both firms were early purchasers of the UNIVAC and had an important influence on the sale of UNIVACs to other businesses. Also represented in the group was the U.S. Census, which purchased the first UNIVAC from Remington Rand.

The conference was organized and supported by the Unisys Corporation in concert with the Charles Babbage Institute (CBI) and the Smithsonian Institution. Anne Frantilla, corporate archivist for Unisys, was responsible for developing the conference and bringing together the participants. The Smithsonian hosted and recorded the conference. CBI undertook the production of this transcript, and has added the audio tapes to its oral history collection.

Editing of this transcript has been minimal. The text was altered only when an exact transcript of the spoken word did not adequately convey the intended meaning. More substantive changes and editorial remarks are enclosed in square brackets ([ ]). Also note that "UNIVAC" (all caps) conveys the computer, and "Univac" generally means the Univac Division of Remington Rand, later Sperry Rand. The editing of this transcript is unlike other oral interviews conducted by the Charles Babbage Institute in that participants were not given a chance to review their comments. The number of participants simply made CBI's standard practice infeasible. However, John Swearingen and Frances and Richard Woltman graciously agreed to review the transcript, and most of their recommendations were incorporated in the final transcript.

Bruce H. Bruemmer, editor

UNIVAC Conference
May 17, 1990, 10:00 a.m.

SESSION 1

GALLER: Well, thank you very much everyone. We are, in fact, on the tape now, I believe. First we will go around the table and ask you to say your name and what your role was at the time of the period that we are talking about. One of the main reasons for having you say something is to identify your voice, but also we'd like to know who you are. I'm Bernie Galler and, what was I doing back then? I was in college. [laughter]

UNIDENTIFIED: Could you amplify what the time frame is you're talking about?

GALLER: We're talking roughly 1951 to '56. We'll go clockwise.

ROSIN: I'm Bob Rosin. I was younger than Bernie, and also in the university.

SWEARINGEN: I'm John Swearingen. I was hired by Roddy Osborn in 1953 at Louisville -- Major Appliance Division -- to work on the computer project at General Electric.

SHULER: I'm Cecil Shuler. I was a Remington Rand tabulating machine salesman in Nashville, Tennessee at that time.

ADAMS: I'm Armand Adams, better known as Army. During this period I was a little bit in transition. I was, at the beginning of the period, working for the U.S. Army Ordnance Corps in anti-aircraft fire control design. When I left there I went through a series of [companies]: a small company of my own; Beckman Instruments, who bought my company, then a company called Leeds [?] and Northrup. I was hired by Jim Wiener in 1958 as the administrative assistant to him. I was chief engineer at Eckert-Mauchly.

CERUZZI: Hi, my name is Paul Ceruzzi. I was around back then but I don't remember too much about it. [laughter]

HUFF: I'm Morgan Huff. I came to Eckert-Mauchly in June of 1950 as a computer programmer. Then in 1953 I went down to Louisville and joined the GE folks -- John Swearingen and Arthur Andersen and folks -- and helped them get going on their payroll. Then I went to Pacific Mutual in Los Angeles, and there had a love affair with PM, as we called them, and with Arizona Public Service, and a service bureau in Los Angeles.

CHINITZ: I'm Paul Chinitz. I joined Eckert-Mauchly also in June of 1950 as a programmer until 1953 when we moved from Philadelphia to New York to set up the national sales office. I became director of training [at that time].

WILSON: I'm Lou Wilson. I joined the group that later became Eckert-Mauchly, which was initially called the Electronic Control Company. I joined them in October of 1946, and I had previously worked with both John and Pres[1] during the summer of 1941 when they met each other at the Moore School. At the start of the period [under discussion] I was a project manager in engineering, and at the end of the period I moved from engineering into marketing.

MARQUARDT: I'm Donald Marquardt. I was with the Du Pont Company beginning in early 1953 prior to the delivery of the UNIVAC at Du Pont in 1954. I did technical computing applications in the engineering department during that early period.

DANEHOWER: I'm George Danehower. I went to work for Eckert-Mauchly sometime in 1950 -- I don't remember the month. During 1950, '51, and '52 I worked as a programmer, but primarily with Lu Harr in responding to different customer inquiries, and giving presentations. In 1953 I was sent by Remington Rand to Springfield, Illinois as the on-site representative at the Franklin Life installation. Then in early 1954 I left Remington Rand and joined Arthur Andersen and was immediately assigned to the GE installation where I remained until it was completed.

[1] John Mauchly and J. Presper Eckert

GALLER: Okay, thank you. I guess the first question we might start with is, what customers were in fact considered the appropriate targets for the UNIVAC? What kinds of customers did you think would be using the UNIVAC and would be good to start with? Please don't hesitate to jump in.

HUFF: Well, as I recall, we looked at the fifty largest companies in the United States and we figured that maybe we could sell fifty of those people. So you're looking at the Met [Metropolitan] Lifes; you're looking at US Steel; you're looking at all of these large companies with a lot of work going on. And, really, those were the targets.

GALLER: Did you think of them as scientific or commercial, or didn't you care?

HUFF: Didn't make any difference.

GALLER: You thought you could sell to either kind?

ROSIN: For commercial computation, or for scientific?

HUFF: Either one. The UNIVAC had the tape input, for example, where it could handle large volumes of data. Also, we had a pretty fast processing machine. And so, we thought we could satisfy the [needs of both commercial and scientific applications].

ROSIN: Was it expected that your first sales would in fact be to the government? How long did you think it would take to get into the commercial marketplace?

HUFF: Well, you know, we had the first four government contracts. But I'll pass that on to Lou.

WILSON: Long before we sold the machine we had a development contract from the Census Bureau to demonstrate the feasibility of some of the major components. This included a tape servo mechanism, a memory device, a printing

device, a device that would input information from a keyboard, and read information out, and operate a typewriter. Those were demonstrated. The demonstration devices were not the devices that were used in the ultimate system, but they demonstrated an approach that could be made to work.

ROSIN: What year was the demonstration? Do you recall?

WILSON: The contract, I think, was signed in either 1947 or '48, and the demonstrations were in late '48. In fact, there was a very interesting anecdote. One of the demonstration pieces was a demonstration decimal adder, in which you set two banks of switches, and then set the answer in a third bank of switches. If the machine disagreed, a light would light. In the first demonstration something went a little bit wrong. Pres Eckert was busy demonstrating it and the error light went on. He immediately flipped a switch and said, "See, if I flip a switch the error light goes on." [laughter]

DANEHOWER: As Mo indicated, the larger companies were the target. However, that sort of implies, I think, that there was an organized campaign to enlist and sell those customers. I don't really think that actually happened. I think what happened was that as the word got out about the UNIVAC, the inquiries started to roll in so that the majority of our time was spent answering inquiries as opposed to going out knocking on doors. Now, that's from my perspective. I was a programmer and I was helping [to] answer some of the inquiries. Now, Mo, maybe you can modify that somewhat.

WILSON: To go back even earlier... When the logic of the machine was still being worked out [as were] the definitions of what the machine was to be able to do, there were a couple of customers who took an active part in meeting with some of our staff and doing planning. Two of those, as Betty just pointed out to me -- helped my memory a bit -- were Prudential Life and A.C. Nielsen. The reason Nielsen did not ultimately buy was that the early machines were all committed and they couldn't get one in time to serve their purposes.

GALLER: Who initiated the contact with Prudential and Nielsen? Did they come to you or did somebody seek them

out?

WILSON: Betty, do you know?

HOLBERTON: Ed Berkeley was secretary of ACM [Association for Computing Machinery]. He was also working up there at Prudential, and there was enough contact around to know that... A.C. Nielsen was also attending ACM meetings in Aberdeen, so the word was getting around.

CHINITZ: Well, the society of actuaries had a committee to study, at that time, the new recording media and computation media that was active.

ROSIN: Okay, what time was this?

CHINITZ: The first report that I remember came out in '53, though I think that the study started much earlier than that.

ROSIN: I'm getting confused [about] time here, because Mr. Huff is telling us about commercial contacts, and at the same time Mr. Wilson is making clear that there was initial government sponsorship, at least in development studies, and I guess initial contracts for the first few machines were with the government.

WILSON: The first four machines, certainly, were all government. I'm talking a bit earlier than Morgan is talking. I'm talking late '40s. He's talking early '50s. The question of who solicited whom... When Remington Rand bought Eckert-Mauchly in 1950, we had already developed plans for turning out one machine a month. They reviewed these plans and said, "You're crazy. Nobody will buy twelve of these machines a year." So they immediately cut back the production planning to six machines a year instead of the twelve. The total sales force consisted of two people -- Dave Savage in New York, and Luther Harr in Philadelphia. Not only that, as Cecil Shuler can tell you, there was no mechanism for paying any commission to sales people in the sales offices if they sold a UNIVAC. He came to New

York with a signed agreement in his pocket, sat down and said, "When you tell me what my commission will be I'll give you the order." [laughter]

GALLER: Did that, if fact, start the...

SHULER: That's pretty much the way it was. I brought in a fellow by the name of Bill Cunningham, who had been with Prudential earlier and had come to [?] Life and Casualty as a consultant. Between the two of us we had put together their program. When I had their signed contract in pocket I in fact did go and sit down in front of Luther Harr's office and ask for an appointment with John Parker, who was then the vice president and general manager. He had said, "Well, John's awfully busy right now. Tell me what you have got... what you want to see him about." I said, "Well, I want to talk to him about commissions." And he said, "Well, you know, when people get around to selling computers like that we'll probably have a commission program." I said, "I've got right here in my pocket a signed contract, but you're not going to see it until I get my understanding as to what you're going to pay me." Because at that time, Remington Tabulating Machine salesmen were getting 20% commission on the sale, I think, and this was a contract for $1,250,000. That was unheard of. [laugh] But the truth of the matter was that John immediately saw me. [laughter] He invited Mr. Cunningham and me over to his apartment, which was in the Gramercy Park Hotel -- the top suite there -- and met us with the Filipino houseboys and so forth. We had a royal reception. And from them on, why...

ROSIN: Did you get a commission? [laughter]

SHULER: Yes, I did.

GALLER: When you talked to a customer, who did you talk to -- the president, the vice president, the DP manager, the marketing...?

SHULER: Well, I always talked to the top guy -- the guy that could sign the order. In the case of Life and Casualty,

we started out with a fellow by the name of Paul Montcastle and Gilford Dudley, who were chairman of the board and president, and got their blessings on the whole program. They didn't say they would buy anything, but depending upon the output of the study, why, they had more or less agreed that they would be receptive.

GALLER: Did they understand...?

SHULER: No, they didn't understand. The fact is, I didn't understand. [laughter]

ROSIN: They already must have had data processing applications.

SHULER: Yes, well, I was their tabulating machine salesman. Fortunately, I knew more about what was going on in the data processing operation in that company than anybody else -- in their company, or anywhere else, really -- because I had worked with them for several years.

GALLER: What did you know about the UNIVAC?

SHULER: Well, I had initially only seen what I had seen in brochures. I started out at Remington Rand in 1942, so I had a bit of experience in selling data processing equipment. I had made enough money to say that I could afford to take a kind of sabbatical. I went to Paul Chinitz's first school in New York City. I went through the 001 and then the 002s. When I saw what we had there I came back and got the customer to send the fellow by the name of Cunningham that I had mentioned to the school. So, by being the outside guy [with an] inside man, we put together a recommendation to the company and that led to the purchase of the computer.

GALLER: Did you have formal training within the company about what the computer could do and what a computer was?

CHINITZ: The history, I think, of the marketing really breaks into two parts. From 1953 on, you had a national sales

headquarters in New York. That was set up with a training activity, a service bureau, and a sales support activity that did surveys, put together proposals, and made sales contacts with people. So, after 1953, when this training department was set up and advertised in brochures, and there was a fee charged, you got a lot of people coming in who, as my recollection serves me, were mostly in the middle or upper-middle management level that were familiar with the data processing requirements of [companies]. They took a two-week course on computers, which was a beginning course on programming the UNIVAC I and some system analysis work.

GALLER: Now, these were customers... people coming in?

CHINITZ: Customer prospects.

GALLER: What about the training of your own people? The marketing force?

CHINITZ: The marketing force... There were some that came in, but mostly none.

SHULER: There were about fifteen people in all of Univac (or Remington Rand at that time) who were part of the field marketing organization. They took a training program that was the same as was given to programmers. As a matter of fact, when we went back to try to select programmers within the organization, Bill [Cunningham] and I had to run a screening program of the people in the company to try to select out of the candidates (which in the case of Life and Casualty we said, "Anybody can be a candidate for a programmer of this system").

GALLER: What were your criteria for selection?

SHULER: First of all, interest. They expressed interest in becoming a programmer. Between Cunningham and me, we ran half day programs each day for probably six or eight weeks (I'm not sure how long now). But out of 130 people we ended up selecting about fifteen or sixteen people who showed the most aptitude towards programming, because what I conducted was my equivalent of 001 and 002 training class. I wasn't a programmer, but I learned enough about

coding to be able to communicate.

DANEHOWER: Prior to 1953, as I think you have already indicated, there essentially was, as I recall, no sales staff or concentrated marketing effort. In answer to your question about who we talked to... at Franklin Life we talked to Dick Dotts, who I believe was financial VP at the time. Is that right?

HUFF: No, he was... at Pacific Mutual...

DANEHOWER: I mean Pacific Mutual, I'm sorry. At Franklin there was Al ? [Danslowe (?)] who was VP [of] finance. But even there my recollection is that the potential customer was the one that contacted us as opposed to our contacting them initially.

GALLER: What was the cause of the transition from this ad-hoc, two-person, informal activity to the fifteen people that Cecil mentioned?

DANEHOWER: I can't answer that because I had moved to Springfield and I was sort of out of the mainstream.

SHULER: Well, there had been no training program -- nothing in the field. Remington Rand had a tabulating machine division, and we were the only people that had any field experience in selling automated systems. It finally became clear, I think, to someone at Remington that they should have some people in the field who knew something about the UNIVAC system, if nothing more than to be able to handle inquiries on a local basis. At that time they really didn't think that anybody in the field was going to handle...

CHINITZ: They weren't even authorized.

SHULER: No.

CHINITZ: The tab group in Remington was a different organization from the Univac marketing department. They were on different floors; they had different management.

WILSON: I wonder if any of you are aware of how Remington Rand acquired Univac in the first place. Univac was being funded by an outfit called American Totalisator. And the president of American Totalisator, who was the only one in his organization who was really interested, was killed in a plane crash. At that time his colleagues wanted nothing more than to get out of their investment as quickly as possible. They looked for a customer. Remington Rand had acquired a company named Rodick [?] Rubber Company, which made the platens for their typewriters and rollers for the card feeds and so forth. The president of that company was a man named Arthur Draper. Arthur Draper (I have a picture of him right here) was a special assistant to Mr. Rand, and he persuaded the organization that there was something to buy here. Having acquired it, they really didn't have the vaguest idea what to do with it. [laughter] There was no one in the organization that really understood. In fact, there was a very interesting little event. Mr. Rand came on a tour to see what he had acquired. One of my responsibilities was the Uniprinter -- that very fast printing device that was shown to you a while ago. [laughter] I programmed the Uniprinter to print out a description of what it was doing. Mr. Rand looked at it and said, "That's very interesting, but why is that an IBM typewriter?" [laughter] Whereupon we explained how we had arrived at the IBM typewriter, that it simply seemed to hold up better. [laughter] Somebody cried, "Take that label off that machine! I don't want it seen here!" And Fraser Wells got a screwdriver and pried the label off. You may still be able to find an IBM typewriter without a label nameplate somewhere around. [laughter]

BARTIK: There is something I would like to say. I'm Jean Bartik and my husband took a job in Washington, and I had done logical design for UNIVAC I. Rem-Rand had just bought Univac so they decided they should hire me to work with their sales force in Washington, which they did. Well, they didn't know what to do with me. In fact, they called me on committees. Generally, the attitude in Washington -- in the Washington sales force -- was that Eckert and Mauchly were a bunch of dreamers and didn't know what they were talking about. Anyway, they decided to use me to get entree into government agencies to sell typewriters and other things. I used to go out and describe UNIVAC and then they would hustle me out of the room, and then the salesman would sell them typewriters.

[laughter] Lo and behold, they had a Kardex system with the Aviation Supply Office for the Navy. They were about to throw them out and get IBM machines. They decided, well, maybe the UNIVAC could save this installation. That's the first practical job they ever gave me to do -- a flow chart for the inventory control problem for the aviation supply office. They gave a presentation to these people and they went ape. I mean, they had never heard of anything so exciting in their lives. That was the first group in the Washington area that really got enthusiastic about the UNIVAC, because these were the lieutenant commanders and the guys that really didn't work for the Navy. That was the first practical thing that they ever did out of that Washington office.

CHINITZ: Can I follow that up, Jean, because I did work on that. The next step in this early period before 1953 was, after an interest developed in the customer prospect, to prepare a demonstration program. Usually that demonstration program involved some critical aspect or some significant aspect of the proposed problems or applications. So, the group of programmers at the Eckert-Mauchly plant in Philadelphia mostly were involved in preparing the demonstration programs. This would involve two or three months of programmer work -- two, three, or sometimes more programmers until you developed an application that generally was several runs on the computer. Then you would call the customer or prospect group up to the plant here and you ran a demonstration to show this computer really could do the job. From then on, if the demonstration was successful, you would approach them for a contract.

ROSIN: How long did a demonstration run? You said three or four runs on a computer. What was a typical customer visit like, or prospect visit like, in those days? They came in the morning and...

CHINITZ: You scheduled the time on the computer, which was mostly on the Census Bureau system that was still set up at the plant. The demonstration all together might run for an hour -- the computer was not running all the time because you had a lot of tape reels to change and to set up. You printed out results, which before 1953, or 1954 actually, came out on the electric typewriters, which was generally a disastrous experience. [laughter]

HUFF: Talking about disasters, several here may have recalled the demonstration that we gave to the Navy there in

Philadelphia. We lost all of the input tapes. At that time we were having trouble with the reading and writing on our servos. We had this big magnet that we'd clean all our tapes with to make sure that when we wrote something on it that there wasn't anything dirty on the tape.[2] Well, unfortunately, all the inputs to this demonstration for the Navy were erased about fifty minutes before the admirals came in. The admirals all came trooping in, and Herb Mitchell put a sort routine on the computer. It moved a lot of tapes [reading data] in and out. And Herb would describe, "Okay, here's your inventory control coming here. Here's your answers coming out." Fortunately, we had saved output from a lot of the [trial] runs before the demonstration. So we finagled those tapes -- took those tapes and printed it. But this is one of the first times you really had a demonstration bomb. And it bombed!

GALLER: Now, you just used up one of our anecdotes for tonight. [laughter]

WILSON: To give you an idea of the kind of stone wall you ran against when you tried to talk to people in sales, I think you might better understand... When we were putting together the Census Bureau machine we hired a guy who had experience of assembly of electronic equipment -- quite a bit of experience -- to handle the management of the actual construction of the equipment. After he had been there a couple of months, I was talking to him and asked him how he liked the job. And he said, "It's the most difficult job I have ever had in my life." And I said, "Why?" And he said, "Well, you characters don't have enough sense to know that what you're trying to do is impossible." [laughter]

DANEHOWER: To extend those anecdotes just a bit... It seemed over time that the more demonstrations that we gave we kept encountering more minor disasters. So, it later on became common practice during our tests of the demonstrations to save the final printer output tape, because that was the highlight. In other words, you would take that tape to the printer and [produce] the prospective customer's output -- you know, his name, the things he knows about. We would always test [the final program] to make sure it ran, but somebody would make a modification in one of the programs and then it wouldn't run. Anyhow, we would always get a good output tape -- printer tape, put it on top of the servo, run the demonstration, and if something [went wrong] we would put on a sort, and then at the end,

[2] That is, the tapes were erased to ensure that all previous data had been removed.

instead of taking the printer tape off the servo, we would take [our reserve output tape] off the top of servo over to the printer, print it and it was beautiful. [laughter]

GALLER: Now, let's ask the customers. [laughter]

UNIDENTIFIED: We believed it.

GALLER: What were your expectations? We have some people representing customers here. What were your expectations of the UNIVAC? What did you think you were getting besides a demo tape that printed?

SWEARINGEN: I didn't go to any of the demonstrations, but once we had [our computer] we were running demonstrations all the time. And I have to say the demonstrations were disastrous. The ones I remember were always a disaster, and I don't know if there were any that worked well. We improved the procedure for demonstrations by, as George says, doing it in advance. We would save every step out of every run and set them on the top of servos because we knew that we were going to have failures. The operators then would just pick up the one that had been prepared before. Demonstrations made the computer nervous [laughter], especially servos. You know, strings would break; operators would drop loops down in the air columns. You just could not get through a demonstration with people watching. The expectations of General Electric were (and it's unfortunate Roddy isn't here because expectations were one of the few things I remember talking to him about)... Roddy Osbom sold the UNIVAC at General Electric. One of the things he would do was paint the picture of doing payroll. He would say, "Name one of the paymasters." Well, there was only five of them. He said, "I can see Joe Vogel bringing his time cards in and putting them through this window and 20 minutes later we hand him checks." After a little while it dawned on me it was not going to be done in 20 minutes. I said, "You've got to make it longer." Well, the first run took (in good time, not elapsed time) 44 hours to do weekly payroll. But our expectations were that we would get payroll done, not in 20 minutes, but in some brief time, that it would be much less expensive than anything that we had done before. The second thing that we had in mind was that we would do factory inventory control to reduce material in the factory, reduce the need for raw materials stacked up in the factory, and to keep track of material as it went through the

factory. That was just an impossible job [without a computer]. Our intentions were that we would use the computer to do what could not have been done before.

ROSIN: And did it succeed?

SWEARINGEN: Yes. A footnote; one of the reasons that I have always felt that the General Electric installation did not get credit in those early days was that the material control system was so good that the General Electric managers would not let us go on a lecture tour to talk about it. They said, "This is an advantage that we do not want to pass out."

ROSIN: Can you describe a little bit of the political, cultural climate in General Electric prior to and then during the push to bring UNIVAC into the company and what had to be overcome? What was difficult, what was easy?

SWEARINGEN: In 1953, General Electric was finishing up the construction of Appliance Park in Louisville. It was a factory, or a series of factories, that they invested $300,000,000 in the 1950s, which might have been something like the annual revenues of the company -- an enormous investment. I joined them at that time. Roddy Osborn hired me. He was the person in charge of procedures or some title like that. It was his notion that with this gigantic new factory that had been built so that GE could get away from its ancient, outmoded factories all over the east, to bring new factory technology to bear, the offices ought to have new technology. He hired me because I had experience working on IBM tab equipment. I joined a staff of about fifteen people, and I was the second person that had any tab experience on that staff. He immediately sent me out to Appliance Park, where the factories were under some stage of completion, to join Harold Hamilton, the other guy with tab background, in installing a punched card payroll for the Home Laundry Division. When we finished that, that was the first punched card payroll in that division and maybe in General Electric. I do not want to say that, but it might have been. So that's the climate. GE just knew nothing about business automation -- no experience in it. Once or twice in my tours in the payroll offices we would talk about it and they would tell me about some facility elsewhere in GE that tried it and threw it out. You always had the feeling when they said "threw it out," the machines were pitched out a window or down a stairwell. They were very inhuman

about it. The people I had talked to in my preparation for payroll - clerks and timekeepers, etc. - were always very tolerant and courteous to me, but they just looked upon me as another aberration from headquarters that had to be tolerated for a while and that would go away eventually. I did not interrupt their work and [get in] their way. As I say, they were very courteous but there was no confidence that anything was going to happen. It was just another pipe dream.

GALLER: How was payroll done before the punched card system, and whose punched card equipment was in fact being used then?

SWEARINGEN: Payroll was done with pencil and paper.

GALLER: Literally by hand.

UNIDENTIFIED: On ledger.

GALLER: Okay, fine. I think we tend to overlook some of this.

CHINITZ: With a very complicated payroll you had group incentives, which was one thing that made the computer application so large and difficult. It involved far more instructions than one anticipated.

SWEARINGEN: The General Electric Appliance Park factory payroll consisted of people who... It was an incentive payroll, and people might work together in a group as an assembly line. They all had individual rates, but the rates would be impacted by the efficiency of that assembly line, in which they all participated. Then there would be people who were operating presses who were paid basically by the parts they pushed through the press [i.e., 2 "piece rate"]. Of course, then there were all the peripheral payroll activities -- what you got paid if the press wasn't working, hourly rates, and so forth. As you say, it was a very complex payroll.

WILSON: To help some of you younger folk get a feel for how different an approach was being brought up here, you asked earlier, "Who did you talk to, the data processing manager, or vice president?" There was no such thing as a data processing manager. There was no such thing as a data processing department in 99% of the [companies] you talked to. If they had anything, they might have a tab division that used tabulating equipment, but even those were not all that widespread.

GALLER: Okay, whose tab equipment was in most of these places at that time? Was it Remington Rand, or IBM, whatever?

SWEARINGEN: There was none at General Electric.

SHULER: Back in the 1950s I was in the tabulating division -- a salesman. In Nashville, Tennessee we had an equal number of installations of tabulating equipment, as did IBM. They really hadn't started taking off into the big penetration in the tabulating machine market until about that time.

GALLER: What do you mean, equal numbers?

SHULER: I mean installation for installation. I had an installation in Life and Casualty and they had one in National Life, for instance.

UNIDENTIFIED: Square holes versus round holes.

UNIDENTIFIED: Well, I know that.

MARQUARDT: Perhaps I could chime in at this point and run through a parallel commentary on both my experience and the experience at Du Pont. I had come to Du Pont early in 1953 after a couple of years at Camp Dietrich in the Army. At Camp Dietrich I had had experience with Remington Rand tabulating equipment and with some of the early

Remington Rand electronic calculators that were attached to tab equipment. But when I came to Du Pont, I started at the engineering department, and at that time the chief engineer of the department was Granville Reed. He was a far-sighted, strong leader of the engineering function and the technical function of the corporation. He and some of the men who reported to him had a vision that perhaps these new, electronic computers that were being talked about so much might be a factor in the future in technical work and in engineering work. Although I was, of course, young at the time and was not privy to the inner circles of the planning, nevertheless the posture that I perceived was that he made, more or less on his personal initiative, a decision that the company should acquire one of these new devices as an investment and learn what it could do in engineering project and technical work. So the focus for the UNIVAC in Du Pont was on technical applications, not on commercial applications. We did have elsewhere in the corporation a large battery of IBM tabulating equipment that I had occasion to use also during this same period for commercial work. When the UNIVAC was brought in, a fund was set aside to provide money for a whole series of new groups that were formed -- a group in statistics, a group in project engineering concepts, a group in mathematics, a group in economic analysis, and things of that sort.

So, new supervisors were appointed, and these people set off to learn what they could do. During that early couple of... several years, a number of new things were developed. One of them was a procedure for statistical analysis of data which subsequently was published in a magazine called *The Programmer* that Univac put out. I have an example here. In it is described some of the contour plot programs and so forth that were developed on the UNIVAC. In my own case, I was in our research division of the engineering department and I used the UNIVAC primarily for technical applications. A principal one was a highly unstable differential equation -- a series of such equations that I was working on with a co-author, Bernard Coleman, who later went to Carnegie-Mellon University. We published a series of papers in that area. We were particularly focused on things like numerical analysis. How do you solve a differential equation numerically without having the whole calculation blow up on you because of instability of the algorithm? So we took advantage of some early work by Carr, which some of you in the ACM may remember, and others, and found the numerical solution to a differential equation for the breaking strengths of bundles of fibers on various kinds of loads. I also did some of my early work on non-linear estimation using the UNIVAC. One of the interesting anecdotes is it took well over five hours to do one of those runs on the UNIVAC for the unstable

differential equation, and almost as long for some of the non-linear estimation work that we were doing at that time.

Just a comment or two about the UNIVAC as a piece of hardware and its architecture from the point of view of technical applications, particularly statistical applications. A great deal of sophistication, I think, was present in the size of the word length, it being twelve decimal digits -- just a beautiful choice, I think, and longer than the word length of most other machines at that time or that followed not long after. It was just enough extra to prevent serious buildup of rounding error, and give good, solid results. Some of the competing machines doing the same kinds of problems got nonsense results just because the word length was not long enough.

Somebody was describing an anecdote earlier about the hardware. One that I remember was that there was a time when a repair man went inside the mainframe of the computer to do some repair and handled his screwdriver inappropriately. The net result was that one of the mercury tanks was out of commission. So, the machine was down for an extended period for a new memory.

GALLER: Interesting, because I think almost everyone of us knows of some situation with every machine where a screwdriver put it out of business. [laughter]

ROSIN: Can I ask you just a couple of other questions following up on what you were saying? Were any systems other than UNIVAC I considered at that time? How was a decision made, and did Du Pont approach Univac? Did Univac approach you? What was the process? I think that's something that today would be perhaps a little mysterious, ought to be amplified.

MARQUARDT: Yes. From my perspective there were a great many unknowns in that whole arena, because I was just too remote from the decision-making group to know for sure. But I can comment that at that same point in time there were in the engineering service division, which was the center in which the UNIVAC was located organizationally in one building of the Wilmington area -- the Demours building -- there were services that went to the whole corporation in the field of technical and project engineering. About twelve miles away at our experimental

station where the research division [unintelligible] was located, to which I was organizationally attached. There were other people who were highly interested in the new computers. Quite parallel and somewhat earlier, about a year earlier, we acquired an IBM card program calculator, of which I was put in charge. So, we did a lot of technical work on that machine and also on the UNIVAC. The focus in both arenas was to find out what these new computers could do. I would guess, from what I observed and heard at the time, that the initiative may very well have come from Du Pont, but I really can't say for certain.

SWEARINGEN: I think it is very unfortunate Roddy Osborn is not here, because that's an important question and he's the one who did it. If there is some way that he can be interviewed separately, I think it's just crucial to this whole history. It really ought to be done, because he is the man who brought the UNIVAC to General Electric -- no one else. I give no one else credit for that.

I would like to explain a little bit by giving my view of the background and culture at the time. I didn't have the same view of Univac or of Remington Rand that Cecil does. I caught up with punched cards in the Army in 1945. Every corps headquarters in the Army had a machine records unit that was in a semi-trailer: two key-punch machines, two sorters, a tabulating machine, punch machine, and a collator. They were all IBM. They were manned by soldiers. There was one soldier in that group, by agreement, who had a staff sergeant rating who was in the Army, a soldier, but he was also paid by IBM -- a former IBM employee. He was the maintenance man on that machine. That got IBM all over the government. I subsequently came to work in 1950 at CIA to install punched cards down there. That was an IBM installation. Remington Rand was looked upon with scorn. Anyone who even suggested it was an outcast. IBM got started up at Baltimore Social Security in the 1930s. Most of the people that you talked to in Washington in the 1950s who had had any experience with punched cards had started there. In the Depression they would go up there and get a job. It was IBM. Where I was, Remington Rand was unthinkable. The salesmen had a difficult time. When Osborn said he was going to get UNIVAC, GE just erupted. Those who knew anything about it said, "How could you go with that outfit? How did you not pick IBM?" And IBM erupted. [laughter] It was a courageous decision on his part.

CHINITZ: In that view, the first converters from punched card to magnetic tape, which was to be the entry of data into the UNIVAC, were the converters for IBM cards. And it was a number of years later before we ever made a Rem-Rand card-to-tape converter. But there were several factors, I think, to keep in mind in this period up to about 1953 on the marketing of the UNIVAC. First, the UNIVAC was not offered for rental. It had to be purchased -- a multi-million dollar purchase. IBM's equipment was rented. Except for life insurance companies for which purchase had a financial advantage and the government agencies where it generally didn't make any difference, I think most commercial operations there were concerned about spending several million dollars outright because that was then a capital investment. It had a different tax result than rentals where you could take it off as an operating expense. Second, the Uniprinter -- the electric typewriter output in there -- was completely inadequate for any commercial application. It was not until 1954 or early 1955 that we got a high-speed printer developed that would really handle [the requirements of] commercial applications. So in that period up to 1953 you had to content yourself mostly with those potential customers that did not require heavy printed output, which would have been scientific and some inventory control type problems.

ROSIN: I see.

GALLER: George has been waiting very patiently.

DANEHOWER: I think my point I was going to make has already been made, and that was that Cecil's experience in Nashville of the ratio of IBM versus Remington Rand at that time was not typical.

SWEARINGEN: No, I know it's not.

DANEHOWER: That was my main point. By far, IBM dominated the market.

WILSON: Just in reinforcing the same point. John's comments... after I moved into marketing I was the guy that headquarters brought in to try to answer the technical questions that people got stuck with. We had one potential

installation in the Army where we were talking to a colonel who was the guy who had to make the decision at the working level. His answer was, "Look, you have convinced me that your machine is what we ought to be going with. But if anything goes wrong and I've recommended UNIVAC, I made a mistake. If I recommend IBM and anything goes wrong, IBM made a mistake."

ROSIN: Do you think that was the first recorded time in history that that argument was made. [laughter]

UNIDENTIFIED: It was made regularly.

CHINITZ: Or they made the decision to go with the best that was available and couldn't be faulted if it went wrong.

MARQUARDT: Yes, I just wanted to reinforce that same perception by pointing out that it probably was not by accident that in Du Pont UNIVAC was acquired by the engineering department for technical applications where there was no prior history of serious computer or tabulating work. Whereas, in our treasurer's department there was a very heavy commitment to IBM equipment, and it would have been very unlikely that they would have gone that route. The treasurer's department was a party to the engineering research division's acquisition of the IBM 650 (a card program calculator) and shared in the costs and the use of that machine. That was easy because it was within the IBM framework.

SHULER: A question you asked earlier was, "What did the customer expect out of it?" I can speak from what I knew of Life and Casualty's expectations. Actually, the contract that we got from Life and Casualty was from a subsidiary called Electronic Data Services, a wholly-owned subsidiary that we had suggested they ought to set up because there wasn't going to be any way that Life and Casualty could make use of the full power of this one system. We got with their general counsel and we put together a subsidiary. Electronic Data Services actually purchased this equipment. They went around actively trying to market [their services]. We ran training programs for other insurance companies, for shoe companies, and so forth. Little did we appreciate once we got into it, of course, that it took two or three or four [computers for Life and Casualty work alone]. And, Mo?

HUFF: I have a paper before me written by Mr. Wesley Bagby, controller of the Pacific Mutual Life Insurance Company. He gave this address to the Controller's Institute of America in November, 1955. Let me quote a few things from his paper here: "Let me interrupt our chronology here to caution you on one important point. You cannot rely on the equipment manufacturers to give you too much help. First, they're prejudiced. Second, they already have so many live prospects that they're hard put to assign competent manpower to your problem. Third, and most important, they just won't have sufficient knowledge of your business. You will have to do most of the work yourselves."

They started in this game in September 1952 -- Pacific Mutual -- and they sent two of their people to programming school, I think early in 1953. In June 1954, they decided that they were going to get a large-scale electronic computer. They looked at IBM; they looked at a combination of large-scale and a combination of 650s; they looked at Datatron at that time. And finally, they made their decision. Let me quote again here: "There were three items of difference, however, which influenced our final decision. Remington Rand's UNIVAC could be leased or purchased outright. IBM's 702, which they were competing against, could only be rented. Second, UNIVAC, one of the specific models we were considering, had been thoroughly field-tested. The other, IBM 702, had not yet been used by any customer. Third, it appeared to us that UNIVAC had some technological advantages."

I do have some artifacts from General Electric. I have a run book for the group incentive payroll system. This is the actual coding of it. I have the program for the applications of an electronic computer system to material scheduling and inventory control. And I have what we call our "UNIVAC Programming Techniques." At General Electric we started early on to develop some programming standards. We did an awful lot of work, and this is the product of that. I know that I carried this set of programming standards on to Pacific Mutual, the Arizona Public Service, Life and Casualty, and I am quite sure a lot of other installations have similar or perhaps the same type of information.

A little aside on John Swearingen and the payroll system at General Electric: we finally got the system to work and we ran our first test of the entire system. In the original projection in a sales analysis of General Electric it was

estimated that the UNIVAC could do a 10,000 man payroll in four hours a week. We ran a test of 600 employees through this system for the first time -- 600 employees. 36 hours later we got through the final program and that is when I left town and I went... [laughter]

SWEARINGEN: That was not elapsed time; that was run time.

GALLER: I have a note from Gene Delves who says he can amplify on Swearingen's comments about GE management's reaction to the decision. Maybe it is a good time to invite...

HUFF: What's the question?

GALLER: His comments about GE management's reaction to Osborn's decision to select the UNIVAC.

DELVES: I am Gene Delves at Arthur Andersen. Arthur Andersen was engaged to assist in doing the feasibility study for the computer at General Electric in April of 1953. The report was delivered on July 15, and it recommended the UNIVAC I over the TBM, which was at that point the competing IBM machine. Just as Mo read in his report, some of the reasons were the same -- that the UNIVAC was superior in that it was a tested machine, the mainframe worked. It had lousy peripherals, but [improvements] were promised. On the other hand, the TBM never worked. In fact, it never really existed. It had marvelous peripherals, but there weren't any tested on the computer. So Arthur Andersen wisely recommended you're better off with a computer that actually has been tested than peripherals that work.

IBM put a great deal of pressure on GE management to not go with the UNIVAC I and used all the arguments that I am sure many of us heard: "You have to walk before you run; therefore you should put everything on punched cards first," which would give them time to get a computer out, and such things as that. So when Roddy made the decision to go with UNIVAC I, I know that he got a tremendous amount of heat from Schenectady. We know what happened at Arthur Andersen because one of the staff persons at Arthur Andersen in New York who was working

on his master's degree used the GE report as his master's thesis. It was common at Arthur Andersen in those days that copies of these reports were put in the libraries of all of the major offices. His professor thought it was such a marvelous thesis that he wanted it published. This poor guy was between a rock and a hard place, so he let it be published. Of course somebody at GE saw it and GE management was so furious because they were feuding with Roddy about this decision. So Arthur Andersen had to recall all those reports and burn them, and there are only two left in existence. As far as I know, there are still only two left in existence, and I have one. [laughter]

CERUZZI: I have a Xerox machine. [laughter]

GALLER: I have always thought that one evolved from punched card equipment to a computer like the UNIVAC. Were there, in fact, UNIVACs installed directly from manual systems?

MANY: Yes, at GE, Arizona Public Service, and several others.

SWEARINGEN: There were no systems; there were no machines. There was an installation in the Home Laundry Department that did payroll. That was one of six departments. You might say there was a little evolution there, but the other departments had no mechanization at all. None of the other initial applications had any forerunners. The material control system had no machinery on it. Sales was all done by hand: telephone calls, general accounting system. General accounting was mechanized on 3x5 cards which were sorted and run on an adding machine.

GALLER: Now, you talked about how often the machines went down, in the demos and so forth. What about the maintenance? Who did the maintenance? Was it any good? Did the customers have to provide their own? Did Univac provide good maintenance, or maintenance at all?

SWEARINGEN: Maintenance was done by Univac, a crew of about five at Louisville. It was constant fee.

UNIDENTIFIED: Constant fee?

UNIDENTIFIED: They were on-site, full-time employees.

SWEARINGEN: You would fail in the middle of a run, and you would call a maintenance guy. He would have to go in and plug in the scope and start pulling tubes. The 44 hour payroll... You just got the checks out in time to start the next one.

GALLER: Was that general experience that maintenance was always necessary?

SWEARINGEN: Reliability, yes.

CHINITZ: Maintenance people generally were assigned on-site, and were more or less permanently located there and weren't sent out from a central office on-call.

GALLER: Were they always maintaining, or were they...?

CHINITZ: Well, things got better. [laughter] I think in the early period before 1953 the reliability of the equipment was good; the answers were correct when you got them because UNIVAC self-checked [computation via duplicate circuitry]. But it went down very, very often. After the national sales office was set up in 1953, a maintenance organization was established, and it was drawn, if my recollection is correct, from Engineering Research Associates [in St. Paul, Minnesota], which is the other computer group that Remington Rand bought. They got a group of their engineers that formed the core of the maintenance organization, and they trained the field support people who went out.

DANEHOWER: There were some customers who did their own maintenance, and also, while there was a lot of maintenance on each of the sites, bear in mind that there was a rigorous schedule of preventive maintenance. In fact most of the maintenance that we are talking about was scheduled, although there were those horrible periods. But

there were certain early customers who hired their own maintenance personnel and did their own maintenance -- specifically, Franklin Life hired Bernie Scott who had been doing the same thing for the Census Bureau. And Pacific Mutual did their own maintenance; I forget the individual right now.

CHINITZ: Those were purchased.

DANEHOWER: Yes, these were both purchased machines, as opposed to rental machines.

HUFF: Pacific Mutual had their own maintenance crowd. Arizona Public Service had their own maintenance. Life and Casualty had their own maintenance. At the beginning, Remington Rand recommended you have so many hours a week scheduled maintenance whereby you turned the computer over to the engineers. They would go through a prescribed set of routines to test all the different components and what-not. Well, as they gradually got into production, they cut back on that scheduled maintenance. Having run two UNIVACs for ten years I know the figures -- that toward the last six years we had no scheduled PM,[3] because we found out that we could fix troubles very, very fast. We saved more time by not having scheduled PM than if we had taken scheduled PM. As a matter of fact, over a ten-year period the up-time on the two UNIVAC Is was 82%. We averaged 82% good time. In other words, we lost 18% for various reasons.

ROSIN: Just to put that in context, that was considered very positive.

HUFF: Yes, we thought it was pretty good.

ROSIN: You have to understand, in 1990, 82% up-time would be considered very bad.

HUFF: Oh, sure.

[3] preventive maintenance

SWEARINGEN: There was another side to it. Part of the time in Louisville I was operations manager, so the maintenance was an acute item. It had nothing to do with the competence of the crew. It was the reliability and the engineering of the machine; also, the low speed of computation. In the payroll system there was a run that took -- at full payrolls of 10,000, 11,000 people -- six hours from start to finish. A six-hour span on that computer without failure was unusual. You know, that was the hurdle you had to get through every week. If you were in it so many hours and failed, you had to start over. So when you get to Sunday morning and you're still an hour or so from having payroll checks, your schedule for preventative maintenance is gone. The maintenance people may have had the computer more than you've had it all week.

GALLER: That goes back to the software people may not have programmed in checkpoint restart, but that's a separate question.

SWEARINGEN: That was not possible. Well, there were software failures; I don't want to ignore that. The major problem was failure of the computer in midstream.[4]

GALLER: Donald?

MARQUARDT: I think it might be appropriate to get into the record from a user's viewpoint one of the big advantages of the UNIVAC was in fact the ability to rely on the accuracy of the numbers when they came out. You might have a stop along the way. You might have to restart, but due to the double-checking and all the rest, you really could rely on the numbers. Now there were some other computers that I used during that same period where I would make two and three runs on the machine and come up with two or three sets of numbers and I really had to take a statistical average, or some other kind of... [laugh] So the reliability of the UNIVAC I from a user's-group viewpoint in terms of contemporary machines was very high.

WILSON: To put things in the frame of reference, when we were designing UNIVAC, which had 5000 vacuum tubes,

[4]Checkpoint restart provisions were added to the GE payroll program and other applications as a result of GE's experience.

we went to vacuum tubes' manufacturers. We wanted life information. Nobody had ever run a vacuum tube for more than 500 hours. When we talked about lives of 10,000 hours they looked at us as though we were from outer space. So we had to run our own life test, and we had to decide on the design criteria of how to use these things -- in what ways to derate, and what ways to minimize the stress on components in order to attain any kind of reliability. Betty Holberton just handed me a letter, which is addressed to Mo here, dated December 6, 1953, from Betty. Betty at that point had left Univac some time earlier and was working for the Navy; the Bureau of Ships. She says here, "Our installation seems to be running very well, with a computer available -- good time, averaging between 85% and 98%." So things were not as bad as sometimes painted.

GALLER: Right, I am glad we're putting that in perspective...

CERUZZI: I wonder if, in this case, there were ever times when maintenance was a problem for security reasons, either if it was military installation, or if it was a commercial installation where you had some trade secrets that you didn't want to let out to someone else.

CHINITZ: I can't think of what trade secrets or application secrets would have been available to the maintenance man since the memory was dynamic. When you shut the machine down for any purpose all the internal storage was lost. All you had permanent was on the magnetic tapes which you could not read by eye anyway. I can't think that there was, and even...

SWEARINGEN: It was not an issue at General Electric.

ADAMS: I just have a comment pertaining to maintenance. I happened to go out to Franklin Life when the UNIVAC II was shut down in the early 1970s. Franklin Life offered this to Sperry Univac in any form; it was a functioning unit. A gentleman by the name of Rip Van Winkle, [laughter] who was involved for many years, pulled the switch. But this poor gentleman -- I would say in his middle 40s -- was now without a job. He had spent his entire working life maintaining UNIVAC I and UNIVAC II for Franklin Life. Now, fortunately, Franklin Life had a retraining program. But

he was completely obsolete; he couldn't go on with their new system, because the experience was altogether new.

ROSIN: I want to pursue a slightly different tack, but it's really in the same direction. We seem to be making a transition now from a computer as an experiment at GE, and reaching out in Du Pont; to its use in the government. Would any of you care to speculate the first time that a UNIVAC became indispensable in an operation? That is, if UNIVAC disappeared and was not perhaps replaced by another computer, the company would really be in trouble, or an organization would be in trouble.

DANEHOWER [?]: In the first payroll we turned out in General Electric, it was indispensable. We did not let go. We had 11,000 people, a vociferous union. Today's payroll is based on last week's. I think it is important to note that the importance of maintenance and a healthy machine was [greater] in the commercial data processing applications than it was in the more scientific engineering, where if you were doing a calculation for something and the machine conked out, well, you just waited until it was fixed and started over again. However, in the case of the payroll when you have got ten or twelve thousand people waiting there for their paychecks, I mean, you've got to have those paychecks. In fact, there was one occasion at GE where the machine did go down, and this was about 1955 I think. We were afraid that it was not going to be fixed in time to meet the payroll deadline. So a group of us from GE (and Mo was with us by now and the bunch from Arthur Andersen) loaded magnetic tapes in the back of a big black limousine that we rented and drove from Louisville to Franklin Life Insurance Company in Springfield, Illinois, and ran that particular payroll. I forget if that was where we actually produced it, or whether they had gotten the machine fixed at GE...

SWEARINGEN: I think it caught up with you at GE, and actually came out of the local computer.

SWEARINGEN: There was another time when we got on an airplane for New York, the same way.

DANEHOWER: Right.

CHINITZ: Yes, that was one of the purposes in establishing the Service Bureau in New York and then later in Los

Angeles at Remington Rand. [It was necessary to have] backup facilities for commercial applications; once you got on the computer you were committed. There was no way of making another scheme work. Also, I do recall that during the marketing effort after 1953 the question would often come up about what happens if the machine goes down more or less permanently or for any length of time. It was hoped that the group of UNIVAC installations in there would be able to form a network where you could get some emergency use of the computer time.

GALLER: Let me mention this. People are handing me cards with very interesting comments and questions. I will have to exercise my judgement as... sometimes to introduce the comment as pertinent right now, and some other times we will pass it to Paul for later discussion. Please understand if I have to make those judgements. Bill... What is your name, Bill?

MATTER: Bill Matter.

GALLER: Thank you.

MATTER: From Arthur Andersen.

GALLER: I'll make your comment, okay? Thank you. He mentioned that two years in a row at Christmas-time GE had to go to another installation to process the payroll at Franklin Life and Metropolitan. So I think that that's in support of how you couldn't go back; you simply had to find another operational place to do it. Carl Hammer mentions that UNIVAC I tapes could be read by eye. He quotes "VISAMAG."

WILSON: This was a suspension of finely divided iron particles, and you would dip the tape in it, and then with a [magnifying glass you could actually read the pattern].

GALLER: They did it on IBM and I am sure that other people did it on the UNIVAC. Thank you. And Joe Sberro mentions that -- this was a security question -- all outside programmers, maintenance, and so forth had to be sworn

as census agents to protect privacy. So there is that aspect.

WILSON: We are talking entirely about UNIVAC I here, and the time period you are talking about, up to 1956, there was a lot of new equipment that came in toward the end of that period. For example, I have here a picture of a machine -- the first solid-state machine that was done, which was built for the Cambridge Air Force Research Center and it used what were called Foractors [?] -- magnetic amplifiers -- as the power amplifying devices and germanium diodes for the lodging. And the UNIVAC LARC, of which two were delivered, one to David Taylor Model Basin and the other to Livermore Laboratory, came in toward the end of this period. To emphasize the need for backup that Morgan mentioned -- I had the responsibility for trying to sell LARC, and unfortunately, having sold them to the government... the company wouldn't take the orders. But at one point Metropolitan Life was interested actively in acquiring a LARC, but they felt they had to have backup in New York City. They agreed to buy two LARCs and put one of them back in Remington Rand's office if Remington Rand would guarantee to pay them some reasonable amount for time on that LARC that Remington Rand used. Then management turned down the offer.

GALLER: Okay, should we raise this question? Okay.

ROSIN: Apparently, during this early period, computers -- UNIVACs -- were being justified on the basis of estimates and demonstrations that proved not always to be entirely accurate. [laughter] That's what I heard.

GALLER: They were impressive.

ROSIN: Right. What sort of reactions were there, political or policy or management reactions inside of your companies when, in fact, machines were not able to carry the weight that had been suggested they might be able to carry? Were there threats to remove the computers, for example?

CHINITZ: Yes, there certainly was, at least with Consolidated Edison in New York; the system was not able to perform and was removed.

ROSIN: What had been their expectations, and what in fact was the nature of the failure?

CHINITZ: Well, I am not certain. I was not on that account at the time. I think the problem was that it could not perform the application, which was a public utility billing thing, in the time frame [promised]. But there may have been some political aspects to that decision as well.

ROSIN: Was the machine withdrawn before the application went on the air? I assume...

CHINITZ: The machine was installed and I think they were in the process of putting the application on. That is, parts of it were on there and it was never fully implemented.

GALLER: Joe Sberro. It looks like he's about to say something.

SBERRO: I left Paul's shop at Univac to go to IBM on the Con Edison account. The failure was political, because the person in charge of the UNIVAC wanted to put all New York City customers on the billing system. The person running the IBM account put billing for part of one borough and it ran beautifully. But you could not take 7 million accounts and convert them all at once. It was not a machine [problem]; it was an example of competition at the time.

SWEARINGEN: The thing that sold UNIVAC to General Electric and its board was the results -- not how well it ran. The fact that some of us would have to stay up all night to get the payroll out was of no concern to anyone else at General Electric. But the fact that they continued to cut back on the clerks in the payroll offices... The first good news I ever heard was when a paymaster was enthused about [the computer] and bragged about it and said that he had had a visit from the payroll office somewhere else in General Electric. They had come in to see him (this was in the winter time). They looked at his office and he had his space that he had originally, but there were no clerks in it anymore -- all empty space. The people accused him of having the guys stay home that day. [laughter] The first thing they did though, they looked around and didn't see anyone and they said, "Are they all out on coffee breaks?"

"No, I don't have that many people." They went over to the coat racks and checked how many coats were on the coat rack, and then they accused him of having people stay home that day. The other thing that sold it was the material control system. One department, the laundry department, reduced their inventory of raw material by one million dollars (after the first few months of that application going into effect).

CHINITZ: That's a good aspect of it, but the first one is a negative aspect historically for the computer, not just the UNIVAC but all of them. Other than the inventory control thing and stuff like payroll, the economic justification was the elimination of jobs. What happened was that you got a lot of jobs eliminated from medium-level personnel -- bookkeepers, tab personnel, accountants, and so forth. All those jobs just disappeared and they didn't get replaced by programmers. In my view of it, you had a general lowering of the values of jobs that were available for people.

GALLER: This raises the question as to how these machines were sold -- how they were sold, and how they were bought in terms of expectations. Was it the savings, or was it the ability to more productivity, things you couldn't do before?

CHINITZ [?]: Well, it depended on the application.

F. WOLTMAN: I did a lot of those surveys.

GALLER: You are?

F. WOLTMAN: I am Fran Woltman... or Fran Benthine. I did a lot of those surveys, and we always put in the proposal a comparison of present system costs and our estimate of what the new system was going to be. That included not only equipment but personnel, space, and everything we could think of. [Unintelligible.] Those savings largely came from reduced personnel, and then space also. Subsequently we found, though, that the real payoff came from doing things that could not have been done before, but that was so vague that the salesmen said, "You can't sell equipment on that basis." And they were right.

GALLER: Of course, scientific installations might not have looked at it that way.

F. WOLTMAN: Probably not.

GALLER: Or were you in fact doing so much by hand that you also had the same kind of savings, or were you not doing those things?

MARQUARDT: We really were not doing those kinds of things. For example, this work on statistical data analysis: one just could not do physically that kind of analysis by any other means. When I was at Dietrich we had one instance where one person -- a thoroughly trained mathematician -- sat down with a Monroe calculator for several weeks to do one ten-variable multiple regression. Of course there was no way of knowing whether it was exactly right when it was all done. But it became a routine very quickly once we had set up the scheme to do it, and it was done in terms of general purpose matrix mathematics on the UNIVAC. [It was] a lot of tape manipulation -- very complex. Young ladies who had to run it developed muscles that they wouldn't have otherwise developed because [of handling all the metal magnetic tape reels]. I think they were five pounds each or so. In any event, we came soon to rely on that method of taking data in plants and other research installations and analyzing the data and getting the results. There was just no way that you could do that work any other way.

ROSIN: Did you find it gave you a competitive advantage as well, or is that...?

MARQUARDT: Oh, yes. Well, insofar as technical work tends to be a little further from having an obvious economic, short-term payoff. Nevertheless, there was no question that we could see ourselves well ahead of the competition in this arena.

WILSON: In this area of doing things you couldn't do otherwise, I don't know how generally it is known but the feasibility studies for the production of the hydrogen bomb by Edward Teller and associates were done on one of the

UNIVACs in Philadelphia. They requested and got permission to use one of the existing systems that had already belonged to another government agency to do these calculations; there was just no way to do it otherwise.

CHINITZ: In fact, in the period of at least 1952 to 1953 Univac operated several computers at the plant sites specifically to do atomic energy computations.

CERUZZI: Were these systems that had already been sold but not yet delivered?

CHINITZ: Yes, I can't recall whether the Census machine, number one, which was still there, was used. But I think [with machine number two] there was a system for Livermore that was used.

WILSON: The Army Map Service machine was also used.

CHINITZ: Yes, I think there were two or three that were used consistently for some period of time. I was managing that operation and we were running 24 hours a day on the equipment. Various AEC applications would come in. We did not generally program them. There were a couple occasions where we did. One, we helped program atomic power reactors for the Knolls Atomic Power Lab at GE in Schenectady, and for the lab at Princeton, New Jersey. We ran the systems there for 24 hours a day, and we ran through Christmas doing these problems at the plant.

CERUZZI: Did you have to worry about the customers getting upset that you were holding back their delivery because you were using it for demonstrations or for some other...

CHINITZ: I wasn't aware of that. I think that the systems were in the plant with the customers' agreement. They may not have had the site ready at the time or, in the case of the Livermore machine, may not have wished to dismantle the machine and ship it out there and lose that period of time at a critical point.

ROSIN: With the few minutes we have left, if we can take a slightly broader perspective, and get into personalities

for a second. One of the things that surprises me in all of our discussions so far this morning is there have been little mention of Eckert or Mauchly. These two gentlemen certainly had a lot to do with these systems you're talking about. What role did they play in these systems, and introducing these systems to customers and so forth? Any at all?

WILSON: There was a very distinct division between Eckert's and Mauchly's contributions. Mauchly was the applications planner -- the person who worried about, "What are you going to do with these machines?" Eckert was the engineer whose job was to find how you were going to build it, what kind of standards you were going to use for components, and how you were going to get the job accomplished. Mauchly was exposed a great deal to customers as well, to talk about the wonders of what you could do with these machines. Eckert stayed home and tended to getting the stuff built.

ROSIN: Did our friends from GE or Du Pont ever have a visit with John Mauchly?

BETTY HOLBERTON: I was with Eckert and Mauchly from 1947 on, and I went with Mauchly on these trips -- to Du Pont. I remember Martin Marietta, because we went to the engineering department, who was thrilled with this concept of a new computer, but they said they had no money. "You have to go talk to the Data Processing Group," which was a fiasco. This is what happened all the time. We went to Du Pont and up and down the East Coast... something in Baltimore -- I guess that's Marietta. But I can remember going out and every time Dr. Mauchly would say something about "How much time?", he would look at me in *that* way. [laughter] We two went out selling all of the time. [Whether we were doing] problems or doing design, [we were] out on the road doing everything.

DANEHOWER: But wasn't that in the early, early...?

HOLBERTON: 1947 to 1950, the [?] UNIVAC took over.

DANEHOWER: Yes, but in the 1950s... 1950 on...

HOLBERTON: 1951 on... 1950, correct. 1950 is when RCA, or when Rem Rand...

GALLER: Rem Rand took over, then Mauchly was not involved in the sales effort, right?

UNIDENTIFIED: No.

CHINITZ: He was doing programming research, and Eckert was busy always planning on the next machine before this one was finished. They, in my recollection, were not actively involved in customer activity.

R. WOLTMAN: I was involved during that period and had their [unintelligible] in the program. It was a course -- triple zero. It was a one-day seminar, and Mauchly's prestige was used as much as possible. We had a section on the program called...

GALLER: When was this?

WILSON: January 4, 1955.

R. WOLTMAN: But it started in 1953 when we moved to New York -- that series of programs.

GALLER: So he was there, as you say, for prestige?

R. WOLTMAN: Prestige, yes.

GALLER: Okay, but he was not actively marketing.

R. WOLTMAN: Right.

ROSIN: In my other question (I suspect it's more sensitive than I imagined) is the relationship between the UNIVAC crew (obviously people with rather high spirit, I guess, and feeling rather positive about things) and this new organization that came into the whole Rem Rand Sperry picture called ERA.[5]

UNIDENTIFIED: Yes.

[laughter]

GALLER: Let the record show that there was laughter...

WILSON: I would like to make some comments in that area.

GALLER: ... Concerned laughter.

WILSON: There was an interesting dichotomy there in that essentially the two groups worked for two different arms of the Remington Rand organization. This was a definite competition fostered by the struggle within management to decide who was going to replace James Rand when he retired. They were both busy trying to build. Later on, we did get to the point of a great deal of cooperation, but there was very active competition. For example, ERA and Univac both submitted proposals for what ultimately became the Univac LARC. ERA, in turn, submitted a proposal for a redesign of UNIVAC I to make UNIVAC II at a much lower cost than the estimate supplied by Philadelphia. It was a complete fiasco. What happened at that point was that several of us -- Herman Lukoff, myself, and Art Gehring, a logician, and a number of technicians spent an entire summer in St. Paul redesigning the machine that they had designed.

CHINITZ: Another comment on that. In 1953, when the national sales office for the UNIVAC I was set up, the vice

[5] Engineering Research Associates

president and general manager of that was John Parker, who had been the head of ERA. He was brought in to head up the UNIVAC marketing effort. We were primarily concerned with marketing the UNIVAC I and then later the UNIVAC II. But also he brought in a technical person from ERA, Graham Smith, who was a part of the marketing effort for ERA equipment. Most of their equipment was in specific scientific applications, I think for the Department of Defense or the National Security Agency. So there was no direct competition at that period of time until about 1954 or 1955 when the Remington tab group wanted to get into the computer business. I don't know the politics of it, but they made an arrangement with ERA to build what was called the "File Computer," which would be the machine that the tabulating group would staff. It was marketed by the tab division in Remington Rand. They were not a part of the Univac computer marketing group. What they were out in the field was a little different. By the time I got out to a field office in 1960 in Philadelphia the UNIVAC marketing and the tab marketing and File Computer were all in one group. But at the beginning there was...

GALLER: This competition that you are talking about probably had something to do with the later split when Control Data got started.

CHINITZ: Well, that was a problem, but I think the Control Data split was that the man that replaced Parker as head of ERA, Bill Norris... I've got to back up a little bit here. My recollection was in 1956 after Remington Rand merged with Sperry Gyroscope to form Sperry Rand there was a reshuffling of the national marketing effort. Some people were boosted out. Luther Harr, who was the sales manager, and Mr. Parker were to be boosted out, and the new national marketing group that was to take over was headed by Bill Norris. There were problems because some of us didn't like him and we left. [laughter]

GALLER: That's an understatement.

HUFF: Competition. Just about this time, 1954 - 1955, I was in Los Angeles and was dealing with Douglas Aircraft. Douglas Aircraft was the largest Remington Rand tabulating installation in the United States. They also had Northrop Aircraft, which was also a very large tabulating organization. We tried to interest these people in the

UNIVAC I. There was absolutely no way. On the Douglas account tab division had seven salesmen that were making like $75,000 to $100,000 a year. They didn't have the slightest idea of what kind of commission they would get on a UNIVAC I sale. They were absolutely uninterested. File Computer was what they were after. They knew exactly what they would get if they installed that File Computer. As a matter of fact, I think they installed the very first File Computer; it never worked. But this was another part of the competition. Again, the sales force of Remington Rand.

GALLER: This brings me to the question, didn't the top management have the vision that would have said, "Let's give these salesmen the appropriate incentives to make computers our business"? [pause and laughter]

WILSON: I dealt with top management, both as an engineering manager and then later on as a sales manager. I reported directly to the director of marketing and was responsible for the sales of equipment that came out of St. Paul, as a matter of fact, although I was in Philadelphia originally. Top management didn't have the vaguest idea of what they had or what you could do with it. As a matter of fact, when UNIVAC I design was completed, a group of us had gotten together and started on the design of a new machine which would have been roughly the equivalent, but perhaps two to three times faster than the IBM 650. We were told by management to stop wasting our time with such nonsense; there's no market for a machine like that. Although not generally known, the memory of the 650 was a drum that was designed by a man named Arnold Cohen at ERA. For the first 650s that were delivered IBM was paying Rem Rand a royalty on each machine. They decided that from the viewpoint of anti-trust responsibility this didn't look like a good idea. So Watson and Rand got together and made a deal for a flat payment to handle possible future royalties. After considerable argument they agreed on a royalty payment for the equivalent of 100 machines. IBM marketed thirteen-hundred 650s.

SHULER: Well, I was personally involved in the File Computer work. Our engineering development center in Tullahoma, Tennessee had installed a unit of ERA called the 1101.[6] The 1101 was a small, drum-oriented computer that would work in so-called real time. [I worked with] a fellow here in Washington by the name of Lee Johnson

[6] Editor's note - The computer at Tullahoma was probably an 1102, not an 1101.

(some of you know him) because we had applications that lent themselves well to random-access memory work. We had some contact in St. Paul at that time in the engineering side. We promoted the idea that, if they could come up with this thing, we believed that we could sell quite a few of them. And that we did. We sold quite a few File Computers before it was all over.

CHINITZ: 150... something like that sticks in my mind.

SHULER: Yes, something like that.

WILSON: Just a little in passing remark. The first machine out of ERA was called the 1101. Does anyone know why? It was the 13th contract they got, and 1101 is binary 13.

GALLER: Right. Let me, by the way, call to your attention to Volume 1, Number 1 of the *Annals of the History of Computing*, which contains an article, a very interesting article, about the history of ERA by Arnold Cohen and [Erwin Tomash]. You might want to look at that. Army.

ADAMS: I realize you are getting close to closing. But I think where you are, it might be interesting [to highlight] an article that I think has sort of disappeared. It was in *Forbes* [dated] February 1, 1960, and the title is "Vicker's 5-Year Ordeal." It's one page, and I would like to add this to the artifacts. I don't think it's worth going into, but there is an awful lot of what we have covered here, which is sort of summarized as how Mr. Vickers saw this total problem in 1960. I think that's interesting. Another quick observation: a lot of what we have talked about is also covered in the Lukoff book[7]; he covers many of these points that we have talked about this morning.

GALLER: Thank you.

CHINITZ: There was a joke in Univac at the time of the merger with Sperry and Remington Rand. The man that

[7] Herman Lukoff, ~~From Dits to Bits~~ (Portland, OR: Robotics Press, 1979).

Vickers sent out (this is a hypothetical individual) to arrange the merger came back and said, "I have arranged the merger now between Remington Rand and Sperry Gyro." And Vickers said, "Remington Rand! I sent you out to merge with Ingersoll Rand!" [laughter]

GALLER: One comment from Cecil and Donald, then we'll have to stop.

SHULER: I was just going to make a comment about Mr. Vickers. In our meetings that we would have, he nearly always attended them. Since his handicap and mine were about the same, we were always paired to play golf. Mr. Vickers was always muttering about he didn't understand that computer business, he didn't understand why we were in it; it was just bleeding him dry, taking all the company's money. Everybody wanted to spend money after money after money. He said, "We've had it x number of years." I'll never forget it. "And we have not done anything but spend money. We are going to have to do something about it." Subsequently, there was a meeting called by several of us who were in Univac at the time to go to Norwalk, Connecticut. We spent about two weeks, locked up behind closed doors trying to figure out how we were going to go out of the business.

MARQUARDT: I think perhaps there is one other subject that you could touch on and you haven't, and that is programming languages for computers.

GALLER: That's in the next session. So, thank you. [laughter] We will continue after lunch, and I just want to thank everyone for making this a very pleasant [meeting].

END OF SESSION

UNIVAC Conference

17 May 1990

SESSION 2

TROPP: Bob just asked me if we have the right cast of characters. We'll find out as we go around. I would like to do the same thing that Bernie Galler did at the opening session, and that's get a quick introduction and a quick voice I.D. So be sure and speak very clearly so that the transcribers know precisely who you are. I am Hank Tropp, and I will let the gentleman to my left go next.

ROSIN: I am Bob Rosin; I haven't changed since before lunch.

DELVES: I am Gene Delves and I started with Arthur Andersen in 1951, went on to the task force in 1952, which was created to research the possible use of computers in business, and went to GE in 1953, and was there for the installation of the first two applications. I left in 1956.

HOLBERTON: I am Betty Snyder, as of 1947 to June of 1950 -- Betty Holberton now -- so that the records have two different names in there over a period of time. I started on the ENIAC and then in February of 1947 I asked Mauchly if I could have a job with him. "You really want to come?" he said. I said, "I sure do." So I finally went on to work with Electronic Control, which became Eckert-Mauchly Computer Corporation, became Remington Rand, Sperry Rand... I left in 1953 when they moved the programmers to New York. I had been commuting from Washington for three years and decided I would take a job with UNIVAC [serial number] 6 at the Navy. I stayed there for thirteen years and then went to National Bureau of Standards where I retired in 1983. I have been in all aspects of the computer field.

KOONS: I am Florence Koons. I started in the computer field in 1947 when I went to the Bureau of Standards, and they had design contracts with Raytheon and Eckert-Mauchly (I don't know what they were called at the time). I stayed with them until the Census machine was completed, at which time I went to the Census. That was sometime in

1950. I stayed with the Census until September 1951. I took a maternity leave, had that extended, decided to quit. [laughter] Times were different; there was not very much available in terms of child care and that kind of thing. The whole psychology of a woman working was different. But I did stay with the field and used the UNIVAC as a consultant. I was fortunate in that since I wouldn't go to work they came to me. So I have had some later experience after 1951 through 1962, I think, when the HEW went off the UNIVAC I, and the Census. But the most exciting period, and the one I was the most involved with, was the early period, which we're not too interested in, I take it, because those were the times when we had no precedents to go by. We were creating everything as we went along, and a very happy, very exciting time.

D. ARMSTRONG: I am Dorothy Armstrong, and I was a tabulation project planner in the late 1940s, and Florence Koons taught me how to program UNIVAC I in 1948. I didn't get fully involved -- full-time -- on the computer until late 1952, when I went for the other Armstrong here [laugh] and spent a considerable amount of time (in fact, 24 hours a day, 7 days a week [laugh]) on UNIVAC I trying to get all the current programs from Census programmed onto the computer. By 1956 I was actively engaged in conducting an evaluation to select what would be the Census Bureau's next generation of computers.

L. ARMSTRONG: I am Lance Armstrong. I started with the Census Bureau in 1942, I believe. After a couple years -- spent three years in the Navy -- came back in 1946 as the assistant chief for development in what was then called the Machine Tabulation Division. We started negotiations through the National Bureau of Standards. I was one of the principal census representatives on that. In 1948, 1950 (somewhere around) there was a reorganization that included setting up an electronic systems division. I had the great good fortune of being able to pick my boss. I went outside to recruit him, and his name was Don Heiser. Many of you here remember Don, who did a great deal for me at the Bureau. I needn't go beyond that, because that was my last... That's not really true. I did buy some equipment from Univac later.

TONIK: I am Al Tonik and in 1949 I was hired by Eckert-Mauchly Computer Corporation as a programmer for UNIVAC I. I very rapidly changed from that end to working with the engineers on helping to specify new computer

systems. I did that up until 1981 when I retired to Florida.

CARTER: I am Lee Carter with Arthur Andersen & Co. In 1953 I reported to the job in Louisville to work at General Electric Company to help Gene Delves and his crew there install the material control system on the UNIVAC.

BARTIK: I'm Jean Bartik. Back in the ENIAC days I was Betty Jean Jenning. I worked on the ENIAC from 1945 to 1948 when I went to work for Eckert-Mauchly; I was a programmer there. Pres needed somebody to check the logical design for the UNIVAC I, so he said, "Well, I could train a programmer to do that." So he picked two programmers, Art and me.[8] And we did the logical design. I was really interested in the guy that spoke this morning and said it was so wonderful that they had all those check circuits in, because initially UNIVAC I didn't intend to have them. It was just intended to have parity check, and after Art and I were so good at our jobs, [Pres] said, "Well, why don't you put in the checking circuits for the UNIVAC I?" We did, and I was very pleased that it was all worthwhile. My husband took a job in Washington and I was in Washington when Remington Rand was blowing the lead we had. And I was there watching in sorrow with it.

HUFF: I am Morgan Huff. I went to work for Eckert-Mauchly in June 1950 as a computer programmer. After about a year I finally began to understand what in the world computers were all about. Finally, in early 1954 I was sent down to General Electric. I went to work with Gene Delves, the Arthur Andersen boys, and John Swearingen on that payroll project. From there I went to Pacific Mutual of Los Angeles, helped them get started; and also got involved with Arizona Public Service to help them get going; and finally got my own computer installation at the Life and Casualty Insurance Company in Nashville in 1958.

R. WOLTMAN: I am Dick Woltman and I started at Harvard University with Dr. Aiken on the MARK-I, II, and III and joined Eckert-Mauchly Computer Corporation in May 1950. Immediately thereafter Remington Rand bought [the firm]. I was in the programming department and I spent most of the time during the period of interest to you -- 1951 to 1956 -- marketing commercial applications to the federal government up to 1953, and then we moved to New York to

[8] Art Gehring

commercial companies.

F. WOLTMAN: I am Fran (was Benthine) now Woltman. I joined Remington Rand Univac [in New York] in September of 1950. I was transferred to Philadelphia and back again. In 1954, I think it was, I was assigned to Dick's staff after doing maybe a half dozen surveys of my own. We got a crew of about 25 trainees in and Dick put me in charge of the ones that were going to do the surveys. Later I did a number of other things including Product Planning. I left Remington Rand in 1966 and went to Western Union Information Systems, and then in 1969 I became the manager of systems development at Elizabeth Arden, and retired in 1983. I did [some] technical writing on a freelance basis until 1987 mostly for IBM.

WILSON: I am Lou Wilson. I think you heard enough from me this morning to know who I am.

CERUZZI: And I am Paul Ceruzzi, the same as I was this morning. [laughter]

TROPP: Paul hasn't changed. It was interesting sitting around listening this morning because one thing kept coming through -- people were asking questions as though they were thinking in today's environment and not realizing that most of what you people were involved in, you were breaking new grounds. Nobody had ever done it before, and that included not only the building of the machine, but I was thinking about a conversation that Gene and I had out in the hall just a few minutes before I walked in, and maybe I will let him elaborate. We think of software; we think of hardware. We forget there were no programming languages. Carl Hammer told me that in the German installation he used A-2 and B-0 in machine language for all of its programming needs in the scientific area. And Gene was talking about wanting to bring into this discussion the role that GE played, or what happened to GE during the early period in the way of contribution to what we now call systems software, operating systems, standards, conventions. You want to take off on that, Gene?

DELVES: We remember very well when we bought a computer from Univac. I forget what GE paid for that computer. John, do you recall? And then for another $12 you could get that blue book. [laughter] $18.50? Well. And it told

you virtually nothing. There it is, Factronics [laughter & general talk] And this was the first commercial installation then, so that any kind of software... Of course, we didn't use that word then. What did we call it? A utility program or something like that. Anything that was available was not oriented toward any kind of commercial installations. So we first started on that GE project developing certain standards, conventions, and that sort of stuff, and developing certain standard routines, like how you check the label, how you read a block [of data], how you did these things. First [we drew] a flow chart, and then we coded it, and ultimately got it onto the tape, things like that. By the time that job ended for Arthur Andersen, which was in 1956, why, the GE team comprised of the Univac people, the Arthur Andersen people, the GE people, had developed what I think at that time was probably the most complete set of standards, conventions, and systems software. Operating systems that did not get adapted by IBM until probably the 360. And a complete set of utility programs, which, as Mo was mentioning, just got picked up and carried around to other installations. I think that was about the biggest contribution that was made by GE.

ROSIN: Did GE get any compensation for this role?

DELVES: I don't think so -- not that I am aware of.

TROPP: Is any of this written up in the literature that you know about?

DELVES: Yes, I am sure that it is. In fact, I know that the archives at Arthur Andersen has copies of all of this stuff. They never throw anything away.

ROSIN: How did Arthur Andersen get involved at all? This is a subject that came up this morning as well. They're not Univac, not the customer. Did you folks have special expertise that you were bringing to the table? If so, how did you acquire it?

DELVES: I will make this very short. The managing partner of Arthur Andersen at that time, from 1947 all through

this period, was a man named Leonard Spacek[9], which is a marvelous name for an accountant. [laughter] He was enthralled with things like punched cards. He invented the concept called "Responsibility Accounting" -- things like that. So he was very much enthralled with the use of punched cards and so forth in accounting. He had a very good friend whose name was Willis Gale, who was the chairman of Commonwealth Edison. Willis Gale was also kind of a [?] person. And so the two of them... I recall that Willis asked Leonard what he thought about the possibility of using computers in business. And Leonard's [reply] was, "What's a computer?" Ultimately, several people in Arthur Andersen, spurred on by Leonard got interested in the possible use of computers in business, went off to Philadelphia to see the UNIVAC, and spent quite a bit of time there. Joe Glickauf, you may remember him, Betty... Joe then came back to Chicago and he built a model computer, actually with just components of a computer. It was called the GLICKIAC. [laughter] A special meeting of all the partners was called in January of 1951, and Joe demonstrated the GLICKIAC. As a result of that, Arthur Andersen decided that it was time to investigate the possible use of computers and brought in a task force in 1952. When GE decided they wanted to look at computers, why, Arthur Andersen was at that point the only third party that was in existence that could bring some objectivity to the project, so that's how we got involved.

ROSIN: It's like your firm had as much vision as perhaps anyone in the United States at that time.

DELVES: I used to chide my partners that in 1953 Arthur Andersen had 100% of the computer consulting business and we have lost ground ever since. [laughter]

ROSIN: The idea of the software packages that you folks developed leads rather directly to the concept of user groups, which we didn't discuss in an earlier session. I was curious whether anyone here would like to comment on when and how user groups were formed surrounding UNIVAC and relationships between that activity and the idea of these software packages.

L. ARMSTRONG: I have an anecdote on computer groups. Some years after leaving the Census Bureau I wound up

[9] pronounced "Spot Check"

in the Federal Systems Division of Honeywell. Since I was manager of technical services, I had a great deal to do with customers -- more than I cared for. I tried to convince my management what we really needed was a user group for the Honeywell 800. My boss said, "Right now, we have got twenty customers, and if each of them has a problem we have got twenty problems. We have a user's group. Each will have twenty problems and that will make 400 problems for us to deal with."

ROSIN: Does anybody here have anything to offer on when, in fact, user groups...?

R. WOLTMAN: My recollection is that the users themselves were instrumental in forcing UNIVAC into going along with the user group concept. I don't think that we formulated the idea ? ? ?.

TROPP: Was this triggered by SHARE perhaps, the fact that SHARE...?

MANY: No. Long before SHARE.

R. WOLTMAN: During the whole process I believe that we sort of kept to the side. We made the users responsible for the group. They elected their own officers and they ran the meetings and set up the agenda. I think we paid for [the meeting], but we sort of kept to the background and answered their questions and took their problems, resolved them the best we could, and brought answers or solutions back to the next meeting. As the other systems came out there were subgroups; each computer system had its own user group. I couldn't tell you what year.

HOLBERTON: I'll tell you what. I've got it here. You want to know whether you attended the first one? [laughter] The first one was held in Remington Rand, 315 4th Avenue on November 17 and 18, 1954. It had an agenda. It has all the people who attended and it seems like a massive number of people. Then there was one the next year -- a second annual, which was in November, also -- 1955. And they skipped a year somehow or another.

D. WOLTMAN: One I remember vividly is the one in Phoenix in May; it was hot.

D. ARMSTRONG: That was much later. That was the meeting with USE?

HOLBERTON: That's right. 1957 is the last one that I had attended. It's called the third [USE meeting].

D. ARMSTRONG: Betty, was it not true that the initial meetings did not include government people?

HOLBERTON: Oh, I don't know about that.

ROSIN: Why do you think that would have been the case?

HOLBERTON: That's not true because Neromoser [?] and Britacki [?] spoke on special routines.

D. ARMSTRONG: The Census Bureau was not contacted in the early days. I know that.

HOLBERTON: Well, we [participated] at David Taylor.

TROPP: Excuse me, but there's a gentleman back in the corner who looks like he just has to say something.

ARMAND ADAMS: I was deeply involved; as a matter of fact, the last fifteen years of my service with Sperry Corporation was director of user relations. I helped write the history of both UUA, which became AUUA, which is now part of QUBE, I understand, and USE, Inc. Betty is right. UUA, UNIVAC User Association, was the first user association in the world, in the United States [at least]. This fact was disputed some ten, fifteen years ago when IBM alleged that they started the user group before, but when we looked at the records it wound up they were started about six months later. So the UUA was the first user group. About a year later what's now known as USE, Inc. started -- UNIVAC Scientific Exchange. They have both continued. Incidentally, I was voted a life member of USE, Inc., which means I got all their information but I still have to pay to go to their conferences. [laughter]

HOLBERTON: Well, while you are on the history of organizations, let me say that USE took over the name that was the UNIVAC Service Engineers Conference, which was held twice a year. These are the maintenance people on the computer, and it was probably one of the mo st effective organizations that you could imagine. We all spoke the same language -- UNIVAC. We didn't have different problems. We all had the same problem. The information went back and forth in those engineering meetings. I was the only woman, but that didn't matter. It was the most marvelous exchange of information among the maintenance people. Far better than the programmers' group because everybody had their own programming language, or their own problems, but here everybody was dealing with the same entity. And it went on for many, many years.

D. ARMSTRONG: Well, USE really didn't become USE until later. It started as UNIVAC Scientific Exchange, because the 1100 series was called the Univac Scientific Computers. So, that's where it got the name USE. Later it simply dropped the name and just went by the name USE.

HOLBERTON: Well, maybe some of the people here will remember Lou Nofry. Now, he was very instrumental in getting this thing started, [as was] Ed Stine from Census. In fact, you know, they put out little mimeograph things -- nothing fancy like this -- because it was set up by the organization that was hosting [each individual meeting]. But I found it was probably one of the better organizations as far as users.

WILSON: A number of years after I moved into marketing I was the official interface between Univac and USE -- Univac Scientific Exchange. It served a very useful function in that not only did the people exchange ideas with each other but it was their channel to the manufacturers to complain about lacks of what they needed. They made themselves very well heard. Among other things their activity got them a FORTRAN compiler for the 1103A, which they did not have initially and they felt they needed. As Army points out, all that Univac did was have a representative there and pick up the tab.

ADAMS: Can I add a comment? In the early 1960s Sperry Univac did actually induce the user associations to

become independent, incorporated organizations. They have continued through today to be independent organizations and have been for some fifteen, twenty years.

TROPP: I want to pick up now on a question that surfaced this morning and people have skirted around today, and that's generally the recruitment of people. You needed to recruit people for things that never existed before -- programmers. What's a programmer? You have to recruit these maintenance engineers that Betty's talking about who are going to service these things that haven't existed before. You have to recruit engineers to work on various aspects including design. How was that done during this period?

TONIK: Well, I graduated in 1949 with a bachelor's degree in physics. I couldn't find a job. Nobody wanted a bachelor's degree in physics. Finally a friend of mine from Prudential said, "Do you know that there's a company in Philadelphia that's building a computer?" "Really?" I never heard of a computer, but, "Get me the address." [laughter] There were no courses in computers; there were no courses in programming, no courses in anything like that. So I got the address of Eckert-Mauchly Computer Corporation. I went there and I found this old brick building across from a graveyard and I walked by it a couple of times and said, "That can't be where I am going." [laugh] Finally I went in and, sure enough, it was. This was a building that had been a hosiery mill or something. It had two floors, about a hundred yards long, and nothing in there except on the second floor in the front office there was some air conditioning. The rest of it was open to the air. I walked in, and I have forgotten now who interviewed me, but it turns out that John Mauchly figured out that anybody with a background in mathematics should make a good programmer. He had devised a little mathematical quiz and he gave it to me. I just zipped through that, you know. It's a good thing because I flunked my personal interview. [laughter] But John Mauchly hired me.

HOLBERTON: I interviewed you and I didn't flunk you. [laughter]

TROPP: How did he train you, Al?

TONIK: Well, first of all he wanted to pay me $2500 a year. And fortunately I managed to turn that down, and it went

up to $3000, which I thought was a great amount of money. So I came on board. I reported for work on a Monday morning, and here in this unairconditioned part of the building there was this group of about 10 or 15 desks -- big wooden desks; not new, you know. Somebody got them from a second-hand store.

WILSON: Not second-hand, fifth-hand. [laughter]

TONIK: Betty was my supervisor, and they sat me down at the desk and handed me a mimeographed manual called the U-100, which I read for the first two weeks of my career, and that turned me into a programmer. What was this manual? Well, it began describing the binary number system and indicated how that worked, and then it went into a description of the UNIVAC I and it showed how the UNIVAC got instructions out of memory and executed them. And then finally it went into the instruction set and described each instruction, and gave a few examples of...

HOLBERTON: I think Art Katz wrote that.

TONIK: It might be; I don't remember. But at the end of the two weeks I was a qualified programmer as far as the company was concerned. The way I really learned to program was that Betty gave me some of her sort programs to check out.

HOLBERTON: So did everybody.

TROPP: But, Betty, do you want to talk about that aspect of training?

HOLBERTON: Well, I had no idea what you [should] ask for. The first person that I hired (I think it was Hildegarde Nidecker), "Did you like plane geometry?" I figured, you know, if you liked to solve puzzles, you must be pretty good. I always looked for that aspect, did they like plane geometry. Actually, they were looking for mathematicians but even so.

WILSON: To give you a rough idea, I did a lot of the interviewing of hiring for engineering. You talk about programming, Betty is an outstanding example. If you ask her what her degree is, she has a degree in journalism. And it's a little hard to see the relation.

HOLBERTON: Only there because I had a horrible teacher in mathematics at the University of Pennsylvania. I was going to have to have him the second semester too, and I decided that's it.

TROPP: Does anybody else want to comment on this? There are a whole bunch of hands up.

DELVES: At Arthur Andersen, the first four of us who got selected were actually tutored by Bill Egglestein at Commonwealth Edison who had taught himself about the UNIVAC. Then in the summer of 1953 Arthur Andersen conducted its first computer programming school. We wrote our own manual because we didn't like anything (this was our UNIVAC programming manual) that came out of Remington Rand at the time (in typical Arthur Andersen arrogance; why, we can do anything better than anyone else). But it was geared to commercial applications as opposed to other applications. I think about 30 or 40 people were assigned to that school in the typical Arthur Andersen democratic way. The people went to school because they were told to go to school, and they were told to go to school because Leonard told the managing partners that "You will send your best and brightest." That's how Lee came to that school; that's how Don Dixon came to the school. Then they were assigned to either General Electric or Commonwealth Edison for on-the-job experience.

TROPP: Dorothy, you wanted to say something. I'm sorry. Florence, go ahead.

KOONS: No, I was just going to say most of us just fell into it. We had no idea what programming meant or what would be needed to use the computers or what a computer was. I know I came to it purely by accident. I needed a job. There was a reduction in the force in the government. I didn't have status. So I was interviewed by Dr. Curtis at the Bureau of Standards, and he was trying to explain what this job was going to be. He said, "Well, you use codes. It's something like cryptograms." [laughter] I really didn't understand what he was talking about, of course, but I

needed a job. It had the classification "mathematician," so I took it. By the time I came on board, Ida Rhodes was there. She claims to be the first government programmer and I was number two. We were in related fields, they needed people, and they just took us.

WILSON: From the engineering end I was doing much of the selecting of people, the filtering of people. No one came in with any computer training; it didn't exist at that time. We looked at people with backgrounds in math -- any of the sciences. I had found that their scholastic record didn't really seem to bear much relation of anything to what we were doing, so I devised a test of my own. I gave them problems to solve -- practical problems. I would give them a test, "Here, sit down and tell me how you would attack this." I would give them a problem and say, "Here's something that's totally unknown to you. How would you start?" Basically on this basis we filtered out those who were not problem-solving kind of people -- puzzle solvers. One of the questions that I always asked people, "Do you do puzzles? Do you play bridge? Do you like to do crossword puzzles?" The people who did puzzles and who enjoyed chess and bridge and so forth were good potential people.

D. ARMSTRONG: Well, I could tell you a little bit about the Census Bureau's experiences in recruiting programmers. I think we recruited from many different sources over the years. We started out when Florence came back to the Bureau, with a group of people who were primarily mathematicians. Only one of them remains with us, and there was very little done at that time except a small amount of work on the 1950 census of population. Later, there were a few of us who were tabulation project planners; people with experience in punched card equipment. Lance and I came from that background. But we found that it was most successful if we recruited the young people, the junior professionals from the various subject matter divisions. Now we are a statistical agency, and we found that it was very important that the programmers understand the application. So I guess the first formal class we conducted -- was it not Lance? -- we conducted with those people, and those people became the senior programming people at the bureau for many years in the future. Later, we had to recruit from the registers, of course, and we just took bright, young college people and developed a test or something like what Lou talked about to try to screen them out.

TROPP: Bob just commented that you were way ahead of your time. [laughter]

F. WOLTMAN: In line with that, Dave Savage, who was sales manager in New York, took exception to the idea that you needed people with a mathematical background. His view was similar. He said, "In the first place, I don't think I can sell the computer on the basis that the customers will have to hire mathematicians, and will turn out of jobs people who knew the application, you might say." So he hired me and some others who had just a general business background, as near as he could tell, that would be similar to what his potential customers would have.

WILSON: Of course, unless I am very much mistaken, Dave Savage's background is in physics.

UNIDENTIFIED: Yes.

F. WOLTMAN: Yes, I think it was.

TROPP: Jean, you wanted to say something.

BARTIK: Well, we did talk about that a lot in the early days of UNIVAC, and we used to argue about what kind of a person [made the best programmer]. We had this little test that Art Katz worked out. We used to give these people this little test, and then, basically, I don't know what anybody else used, but their enthusiasm for doing something new was what always impressed me personally. But anyway, Hildegard Nidecker came along, who had much experience in doing calculations for the Army. And she flunked his test, so nobody wanted to hire her. Then he said, "This is ridiculous. This just proves to me that the test is ridiculous." [laughter] "We know that she is going to do a good job," and in fact [they hired her] and she retired from Univac [in the '80s]. So the truth is we did it by the seat of our pants, and I personally did it if I liked the person. [laughter]

L. ARMSTRONG: A little amplification, or maybe obfuscation. [laughter] From the Census' experience there wasn't any "outside" to go to, really, for all practical purposes. Initially, we basically drew from inside the Bureau from two sources: one, primarily mathematical statisticians, and the other, primarily tabulation project planners. We did not go

out to the survey statisticians in the subject matter divisions. We didn't go looking to the population division to provide programmers, or the agricultural division to provide programmers and so forth, although eventually it turned out to be a very good source. Initially, as I recall, the mathematics statisticians (as junior programmers) were faster at turning out a program, and had more trouble de-bugging it than did the tabulation project planners, who had been pushing around very large masses of data and were used to rigorous checks and rigorous balances. Their programs generally checked out earlier. Now, this was at the initial stage, but given four months, six months on the job, there wasn't much difference. A little later somebody came up with a very high correlation between skill at programming and musical ability, which nobody could explain.

L. ARMSTRONG: On the other hand, it's a hell of way to test for programmers -- "Don't forget to bring your bow and fiddle." [laughter]

TROPP: It is true that later on, after the explosion when suddenly the transistor changes the world, people needed programmers where nobody thought they were going to and they really recruited heavily among music majors.

KOONS: Well, there's a high correlation there between music and math.

TROPP: But that didn't happen until the 1960s.

ROSIN: We could discuss that at great length. We're supposedly focusing on technical issues in this session. I think we are heading in that direction; we haven't quite gotten there yet. Before we get over there I want to ask a couple more questions pertaining to personnel and hiring. One of the things that differentiates this group from the group we had this morning, but I suspect not from people in the industry as a whole, is the number of women at the table. Now, one of you made the comment earlier about the fact that women in the work force (you did, Dorothy) were not prevalent in those days. What was happening in this fledgling field that made them acceptable?

BARTIK: That was interesting at first because the ENIAC programmers were all women. The assumption was that

only women would do this. [laughter] Right, because they considered programming a mundane, dull job -- repetitive, where what you do is go out and you set switches and do things like that. And yes, of course, women are good at this, right? [laughter] So that was the assumption, and in fact when we moved over to the UNIVAC and Eckert-Mauchly, Betty and I were the first two programmers, right? Then it was very gradual that men began to get interested. Herb Mitchell was the first substantial Ph.D.-type that I knew of that was a programmer.

TROPP: As long as we are on social issues, was there a difference in status, and a difference in...

HOLBERTON: Oh, yes, that! [laughter]

TROPP: Tell us about it, Betty.

ROSIN: How about some details? Can you fill us in?

HOLBERTON: Do you want me to read off the salaries of all the people in the company? I have got that with me.

TROPP: Not necessarily. [laughter] I was just generalizing.

ROSIN: We have to maintain good feelings here this afternoon.

HOLBERTON: When Remington Rand bought UNIVAC, as far as I was concerned, that was the end of the line, because their idea of women was to sit beside a typewriter, or punched cards, or something like that. They had no esteem for anybody whose salary didn't come out of Buffalo, which meant that you were more than just a keypunch operator. Every salesman in this country knew that my salary came out of there. It wasn't very much, but at least it was more than a secretary. You felt it; there was some resentment against a woman because you had essentially moved up all the way up from the bottom. I couldn't stand it, I'll tell you that. That's the reason I left, because I could see what was going to happen. They would milk you for everything that you knew, or that you had thought of, or

whatnot. When they had gotten it all written down, "Thank you very much," and leave. I could see that coming. I don't know how it worked out for the rest of the women there.

ROSIN: Well, comment on it.

F. WOLTMAN: I felt it in customer situations, too. I went down to Humble Oil Company to do a survey at one point. They were going to take the group of us, the local salesman and some other local people that were with me to lunch in the executive dining room. There was big consternation because women were not allowed in the executive dining room. [laughter] We went to a restaurant.

BARTIK: When I was in the Washington office of Remington Rand, of course, I was the only technical person on the UNIVAC, and I was a very lonely person. [laughter] But anyway, as I had mentioned this morning, they were about to lose this Kardex account. So the only reason they had me work on it was to try to save the account for the Kardex people; it was not to sell UNIVAC. It was to tell them something exciting and new, and that they were on the forefront of technology. Anyway, when it came time to give the presentation for the Navy... "Have a woman give this? Ridiculous!" In fact, they gave me like fifteen minutes and assigned the rest of the time to the Kardex people, and they had Paul come down from Philadelphia to give the presentation. Well, the Navy people were so excited they practically... I mean, I have never seen such excited people, because they immediately saw the advantage of their inventory control problem being handled by the UNIVAC. So everybody wanted to talk to me. They surrounded me and all this. They had a dinner party and I wasn't invited; I couldn't go. I couldn't go to the dinner party. They had me go out with one of the Navy men's wives instead of the dinner. And they said, "Oh, well, you can't go because we might tell some dirty jokes that you shouldn't hear." The interesting thing was that despite the success of that presentation, they never had me give a presentation. They would have the assistant manager give it, and I would go to make sure he didn't tell them any lies... [laughter] ... and answer questions afterward. I mean, it was just as though they never dreamed that anybody would listen to you and take you seriously.

KOONS: I just want to comment that in the early days of the ACM meetings -- professional meetings -- whenever I

went to register I was automatically handed a packet for the wives. [laughter]

JOHN SWEARINGEN: I would like to add to that the cultural situation. Mildred Henderson, Nancy Tafel, Byron Burch and myself were the GE employees on the payroll project. At one time we all had to go to Erie to the refrigerator department to learn what their processes were for payroll. I went up about three days in advance, and when the rest of the team arrived I met them in the afternoon. They had checked into their hotel, and the two ladies were just angry as they could be because while Byron had been given a room, and I had already had a room, of course, the reservation was made for the two of them to share a room. [laughter] I think this was Roddy that did it, and obviously he is not here to tell. [laughter] I was a little bit surprised because I had assumed that was kind of a normal thing. But the complaints went on for a while, and finally I turned to Mildred and I said, "Mildred, I'll trade places with you." [laughter] And they stopped talking about it.

TROPP: One last comment, and then I want to get on to something else.

F. WOLTMAN: I had a similar experience in that Luther Harr and I went out to Tulsa, Oklahoma one time. The local salesman had been given my name and all, but when we got off the plane he met us and his face just fell [laugh]. And there was a big conversation between him and Luther, and it turned out that there was a convention in town and he had trouble getting hotel rooms. And so he had bunked Luther and me together, not knowing that I was a woman. [laughter] Luther bunked with him. [laughter]

TROPP: Okay, I would like to get on to some of the technology, which was the subject of this session before we run out of time. One of the common myths is that no two UNIVACs were alike. I was discussing this briefly at lunch with Carl Hammer, and Carl says, "Hank, you are asking the question wrong." And he said, "What you really want to ask is, if you have a production line turning out computers, are any two of them going to be exactly identical? And the answer is probably not." Rather than go on with Carl's elaboration, I would like to hear your comments on how you found any differences, what kinds of problems you perceived, or were there none that you saw. As far as you were concerned were they all alike?

ROSIN: I think we have to address that question... two points of view: as a user, but also as the people who were designing and building the hardware systems. It's really two separate issues. How about as users; can we start there?

TROPP: Start with the users.

HUFF: I worked on the number one; I worked on number three; I worked on number six; I worked on whatever the number was at General Electric,[10] at Pacific Mutual, at the Service Bureau in Los Angeles, Arizona Public Service, and then on to Life and Casualty with two more UNIVAC Is. And basically, insofar as programming the machine, it was all the same. I can recall some changes coming in, such as automatic reread. And there were some changes to the servos when you mount the tapes on the Uniservo and that type of thing. But insofar as the programming side of the house, from the management side of the house, I didn't really see or appreciate any differences.

ROSIN: Does anybody have any contradictory evidence?

MANY: No.

ROSIN: How about now down in the engineering side, in the plant?

WILSON: Basically there were changes that happened in the course of production, but these were changes to correct problems that had arisen in the field. In general, it was always attempted at least to go back and make these changes in the earlier machines.

HOLBERTON: Well, remember that all the drawings on number one were different. Number two started the series in which the things were corrected to that phase, but number one was in fact different...

[10] It was 8.

WILSON: To point out the reason for that problem, in debugging the first system there were about eight people involved and we worked in shifts. People had responsibilities for different segments of the machine, but then generally that was divided between at least two people who worked on different shifts. No matter how good your intentions were, things didn't always get onto the drawings, or they didn't always get onto the drawings correctly. These things would be picked up later on, sometimes not until a while later. Then there were changes that were done deliberately to correct known deficiencies, like the early tape servos used a high-performance, multi-power motor to drive the capstan directly. This was very slow, which meant you wasted a lot of space between blocks of information, which was annoying as it slowed down the read-write operations. So we went to a high-speed electro-magnetic clutch. The first ones didn't work very well. There were a number of changes in the design of that clutch as things proceeded. Then things like you found after a while that when you turned the machine off and you turned it back on again you always had some tubes that died in the process. So you installed equipment to turn the voltage down gradually and to bring it back up gradually. Then after a while you stop turning them off entirely. But all of these things were changes that were based on performance experience.

CHINITZ: I have a comment in regard to that. It was also true that as these engineering changes were issued throughout the life of the UNIVAC I production, there would be change notifications and kits that went out to the field installations. Not every user chose to install them in the field, so those various systems would be in various stages of update. Some users wouldn't install them because it meant down time on the system and they weren't particularly bothered by that problem. And there was always that concern that if you shut the machine down to install the change you [might get] a host of new problems when you brought it back up again.

HOLBERTON: I question the 5,700 changes that's in Luther Harr's 1954 news release. In another report, I think it was Met Life talked about 150 minor changes, none of which were a major thing. So I was wondering where Harr's number came from.

TONIK: The only change I can remember that would affect anybody's programming habits was at the beginning they

were going to allow you to replace a block in the middle of a tape. But then they found out that the recording didn't completely erase what was there before, and they had to install an erase head.

HOLBERTON: We never taught them to do that.

TONIK: Well, it was possible.

D. ARMSTRONG: It was never done.

TONIK: You could no longer replace a block in the middle of the tape. You had to rewrite the whole tape, but I don't think that really affected anybody's programming habits.

ROSIN: Did it affect the ability of installations to exchange tapes?

HOLBERTON: No. I don't remember that ever being allowed even in C-6 code.

ROSIN: Well, I was thinking of backup processing, Betty, where somebody would allow somebody to use the system when their own system was down. They would march in with a bunch of tapes and [they had to be] completely compatible.

UNIDENTIFIED: Completely compatible.

ROSIN: Fine. That's great. Let me ask one question to follow up on that.

TONIK: After about system number ten or something, when they went to the top floor of the Pep Boys building and they set up this production line, they had five or six machines being built at once, and they would turn the machines off on the weekends. Sometimes I would go in on the weekends (sneak in -- didn't tell anybody), turn all the

machines on, and there would always be one that was running. I would run it and sometimes something would happen; you know, one of the error lights would come on. I could go to one of the unfinished machines, take a chassis out and plug it into the one that was running, turn it back on and completely redo the thing and run my program. They were completely compatible.

ROSIN: For the record now, I guess it may seem obvious today but at that time it wasn't, were there other systems extant when the UNIVAC I came out for which this was possible? Let me ask a different question -- take a poll. How many computers were there in the world when the first UNIVAC I was delivered?

HOLBERTON: Oh, I saw one in Manchester.

ROSIN: Digital computers. Electronic digital computers.

TONIK: Commercially available?

ROSIN: Not commercially available.

TROPP: There were a couple at Harvard and a couple at Bell.

ROSIN: We're talking about a dozen or two dozen machines in the world. Fewer than a dozen.

WILSON: And all one-of-a-kind.

ROSIN: And all one-of-a-kind. So the story you're telling us is that not only you were you coming out with the first commercial computer, but in fact you were coming out with the first line of compatible computers.

MANY: Yes.

ROSIN: That's a remarkable accomplishment.

TROPP: I am not sure even how compatible the various copies of the Princeton machine were, even though they all came with the same basic blueprints.

UNIDENTIFIED: What about the Lyons and the LEO machines?

TROPP: Well, I wasn't going to bring that in because I thought it was superfluous to our discussion, but that was a whole different world.

CERUZZI: LEO?

TROPP: LEO was a very, very different world. We were talking earlier about how people were worried about losing their jobs. When the Lyons people first got that operational, they took their clerks and staff around in small groups on a weekly basis to visit the computing center that was going to go in and do payroll and inventory control, to assure them that they weren't going to lose their jobs, and how this thing operated. It was a very, very different kind of world.

CERUZZI: Do any of you remember hearing of LEO at the time?

Many: No.

TROPP: Oh, no. It was used by [Lyons Tea Department] for inventory control and payroll.

HOLBERTON: Well, I saw one reference to it to...

CERUZZI: So you weren't really thinking of yourselves as being in the LEO tradition or anything like that?

Many: No.

TROPP: Arthur just had an excellent question in terms of this technology. Did you have to develop any special instruments or put together new combinations of instruments for testing?

WILSON: Yes.

TROPP: Okay, great! Do you want to elaborate on that?

WILSON: In the early stages there were simply no oscilloscopes on the market that were adequate for looking at the pulse pattern within a UNIVAC word. We started off by buying Army surplus syncroscopes and building our own front ends to them, and they worked very poorly. Then the first of the commercial machines came out. Now, I can't think of the name of the manufacturer. The first commercial machines that came out came out just about the time we were finishing BINAC and getting started on the UNIVAC circuitry. After getting on my knees and pleading, I finally got them to buy one. Suddenly we could see the things that we had been sort of playing games with before and seeing a line occasionally that might be what we were looking for. So this was a problem.

ROSIN: What about suppliers of specialized controlling [components] and pieces for your systems? Did you build everything from scratch, or who were your suppliers, and how did you evaluate their products?

WILSON: I was deeply involved in that because at one point I was responsible for acceptance standards on all the components we bought, and we had to develop our own specifications. We developed them basically by buying components and measuring them, putting them on our own life tests and seeing what happened to them, and then deciding how much to rate them. You would buy a ten watt resistor. What kind of wattage can you expect to dissipate without changing more than what percentage? Then you designed your circuitry to allow for the worst,

worst case of all of these things. But there were no existing standards that were really usable; we had to develop all of our own.

CERUZZI: I have a question here. I am not sure who submitted it, but today we are all comfortable with the notion of digital circuits versus analog, and I am wondering if there was a moment when you could identify your own memory that you were conscious of the fact you were working on something fundamentally different in electrical engineering or computing that's digital and not analog; did that ever occur to you at any time?

WILSON: I can tell you how the first program that I got involved with evolved -- it was all digital circuitry. At MIT there was a computer called WHIRLWIND, which was originally intended as a flight simulator. The original contract was to build an analog computer. The Servomechanisms Lab at MIT got the contract on the basis of demo nstrating a simulation of a control system that felt right to pilots. In fact, General Curtis LeMay of the Air Force came to test it out himself. After six months of trying to develop analog circuitry, Jay Forrester and company came to the conclusion that you could not get the precision you needed with analog circuitry. The decision was made that you have to go digital. Then they went looking for people who had some knowledge of digital circuitry. The only people who did were people who, like myself, had been involved with radar during World War II. So we suddenly discovered we were in the computer business.

TROPP: Back to the question that Paul asked; specifically, how did you decide when you got your vacuum tubes which ones you would keep, which ones you would send back? I know how they did it at MIT, but how did you do it at UNIVAC?

WILSON: We decided that the only way to have any degree of repeatability and reliability in what we were buying was to use only tubes that were in very high volume production. So we stuck to tube types that were used in home radio and receivers that were manufactured by the millions. Then we tested them ourselves and expected them to perform pretty close to manufacturers' specs, and then use them at a quarter of the ratings of the manufacturers supply.

UNIDENTIFIED: 25 L6.

WILSON: Yes, 25 L6s.

ROSIN: What about diagnostic software and, you know, the next level up? Assuming that the components worked correctly, how did you diagnose the mainframe?

HOLBERTON: NOF. [laughter]

WILSON: You sat yourself down and you decided what you wanted to test and you wrote yourself a little program in machine language. There were no programs available.

ROSIN: Did programmers do this or engineers?

WILSON: The engineers did it at first, and when things got too involved we went to people like Betty for help.

HOLBERTON: I've got a copy of "New Old Faithful" in my basement.

WILSON: Yes, Old Faithful was a routine that simply repetitively tested memory, and New Old Faithful was the improved version of Old Faithful. [laughter]

CHINITZ: It was an exercise. The checking circuits really are the things that told me when an error came up.

HOLBERTON: Well, it came from the BINAC tests; we had Old Faithful there.

TONIK: Betty put me and Bill Schmidt on a project producing this program that would test the computer. What we

did was we actually wrote a program that used every instruction, and we also did sort of the inverse. You know, if we did an add we would then do a subtract and check the results, and that kind of thing. And the program would run for, oh, I don't know, about a minute on the machine.

HOLBERTON: It sounded beautiful on the radio.

TONIK: And it would do every instruction, variations of it, and then of course it would check all the memory it wasn't using in the program. Finally it would do a couple of taped reads and writes to make sure the servos were working properly.

ROSIN: Did it involve...?

TONIK: And this was the program that all the engineers... or excuse me, all the maintenance men used on preventive maintenance shift. They would put this program on it; it would go "grrrrroooo, rrrrrooooooo." You know, the loudspeaker would allow you to hear what was going on.

WILSON: You bring up a very interesting point -- this business of the loudspeaker. When we were testing BINAC out, we were working two shifts and we worked all night long, and we had a radio going. After a while we noticed that you could recognize the pattern of what was happening at the moment by listening to the static on the radio. So I installed a detector in the console and an amplifier and a speaker so that you could deliberately listen to these things.

HOLBERTON: I would like to ask a question at this point. Does anybody know who actually wrote the first generator for the UNIVAC or for any computer that played music? I have got the ? but I don't have a copy of it.

UNIDENTIFIED: Who wrote it?

HOLBERTON: Herb Finney?

HUFF: Herb Finney, Air Force. Office of the Air Comptroller.

HOLBERTON: I wish there was a copy of the operating instructions. Do you have a copy of them?

HUFF: I've got a copy of them on tape. [laughter]

HOLBERTON: I'll give this to the Babbage if you give... Oh, it's on tape. [laughter]

WILSON: Well, if you remember it, the dedication party, when we got the first machine running, John Mauchly programmed...

HOLBERTON: No, I programmed that.

WILSON: Oh, did you do that?

HOLBERTON: I certainly did. It was supposed to have been a surprise, and we did it at 2 o'clock in the morning. There were some engineers working on the BINAC and they heard it. It was actually an interpretive routine. It only had eight notes and it played "For he's a jolly good fellow," or something like that. But it was supposed to have been a surprise and it wasn't.

L. ARMSTRONG: On music, I recall an early ACM meeting. Before anybody could do this, somebody gave a paper describing a program he intended to write for the composition of music. Not everybody thought this was such a brilliant idea. One of the people who didn't think it was so brilliant was George Stibitz. [laughter] And so George got up and gave an impromptu paper. This was back in the years of god-awful hand-painted ties. And he described a

program called SHUBAC, which would design hand-painted ties. [laughter]

TROPP: That sounds like something George would do. I want to go to one of the questions that's connected with what we have been talking about that's on [unintelligible]. Mine has to do with the delay-line memory, because having seen the specs that Pres was using, knowing how Wilkes scaled it down for the EDVAC, the specs were much stronger than EDSAC was of England. My question is, did it ever really work? And how did you keep it working, how did you keep it tuned, and what problems did you have?

UNIDENTIFIED: It worked beautifully.

TROPP: Because it had really high recall time.

HOLBERTON: I think you're thinking about the BINAC with a repetition rate with a four and a quarter or something like that...

TROPP: Yes.

HOLBERTON: ... Where we had to put Auerbach there beside the machine to keep it tuned up. But we certainly didn't have that.

TROPP: Was it slower for...?

HOLBERTON: Well, yes, because the fact that with all the problems we were having at that repetition rate, the UNIVAC was lower than two and a quarter. Two and a quarter, and then's when the tanks were shortened because we had to meet the specs per from the Census Bureau on a timing basis.

CHINITZ: Well, two and a quarter was the pulse rate, but the carrier frequency was around ten or twelve megacycles,

wasn't it? Lou?

WILSON: Yes, but that was not the critical thing; it was the envelope that you were concerned with -- not the high frequency.

L. ARMSTRONG: This morning there was some discussion of conflict between various elements of organizations and so forth. In the early days, I recall, there was a certain amount of conflict in the hierarchal engineering side, which pitted technicians, primarily former Army enlisted people with heavy radar experience, and engineers, whom the technicians thought looked down upon the engineers. This did create certain areas of friction. One of these was brought to light when the BINAC was delivered... flown out to the West Coast to either North American or...

MANY: Northrop.

L. ARMSTRONG: Northrop. Philadelphia decided that they weren't going to waste any valuable engineering time. So along with the device they sent out a crew of technicians who were to set it up and make sure it was tested out so the engineers could come out and demonstrate it. The technicians worked day and night, hard as they could, did an absolutely marvelous job, got it all polished -- white-glove inspection. And they went down to the friendly supply house, bought a small bottle of mercury, poured it on the floor under the ? crystals, closed the place up until the engineers came in. [laughter]

BARTIK: Well, Pres Eckert was so concerned about the delay-line memory that Art Gehrig and I did the logical designs for a backup machine for the UNIVAC I. We had electrostatic cathode ray tube memory, and it was microcode. We did the whole block documents for that machine, because he was concerned that it wouldn't work and then he wanted a backup system.

ROSIN: Was it logically different from...?

BARTIK: It was micro-coded completely, but of course it implemented the same instruction set.

CHINITZ [?]: Well, that was a cathode ray tube...

UNIDENTIFIED: Yes.

KOONS: I wanted to say that the concern about the mercury delay lines... This concerned the Bureau of Standards very much, and when we were designing the acceptance test for the UNIVAC, one of the things that I gathered from discussing what it should consist of with the engineers at Bureau of Standards was they didn't know which would be worse, whether it was loaded with pulses, or whether the pulses were sparse. So we did both. We loaded it as much as we could (we were not able to load it completely because of the coded decimal scheme), and we just loaded it with things that had only a few pulses. We did not have any problems, I don't think, with that particular phase of...

WILSON: A little anecdote that relates to that acceptance test. We were on the second or third time through the acceptance test and things were going reasonably well. Somebody decided they were cold in this old building that Al described before and reached up to close the window. And Pres said, "Don't touch that! Don't change anything!" [laughter]

ROSIN: I know some software that works the same way. [laughter]

TROPP: Whatever happened to that backup cathode ray tube?

BARTIK: Nothing, as far as I know. As a matter of fact I asked Art Gehrig. Univac, I think, has lost a lot of diagrams, because we kept log books... because Pres was very paranoid about patents, as well he might be.

CHINITZ: He published a paper on that -- an IEEE paper -- the patent on the cathode ray tube memory.

HOLBERTON: I never saw it. That goes into some micro-coded machine and I never heard...

HUFF: There was a test memory built as well, but there wasn't...

HOLBERTON: It was a decision to be made in January of 1949 whether to go one way or another. We had instruction codes already set up. E-1 and E-2 had already been going. The only thing I hadn't heard about was how they were going to get this code into the machine -- this microcode. That I don't think was ever decided -- how it was actually going to be streamed into it.

TROPP: How was the decision made to go the way you went? On what basis was that decision made? Do you remember, Jean?

BARTIK: As far as I know, Charlie Michaels was the person that was doing the research work on using the cathode ray tube. And of course RCA used some. I have forgotten who the guy was...

WILSON: F.C. Williams.

BARTIK: Rajchman. Yes.

HOLBERTON: I think it is covered very well in Herman Lukoff's book.

BARTIK: I don't know because I moved to Washington, and Pres was so concerned about it I commuted back to Philadelphia to finish these drawings.

WILSON: One of the problems that he was worried about with the electrostatic memory was what they called in those things the reround ratio. That is, if you are reading around a particular spot, you get scattering of electrons. And how often can you do this before you lose what you have?

TROPP: Back to a subject that you raised, Florence, and that was this question of acceptance. How did you decide what kind of acceptance tests you were going to have for something that hadn't ever been around?

KOONS: That was very exciting. We had all kinds of conversations about that. Primarily those involved as our consultants were the Bureau of Standards engineers and the statisticians at Census. The Bureau of Standards pointed out that [tests such as] loading the memory and letting it sit with lots of information, letting it sit with very little information, and then see if you get any problems. Also, loading the tape the same way; using the same piece of tape over and over and over again. Those were the kinds of technical requirements we were told to do. What I found even more interesting was [the fact that] the specs were set up in units of twenty minutes' work completed without error. The Census was happy to receive, and they accepted the machine, if it executed x number of twenty minute units within a particular span of elapsed time. That was really not much more than 50 percent. The fact that they could be happy with that kind of acceptance and performance on this machine indicated something about what they expected over what they were doing. To me, as I look back, this is one of the most striking parts of the acceptance on the entire thing. And as you say, we had to do it more than once to get things.

TROPP: It sounded like you were running acceptance tests on components, not on complete...

KOONS: No, it was complete.

TROPP: Was it complete?

UNIDENTIFIED: Yes, absolutely.

HOLBERTON: In fact, Al Tonik's initials are at the bottom of the coding, where you redid it and had conversations back and forth with Florence Koons. I gave a copy to her.

TONIK: I remember studying it and being there at the acceptance test to advise the engineer if something went wrong.

KOONS: I don't remember the details of it. Unfortunately, when I cleaned out my files five years ago I was very thorough, and I didn't even retain a copy of the C-10 code, which Betty was kind enough to make for me along with other things to help recall some things. But the one thing that I didn't need a piece of paper to tell me was twenty minutes [laughter], because that stuck in my mind from way back. And it said so much in just that one detail.

WILSON: One of the things that you have to realize in connection with what you test is that, when the specifications of how the machine was to operate were drawn up, many of the numbers that were given were simply pulled out of the air. Nobody knew whether you could do this or not. For example, Uniprinter, according to the contract, was supposed to operate at ten characters a second using a standard electric typewriter. We put it together and with every thing going in serial fashion you didn't do anything until the last step before it had finished, and it would only run at seven characters a second. So then came a big conference -- what do we do about it? Do we try to persuade them to back off on the spec, or do we try to redesign the thing? So we did both in parallel. We talked to them about the spec, and we designed a replacement chassis for the control chassis in the Uniprinter which would plug into the same socket exactly and use all the same pin connections which didn't do everything in parallel. [It] looked for the conclusion of several things going on in parallel and looked for whether they were all finished, and then went ahead. And that meant ten a second.

ROSIN: When I look through the literature on UNIVAC I it's loaded with a variety of peripheral devices. We have been talking about the CPU; we have been talking about memory. I guess the Uniservos have come up. What about all these peripheral devices? Which ones...? How did they come about? Were customers asking for them, or were they invented in-house? Which ones succeeded? Which ones failed? Betty, do you want to give us...?

HOLBERTON: Unityper I was my responsibility as far as figuring out what should be in it. It came from all the questions that came from A.C. Nielsen and Prudential Life. I have a bunch of these questions here with me. The

Unityper I logic was to be able, without seeing anything, to push a bunch of buttons and not have to worry about alignment or anything else, and have the whole thing be able to be unscrambled and get to the computer. The questions they asked were about the size of the block and how far can you go back. All this combination of things... Although we didn't get either one of the contracts, it had an awful lot to do with setting up a logic of a key device.

WILSON: Which became so complicated that it was unsalable because it was too expensive.

HOLBERTON: $18,000, as I recall, cost.

SBERRO: Anecdotally on peripherals, when it was realized that sales would require a square hole punched card reader, we obtained at Univac through an agreement from Compaigne Bull their punched card reader. And all the blueprints were in French. [laughter] Nobody could use them.

F. WOLTMAN: And then there was the card punching printer. Remember that?

ROSIN: Do you want to tell us about that?

F. WOLTMAN: Well, that came about primarily at Con Edison because of the large volume of data that was going out and coming back in. They did not want to have to keypunch all of those account numbers in recording payments of electricity bills. They sent out a bill and the vast majority of those bills were paid in full. So the idea was not to have to keypunch the account number and the amount, except on an exception basis. So there was that, and then also in some places they wanted to use a meter reading card to reintroduce the meter readings. What had been used before was mark sensing. But mark sensing was not the greatest. It did not have too good a reputation for accuracy. So the card punching printer was developed to meet this need for turn-around documents.

WILSON: Not many of them.

F. WOLTMAN: Not many, no.

DELVES: At GE, I don't know that we had a Unityper or... just had one, I guess.

HUFF: You had one.

DELVES: And maybe a Uniprinter... maybe one, I don't recall, but it was never used for anything if we had it.

SWEARINGEN: Just the console.

DELVES: Oh, on the console, that's right. But GE got, I think, probably the first High-Speed Printer -- the 600 line per minute, printer number two. We got the first and second.

SWEARINGEN: It took two to go.

DELVES: That's right, because the first one was scheduled to be delivered, like December of 1953, and it was. Some of you all know this better, but it was still in [production] in Philadelphia. So December 15 (whatever date it was) they just crated it all up and brought it to Louisville and delivered it along with all the engineers who were still building it. [laughter] So that met the delivery date. There's a funny story, John. You might remember, the engineers would get it to go and then they would put the skin all back on it and it wouldn't work anymore. Somebody... I don't remember whether it was you, perhaps, John, or somebody else that said, "Gee, it probably is afraid to work in the dark." [laughter] We just laughed about that, but the engineers put lights in it and it worked fine. [laughter]

SWEARINGEN: We were talking about preventative maintenance earlier this morning and I was thinking of the computer. I would have to say that the preventative maintenance on the printer and the card machine (and we happened to have two) was 50%. Because one of them was down, one was in operation. When one failed you hoped they would put the other one together so you could jump over and start using that. And that literally was the

way it was for about a year or so.

ROSIN: How reliable were Uniservos in that context? Did you also have spares?

SWEARINGEN: No.

HOLBERTON: You could program for eight. [laughter]

L. ARMSTRONG: They were a little hard to tune. Our engineers finally got tired of going back in there tweaking things so they put a blind screw on the upper right hand corner of the front panel. And the thing didn't seem to be working they would go up and turn the screw a little bit. [laughter] It always worked better afterwards. [laugh]

SBERRO: There were a host of technical problems on the peripherals that extended well beyond the company involved. That is, card stock for printing had to be of a certain specific thickness, environmental stability, and so forth; inks, ribbons -- all of these things on the high-speed peripherals presented new mechanical engineering problems. The thickness and quality of the paper...

F. WOLTMAN: Humidity control.

SBERRO: All of these presented new problems that the engineers at the companies had to go out and work with paper manufacturers, etc., etc. And so...

CHINITZ [?]: You need to keep the speed difference in that high-speed printer in mind. That was four times the normal tab printer.

LOUIS WILSON: At one point it was mentioned that a lot of these high-speed printers were going to be used for printing salary checks -- pay checks. And pay checks very often got cashed in bars. So a project was set up by one

Ed Blumenthal, and he put in a purchase order for a pint each of seven or eight different kinds of liquor to test the inks resistance to alcoholic beverages. [laughter]

TROPP: ... that shows great vision. We had a question raised at lunch. Jean Sammet suggested we ask the question just open-endedly. What was the UNIVAC 1-1/2? Does anyone want to respond to it? We may have to get you to respond, Jean.

L. ARMSTRONG: Oh, that was a machine and a half. [laugh]

HOLBERTON: That's all the extensions that people put into their machines for their one little thing.

TROPP: Jean says no.

ROSIN: Jean suggested it had something to do with the relationship between UNIVAC I and UNIVAC II.

TROPP: UNIVAC II and the instructions that were the number of characters.

HOLBERTON: I don't know what you mean.

TROPP: Jean, do you want to respond?

SAMMET: Yes, to the best of my recollection the situation was the following (and if I am remembering wrong I certainly hope somebody will correct me): because the UNIVAC I was a thousand-word machine there were only three characters needed for the address, and there was an unused character adjacent to those three address bits. This additional character was, of course, used by all the clever programmers. Fine, all programmers are clever. When we went to the UNIVAC II, which now went up to 10,000 words, that character was needed for the addressing. Fine. But there were a number of UNIVAC I programs that people wanted to run on their new UNIVAC II machines. So

there was a switch put on the machine which now blocked out the use of that fourth character as an address bit so it could do whatever kooky thing the original programmer wanted it to do. You had UNIVAC I; you had UNIVAC II; and you had UNIVAC II running in the UNIVAC I mode. But my recollection (and I recall getting bit by this a few times) was that there were a few very strange, quirky situations in which this emulation didn't quite work. That is when you threw the switch so that the UNIVAC II was allegedly operating in the pure UNIVAC I mode. That fourth character wasn't properly disconnected from the addressing, so that it didn't behave in the way the original programmer had written it.

HOLBERTON: That's probably true.

SAMMET: That situation was jokingly called "UNIVAC one and a half." There was no such machine per se. [laughter] It was just that quirky set of situations which occasionally occurred.

CHINITZ: I'm not certain that it was a problem with the fourth character in there. I think that the problem may have been related to a peculiarity in the two-word transfer -- that when you went off from the delay line to the core memory on the UNIVAC II there was a peculiar interchange if you used odd addresses on the two-word transfers that you didn't get on the UNIVAC II. You made use of that in UNIVAC I programming; that switch wouldn't take care of it for UNIVAC II.

SAMMET: Well, I think probably, Paul, what you are describing is the physical manifestation.

CHINITZ: No.

SAMMET: As a programmer, I...

MANY: It was the program.

CHINITZ: You had to start the two-word transfer at an even address.

HOLBERTON: But that was in the manual. The thing she is talking about wasn't.

TROPP: I think we ought to get on to other issues. Arthur, you wanted to say something.

NORBERG: This is not a technical issue; this is a contracting issue. The Army was not going to give money to continue work on the UNIVAC I unless it had a new label. I have seen some correspondence between the Army and Mauchly to submit a contract request for a machine called the 1-1/2 with some modifications on it. [laughter] I wish I had brought those with me.

HOLBERTON: I never heard of that one.

TROPP: Looking back at the list of broad questions you were supplied with in this session, Bob just pointed out to me that we have only touched the surface of the next to the last one, which I would like to read because other people are involved. "What is Univac's place with respect to operating systems, programming language, and application software?" We have circled around that question but never really focused on the actual role that you feel UNIVAC played in those broad areas.

ROSIN: Let me put that in a broader context. I think we would be curious as to what you knew about what was going on outside of Univac (both in the beginning and then in later times), and whether that influenced you, and how you believed that work in and with Univac influenced that work on the outside.

MAHONEY: Do you want to start that now? It's after 3 o'clock. Should we perhaps postpone that until tomorrow morning since that may be part of a larger question of data processing?

ROSIN: That's a good point.

MAHONEY: Well, there's supposed to be an open question period.

HOLBERTON: I would like to read one sentence from a document [dated] December 26, 1947 from Dr. Mauchly to me. This has to do with an information decision on UNIVAC code. This is the last thing he wrote on the bottom, the day after Christmas. "The instruction code should use symbols which are easily learned and identified with the operations by already existing mental associations: 'a' for add, etc." This is sort of the philosophy behind the code stuff.

TROPP: I want to apologize for my question; I'm running over. I misread the schedule. So I want to turn the session over to Paul Ceruzzi. And we'll leave the remaining half hour.

MAHONEY: But we will start with that tomorrow morning.

TROPP: Yes.

CERUZZI: Thanks. I think we have had some very, very stimulating discussions and there hasn't been any problem at all getting people to talk. [laughter] I've got quite a few questions here and I will sort through them. I also want to point out that those of you who are not at this table can answer questions. When you do, identify yourselves for the tape. I do want to just try to start things off by a little bit of summary from my point of listening all day. From the first session I see some questions that have been raised that perhaps we can address or continue on as this may find its way into publication, that there does seem to be a distinction between the scientific applications and the commercial applications that is not quite resolved, and probably won't be resolved today. But it's an interesting question. We had mention of sales people targeting top corporations as potential customers. The origins of UNIVAC came from Mauchly, a physicist, and there were lots of physics and numerical analysis at the origins. It had a 12-digit word length, which one person pointed out was a great thing. Yet at the same time it had, as someone pointed out, a lousy printer.

WILSON: Slow.

CERUZZI: A slow printer. Okay. It had taped memory that you can't physically read...

TONIK: If you printed too many zeros the zero slug would fly across the room. [laughter]

CERUZZI: The point is, I am not sure that we are going to resolve the question, "What was this machine all about?" I think that if you read Mauchly's own writings he has a very clear vision of this as a revolutionary, general-purpose device that would transform society. Yet you have a sales force that is in a punched card world selling to punched card customers, or accountants, or people who do things by hand.

HOLBERTON [?]: Afraid to take a chance.

CERUZZI: You have a lot of educating to do there, learning to do there. It did serious inventory control work at General Electric, and yet at the same time you have people saying, "This is a two million dollar machine; it's replacing people who are doing the job now with a pencil and paper." The thing that also I want to raise is the question, to what extent did people perceive this as a general-purpose computer in an environment of card program calculators, tabulators, mechanical calculators (we haven't talked about them too much here -- the Monroe and the Marchant), as well as the IBM 702 or the IBM 701.

HOLBERTON: That wasn't there at the time.

UNIDENTIFIED: The 702 came two years later.

HOLBERTON: Right. The 701 was after.

F. WOLTMAN: There's one thing in that connection that I think we should note. That is, we mentioned the feasibility and economic justification as coming largely, as we saw it, from replacing clerical people. Most of the early commercial applications were things like payroll, billing, accounts receivable, and so forth -- things that had been done on tabulating equipment. Correct me if I am wrong about this, but I believe that the real pay-off came more from inventory control, materials scheduling, and material control and so on and so forth. But those applications apparently had not been developed on tab equipment -- I don't know whether that was the reason why they were not chosen as applications but I suspect that is why. That could have made a big difference in the way computers were accepted and the degree of satisfaction they then would engender on the first applications.

WILSON: In looking at this question of John Mauchly's view as compared to what salesmen were doing afterward, remember that you started off with a nucleus of people who did not come from any existing art, who were recruited into a small, cohesive group that were full of enthusiasm for what they were doing, and who saw visions of wide applications for this UNIVAC, which meant Universal Automatic Computer. We were then bought up by Rem Rand who thought these idiots down in Philadelphia were insane, nobody would buy these million dollar machines, and there were very few applications for which they were really usable. These were people who were brought up in the tab equipment field, and there was almost no communication between the two. John's vision and what actually happened bore very little relationship from that point on.

R. WOLTMAN: I think you have to put on top of what has been said so far [the consideration of] Remington Rand's management and the way they went. I think beyond a doubt the UNIVAC has proven itself as a universal computer. It certainly has done many commercial applications and has done many scientific applications in the atomic energy field and other [areas]. I think it was very successful. But then you have got to remember that shortly after Remington Rand took over Eckert-Mauchly and started to create a sales force, they also went out and bought ERA who had a very successful line of scientific computers -- more scientific than general purpose. They were then faced with the problem of what do we do with these two lines. So they decided they would take the UNIVAC and emphasize the commercial application and take the 1100 series and market that as scientific. I think that's when the split came about.

CERUZZI: I think that helps to answer one of the questions that I was going to ask. You have gotten comments about how good the UNIVAC was for scientific work, and yet the IBM 701 outsold UNIVAC in many of the aircraft and engineering applications. So maybe that does help to answer that question. I wonder if there is anyone here who would like to defend Remington Rand management, because... [laughter] Do we have any volunteers for this?

TONIK: No, not exactly.

CERUZZI: No? Not at all. I just...

UNIDENTIFIED: Remington Rand management didn't know exactly how to handle this strange bunch from Philadelphia, but they did have the foresight to buy it. [laughter] Remington Rand was the amalgamation of all kinds of little businesses brought together, and this was just one more as far as James Rand was concerned. But the tabulating group, as a separate organization, had little contact with these people until we finally kind of forced ourselves on them. UNIVAC is oriented towards a lot of input data, and had the capacity later to have a lot of fast output on line... it used off-line printers. The punched card was the medium that lent itself quickly to input. Many installations were swayed immediately towards, in this case, IBM. They had a real foot in the door on that group. And it was a struggle from the word go on trying to break through to these IBM data processing crews to get commercial equipment in.

HOLBERTON: One of the things that I remember, after Remington Rand bought Eckert-Mauchly, for a period of maybe six months or more we were all going around saying, "Why don't they send the salesmen to the IBM training schools for salesmen?" We felt that IBM was making a tremendous sales [pitch]. The 701 was nowhere near as good electronically; the whole setup was nowhere as good as UNIVAC I, and yet they were selling.

CHINITZ: Much faster.

HOLBERTON: Only for certain things. No input/output. The former IBM salesmen [who were hired] would come to UNIVAC and would say, "We don't think those tapes are ever going to work. We didn't put tapes on our machines. The card is the thing." You'd be surprised. I've forgotten the name of the man, but he was a big fellow in IBM. He would come in to see the UNIVAC and make these remarks all the time. Tapes were never going to come in.

DELVES: I think Betty is making a very, very good point, that UNIVAC and UNIVAC users were very tape-oriented, or file-oriented, or however you want to talk about it. IBM's approach on the 701, 702, 705 was to really take what you are doing on punched cards and put it on the computer. Therefore, it was all very transaction-oriented. It was simple. The data processing people were comfortable with doing that. But those early applications at IBM were all very successful as far as the people were concerned, but they were not at all sophisticated.

WILSON: There is one other factor that I think is very relevant, and that's the question of production capability. When Rem Rand bought UNIVAC, they cut back on the plant production capability. They would not lease equipment; they would only sell it. In spite of having the production capability of only six machines a year, within two years they sold 42 machines. The result was they couldn't deliver the damn things. So there was no question that customers had to go to the opposition.

MAHONEY: A question about IBM's marketing strategy versus Univac's. My understanding is that when you rented an IBM machine you got more than just a machine -- you got the IBM sales force, which was trained in your business. They accepted responsibility for coming in and helping you figure out how you were going to use this. They had that experience from the tabulating systems. They would take on the problem of programming, installation, and so on. So they were getting a lot more than just a machine, whereas what Univac was offering essentially was just a machine.

CHINITZ: No, no, that's not true. That is not true because a contract for a UNIVAC system gave the customer a commitment that so many UNIVAC support programmers would be assigned to that account.

DELVES: But they never showed up. [laughter]

HOLBERTON [?]: That's not true.

L. ARMSTRONG: One thing I think is being overlooked here. This conference [is focusing on] a relatively short period of time early in the industry. Here we are talking about marketing skills and marketing strategies. Very few of these machines of anybody's manufacture were sold during the period we are talking about. Most of them, and I would guess 80% at least, were bought by the customer who made the buy, not the salesman who made the sale, although the salesman might get the commission.

CERUZZI: I think that we are still circling around a fundamental issue here about the relationship between the management style or the corporate culture of Univac versus IBM, where it seems that the IBM sales force, even if they didn't have to sell the 701, they had to be there to kind of soothe people who were nervous about it who had already decided they were going to buy a computer, and that was lacking in...

L. ARMSTRONG: That's called tap dancing.

F. WOLTMAN: We may be generalizing too much because I found in working with the local people there was the difference of day and night from one place to another. You would go into some areas and the salesman was excellent. Very often he was an old systems man himself who had grown up with the account. He knew more about the account and the customer's business than the customer did. This was certainly true of Al Yount and Great Northern Railroad. Great Northern couldn't do anything without Al Yount. Cecil Shuler was one of them. John Wright from Atlanta was another. There were many of them. But in other places Remington Rand coverage left a lot to be desired.

DELVES: I think we should also not overlook the fact that [under] Remington Rand's management style, if the salesman didn't get the job... didn't get the order, well, that was too bad. In IBM if he didn't get the order he was fired.

That was pure and simple. So if he didn't sell the 701 and they went to a UNIVAC, or if they didn't go with 702 or 705 and went to a UNIVAC, he was fired. Or else he was moved to the country...

SBERRO: I worked in both Univac and IBM in the period we are discussing, and there was a very distinct difference. Number one, IBM, as I saw it at the time, was organized in, if you would, industry groups. I was assigned for a while, for example, at Wall Street. Those people knew the brokerage business, the discount, the banking operation to a "T." A lot of them had come from there. That was their orientation. Secondly, I think a large part of IBM's approach was not to make revolutionary changes but rather, "Hey, we're making a lot of money on punched cards. Let's migrate slowly to upgraded IBM equipment and not make waves in X Company, but we'll do it on a gradual curve."

CERUZZI: I think while we are on this theme, it harkens back to something that has already come up that perhaps can be developed further, and that's the role of third-party facilitators like Arthur Andersen. Were there other organizations that played that role of not being the salesman, not being the customer, but sort of in the middle?

F. WOLTMAN: Ebasco was one. It was big in the public utility industry.

CERUZZI: I'd like to get to some of the questions that people have asked, because some of them are very interesting. Michael Nash asked the question that might apply to the General Electric Company, but anybody else as well. If there were people there who said, "Let's use this machine to help run the production line, and actually build our appliances or products." Does anyone want to answer that? It doesn't have to be a General Electric...

SWEARINGEN: Yes, our material control system was the beginning of that. And from that that was proceeded...

CERUZZI: Did people talk about automating the assembly line itself, having what we now call robotics, but maybe...?

SWEARINGEN: There was a big argument in the factories at that time where the oldtimers said, "We want to make green refrigerators all day long," and the other guy who says, "The orders don't come in that way and we can make

blue, white and green, one after the other, and the only way we will get there is with a computer."

CERUZZI: Was there a lot of progress made or did people try to...?

SWEARINGEN: Well, I was only there nine years; they hadn't solved it when I left. [laughter]

SBERRO: In the public utility business the machines went in primarily for accounting purposes, but a number of the engineers quickly came over and started to use them off-hours to look at load transmission distribution problems in an electric utility situation.

UNIDENTIFIED: But not control.

SBERRO: No, not control at that time -- but things they had been doing with analog computers, with patch cords, 8000 dials...

CERUZZI: In the popular press you get a lot of talk about massive unemployment caused by the computer, and I wonder if you ever considered those things as something to worry about.

F. WOLTMAN: We used to worry about it but it didn't happen to my knowledge.

HUFF: The Pacific Mutual Insurance Company (I think I mentioned this morning) got involved in looking at automation in 1952. Almost immediately they set up a program through their house organ where they would have an article once a month talking about electronics and how it was going to impact the company, and how it would impact the employees. They had a wonderful program where they would let everybody in the company know what the machines were going to be doing, when they were coming in, and all about them, and the fact that layoffs would be through attrition. They assured their people that they were planning this whole operation and that they were thinking of the people first and that their thoughts were in their mind right from the beginning. This program went

over a period of about three years before the machine was even installed.

F. WOLTMAN: Arizona Public Service did the same thing.

HOLBERTON: That's just the reverse from Franklin Life Insurance. I went out there as soon as they signed the contract in 1952, and I was told not to say who I worked for, only that I was going out there to find out what the insurance business and what each person in the company did. [laughter] Never having been in the insurance business I bought two text books on life insurance and I read up until I could get at least the terminology down, and I spent nine months going through that firm where little old ladies had these records in their drawers and they weren't willing to tell me what they were doing. It was very miserable because they were afraid they were going to lose their jobs, and they didn't know that their company had already bought a UNIVAC, had no idea; it was very quiet. So, here I was in an environment in which the people were afraid to even tell me what they were doing, and the company wouldn't tell them that they might lose their jobs.

WELCH: Well, in the account that was given to us this morning General Electric was able to apparently get rid of a large number of their clerks off in the payroll department. But you said at the same time they had a very vociferous union. Was there no conflict there that you felt?

SWEARINGEN: Well, the whole issue of employment was the underlying theme that General Electric wanted with Appliance Park. They built that new factory because they wanted to have fewer people building appliances. When they built refrigerators in Erie, Pennsylvania, there was a time when they had 18,000 people building refrigerators. At Louisville, the largest number they ever had in the refrigerator department was, at the beginning, 11,000. They continued to build more with fewer people. Now that was factory automation, let's call it, although it wouldn't look like today's automation. At the same time that plan was considered there was a row of six factories side-by-side manufacturing the major appliances. In front of that was going to be a large central building for the office building. That's where we were going to put the computer. That's where the staff would be, where all the clerical people would be. That building has never been built. Those people were never hired or never transferred; they don't exist. Today

it continues. There are fewer and fewer clerical people in that place, and I have this second-hand from a friend of mine who recently retired there. They continue to cut clerical staff.

SBERRO: There is a related personnel issue that I encountered particularly in insurance companies. Supervision of a large number of clerks -- 50 to 100 in a shop or a tabulating establishment -- was a stepping stone on the management ladder. Senior managers at some of those insurance companies were concerned that elimination of those work forces would eliminate that internal progression of managers. People would not know how that company worked from the ground up. Where would they get the next generation of managers, at least for that chain?

SWEARINGEN: I'll add a footnote to that. In the last three or four years that I was at that facility, each year I was told that I would have to proceed in the next year with fewer programmers.

HOLBERTON: Did they expect the machine to program itself?

DELVES: During this period that all this was happening the general manager of the Appliance Park whose name was Chuck Reiger, and this whole program was known as the "Reiger-Mortis" program. [laughter]

CERUZZI: Yes. Go ahead.

NASH: Well, I'd like to ask a follow-up question. One of the things that I was struck by, looking at some of the sales literature coming out of IBM in the mid-'50s, was that IBM was selling their machines to industry as a way of increasing control over the assembly line and supervision, and also as a way to eliminate factory jobs and reduce payroll costs. I was wondering if Univac or Remington Rand ever adopted similar kinds of sales appeals in industrial automation, or was that not an area that they felt that the UNIVAC could be sold on that basis?

CHINITZ: You mean advertised?

NASH: Advertised, but also in terms of direct sales appeal. If you look at the proceedings of IBM and industrial seminars they sold machines as a way of automating the factory, eliminating jobs, and increasing control of the assembly line. I was wondering if Univac ever adopted similar kinds of presentations.

CHINITZ: Well, I never recall much of anything of advertising of the UNIVAC by Remington Rand; I don't think there really was any. On industry-wide seminars, I don't think there were too many of those that were held [by Remington Rand].

CERUZZI: We have just a few minutes left and I wanted to just briefly move to some of the things in the second session on the technology. If I could just sort of feed back a little bit of what I gathered in the second session that there was a general feeling that the UNIVAC had its quirks and it was not an easy thing to use or to build or to design. But it did work and it worked very well, and it was a very solid piece of engineering and a revolutionary piece of engineering. In particular, we keep coming back to this theme of the tape versus cards. In fact, I have a sense that today we have a hard time thinking the way people thought back then, but perhaps people didn't think about computer; they thought about a machine that used tape instead of cards. I get the sense that they were pioneers. And maybe why pioneers don't always come out on top.

CHINITZ: Well, the tape and the card were in many respects similar. [Both were limited to] serial access to the data. The big difference between a computer with tapes or card equipment was that in the card equipment a lot of the operations actually were never mechanized as such. It was the operator moving decks of cards from one machine to another, whereas in the UNIVAC you were reading one tape and writing another, and then on the same machine you would read that tape back and you would do another and so forth. The manual effort that the tab operator had to do was really [a very time consuming] thing that was being mechanized.

HUFF: Let me give you a perfect example of this punched card philosophy. We bought a company in 1966. They had a 1410. We moved that operation to Nashville, and I saw their first application. They would bring in decks of cards and start feeding the cards into the 1410. Some of you don't know the 1410... it's a pretty large machine. They

would read the cards into the computer. If there was a card out of sequence the machine would stop. They would try to figure [what caused the problem, but usually they had to] start all over again. Now, to us in the tape business it was obvious that here was an awful lot of big machine time going right down the drain. So the first thing we did, we said, "Okay, let's convert these cards to tape first." Then the first thing we did on the computer was to sort [the input records] and go through a little error check process to catch most of the errors that [previously had to be found by clerks]. We were able to knock off on a daily basis about two hours of processing time on that one particular job. But they had this idea. The IBM people who were working on their account tried to keep them reading those cards because they were using up real good 1410 time, for which they were paying very much money.

TONIK: Yes. But you have got to admire the genius of Mauchly. He knew he was going to build a computer for business use, and he knew in business use they have fantastic files. The only way you could read those files at that moment was through punched cards. He knew he wanted to do something faster than that to keep up with this fast computer. So together he and Eckert designed this magnetic tape system which you couldn't buy on the open market. They had to design their own electroplating system to plate these tapes so they could manufacture them. Univac had to manufacture their own tapes; they couldn't buy them on the open market. With the tapes, you can read these files ten to one hundred times faster than with punched cards.

SWEARINGEN: Well, something we don't mention is that in business data processing a good amount of the time is spent not on calculations but on sorting. You would do a program, to accomplish something you would immediately need to change the sequence of the [data]. That's where the tapes showed up as being the only feasible thing compared to punched cards.

CERUZZI: How about if I take one more question because time is running out. Does anybody have any?

HOLBERTON: All the time that I was talking to Pres, he realized that the tape was just an interim device, that what you really needed for commercial machines was a random access storage. And he was busily thinking about drums and disks from the very beginning. We talked about it all the time. I don't know if you remember these idiotic things

where you had big files, and you had files with arms going down and jerking things out of the wall and all this kind of stuff. I mean, people were thinking of all kinds of exotic devices for random access memory. But I think everybody realized that the tape, being a serial device, was an interim device. I mean, it wasn't the end of anything.

CERUZZI: Okay. Last one.

WILSON: After the Air Force Cambridge Research computer was delivered, Pres and I were being interviewed by a reporter for one of the trade magazines. The question he asked and that Pres answered was, "What would it take to make machines like this applicable in every little business?" Pres gave one answer. He said, "You have got to get the cost of random access memory below a penny a bit." At that point it was several cents a bit. If you have looked recently, it's a couple of ten thousandths of a cent per bit now.

CERUZZI: Okay. This is by no means over. We are going to be reconvening tonight and tomorrow we will have another session, so obviously we haven't run out of things to discuss.

END OF SESSION

UNIVAC Conference

18 May 1990

SESSION 3

MAHONEY: Good morning, everyone. I'm glad to see that some things don't change. I've heard that this generation of programmers could party all night and program all day. I gather you partied all last night. We should probably go around the table with short self-introductions to remind ourselves where we came from and who we are, but also to get a sound check. I'm Mike Mahoney.

NORBERG: I'm Arthur Norberg from the Babbage Institute.

MATTER: My name is Bill Matter, I was with Arthur Andersen at GE in Louisville.

DELVES: I'm Gene Delves, same as yesterday, from Arthur Andersen.

DIXON: I'm Don Dixon, retired from Arthur Andersen and I also worked at GE in Louisville.

CARTER: I'm Lee Carter, also retired from Arthur Andersen, also worked in Louisville.

HAMMER: Carl Hammer, I was in charge of an installation from 1955-1957 in Frankfurt, Germany.

DANEHOWER: I'm George Danehower, Eckert-Mauchly until 1954 and then Arthur Andersen until retirement.

R. WOLTMAN: Dick Woltman, Eckert-Mauchly (May 1950) and was involved in the sales and systems analysis area during this period of time.

F. WOLTMAN: I'm Fran Woltman, was Fran Berthine same as yesterday. I was involved in systems analysis and

supervised a group of analysts who did surveys and proposals.

CHINITZ: Paul Chinitz, Eckert-Mauchly and Univac Programming and in charge of training up to the period of interest here in 1955.

HOLBERTON: Betty Holberton, Eckert-Mauchly and then David Taylor Model Basin, UNIVAC number 6.

MAHONEY: Thank you. I received for Christmas a curmudgeon calendar which has a daily curmudgeon remark. And as fate would have, on Wednesday morning I ripped it to read that "history is a set of lies agreed upon." I conveyed that to my senior colleague who said, "No, that is totally wrong. Historians don't agree." But it seemed to me a proper send off to come down here to an oral history conference. I don't know about the lies, but I hope we won't all agree, that makes it all very dull for historians. We have a set of issues we would like to pursue this morning starting with a general topic and then moving around back to some of the issues that were raised yesterday specific to the UNIVAC. It has to do with the data processing market and reminding ourselves that the data processing market in one real sense didn't exist before UNIVAC. That is, it is easy to go back and say what was going on with electrical accounting machinery was [considered] data processing, but that is to impose a later term on an earlier activity. So we'd like to pursue the issue of how that market was created, what that market looked like. And it is not only a question of creating a market for machines, but also for certain activities. In particular, again reminding ourselves, that as of 1946 there were no programmers. That was a role that was created. Eckert and Mauchly may have known what they were doing when they were hiring programmers, but did GE know what they doing when they were hiring programmers, and how was that role created. I wonder if we could open up with Betty.

HOLBERTON: I think one of the things that started the ball rolling was the start of the ACM, Association for Computing Machinery, in 1947. At that first meeting at New York University it was a night meeting and we all went up on the train, and we signed a document that said these were the rules we were going to live by. But the second meeting in Aberdeen brought out a tremendous group of people who were interested in computers. I have a copy (I didn't bring it with me) of the roster of the people who were there. That was then followed by Oak Ridge. This was

kind of the beginning of a group of people who were interested, got together, and talked things over. And as far as I can remember, this is the way it all got started. The first [meeting was] at the Harvard Symposium in February of 1946, but that was an invited kind of thing, and they had another one a year after. The other one was open to anybody. As you read that list you'll see people that you remember, and they finally did buy a computer. It was, I think, the beginning of everybody talking to each other.

CHINITZ: Well, certainly programmers did exist before the UNIVAC I and the BINAC, the machine they programmed for in particular in 1948 [developed] from the Mark II at Dahlgren in Virginia. Dick Hoffman and I came from Dahlgren and Grace Hopper was there as a consultant periodically.

MAHONEY: Do you think of that position as tied to a specific machine, or was there a sense that there was an activity called programming that was independent of the machine? When did that idea arise?

CHINITZ: Well, certainly speaking of this period 1948 through 1950 at Dahlgren, Virginia, the programmers were tied to two machines. The mathematicians who did the programming were tied to two machines, the Harvard Mark II, and later the Mark III. There was a tabulating group there, under Don Heiser. He was at the Naval Proving Ground at the time. They had a tab group also doing computation, but they were physically and administratively separate.

HOLBERTON: But no job descriptions on that basis. We were called "computers" during the Eniac computing period at Aberdeen.

R. WOLTMAN: At that time our civil service title was mathematician P-3.

HOLBERTON: That's right.

MAHONEY: When was the position of programmer established, was it during this period?

GENERAL [Armstrong, Koons] No. After. I'm sure it was long after. It was not until 1950, or later.

KOONS: I would like to point out that at the Bureau of Standards we were programming not for just one machine, but they were all fictitious in the sense that they didn't exist. They were all designs for the SEAC, the Raytheon, the ERA, and the Eckert-Mauchly machines. It was not tied to any particular machine.

UNIDENTIFIED: Three[?]-dimensional programmers for two-dimensional machines.

R. WOLTMAN: At that time we called the activity at Harvard "programming." I think we recognized that other groups at other universities were doing a similar kind of thing, but we also called ourselves mathematicians. We thought of ourselves as being that, not programmers. We were mathematicians working on this new tool to aid our field.

F. WOLTMAN: When I was hired in September 1950, I was hired as a programmer. That was the title.

HOLBERTON: Well, one of the problems that we had originally with the Bureau of Standards was that everybody was programmed for a different machine and we didn't speak the same language. So three of us got together at Eckert-Mauchly: Viola Hosepian [?], Betty Bartik, and myself. We wrote up a set of flow chart symbols that became the standard for communicating the procedure to be executed by the computer.

R. WOLTMAN: The letter of offer from Eckert-Mauchly which came from Herb Mitchell to me in 1950 listed the position as programmer. So sometime in there we made the transition.

UNIDENTIFIED: I was hired in August of 1949, and I was hired as a programmer. Civil service didn't recognize it.

MAHONEY: John Swearingen has joined us; Roddy Osborn was supposed to but was unable to make it, so John joined the group because he was at GE at the time.

SWEARINGEN: When Roddy Osborn hired me in April of 1953 his staff were called "procedures analysts," I believe. They consisted of persons who had gone through appropriate GE training courses and had been stars in those classes and also who were MBAs, at the time when MBAs were rather scarce. But he hired me in spite of the lack of MBA because I had experience with tab equipment. He said, "We're thinking about getting a computer." He didn't hire me as a programmer, he hired me as whatever title the rest of the staff was. But I got on that staff because the computer was looming in the background and I think all the people who followed me on that staff were hired because there was a computer coming or there was one already there. So their destiny was programmer, even though we did not use that title at that time.

CHINITZ: The question as to when the distinction came about between what was a programmer, a coder, and a systems analyst is relevant. I think pretty early at Eckert-Mauchly there was some feeling of distinction between who was a coder and who was a programmer. The programmer tended to set out the general logic of the problem, and the coder was perhaps a more junior person at the time who [then encoded] it in machine instructions. It was somewhat later when we got more into commercial applications that we began to recognize the concept of systems analyst and did a staged problem specification that was above that of the flow chart.

MATTER: I noticed the people who talked earlier about computer-oriented things in the late 1940s and the very early 1950s are from the East Coast. I was from the Midwest in the Chicago area, and I didn't know the word computer in 1950.

CHINITZ: Me either. I came from Iowa. [Laugh] I only got into computers because it was the only job offered me when I graduated from college.

MATTER: When was that, Paul?

CHINITZ: In 1949.

MATTER: 1949. And you knew about computers?

CHINITZ: No. I didn't know anything about computers, I had never even used a desk calculator. But I was a mathematician, and the civil service [and] the Naval Proving Ground was going around looking for graduate mathematicians to work with computers. I didn't know. I had some application form, I filled it out, sent it in, the next thing I know I got a telegram with an offer of a job in Dahlgren, Virginia, and I went there. I borrowed money to get there, went there early to stop at the Proving Ground to find out what this job was they wanted a mathematician for because if they expected an Einstein I wasn't going to take it. [laugh] Then I met Dick Woltman who was showing me around the Mark II computing center, and I looked at him and I thought he looked like a human being, a person I could understand. If he could do the job of programming, I thought I could. [laugh] He's been my friend ever since. [laugh]

HOLBERTON: The whole time I was at Eckert-Mauchly, I never even asked what my job description is, and to this day I don't know what it was.

MAHONEY: I want to ask some of the Arthur Andersen people about programmers, or these programming activities. What did you tell customers about the need for a new kind of personnel?

DELVES: Lies. [laugh]

MAHONEY: It's nice to know some things remain constant. [laugh]

DELVES: What did we tell clients?

MAHONEY: When they bought this machine did you tell them that they were going to have to hire some people with the machine?

DELVES: Sure. The general approach was that you took application people and you taught them to program. I know long debates about that. Was it better to take a programmer and teach the programmer the application, or was it better to take the application specialists and teach them programming. Since we thought programming was pretty easy, why we almost always recommended that they go that way.

DIXON: Also in the earlier days there was no market to go out and hire a programmer. You had two problems. One was that there was no market to hire a programmer, the other, the need to have the application knowledge because the commercial applications would be fairly broad from one end to the other. Then [there was the] social problem that came up yesterday -- the replacement of people. [Were we] to offer that opportunity to existing employees to be part of this new program? The criteria, I think, were usually some demonstrated analytical ability or skills or education. But probably more importantly, that they work hard.

NORBERG: How were these people evaluated once they began to work hard?

DIXON: Whether or not the results worked. I'm not being facetious. There were no guidelines or rules in the beginning, so that you had to work against results. We would try to estimate how long something was going to take, and what it was to do when it was done. Then you'd just make a judgement call.

DELVES: We used to review programs very carefully. Mo and I were talking this morning about this one guy named John Fedako who was really smart and he could write the cleverest programs, they were always cute, you know? And we fired him. [laugh] We had to write everything over. But that was really the evaluation, was, "How did they work?"

HOLBERTON: You brought up the idea that you favored the people who knew the applications. I think there were a number of us at Eckert-Mauchly who felt if you used people like that all you were going to do is translate the same methods into the new computer, which we knew would not be economic. And this worried us an awful lot, that they

wouldn't take a new look at the way the problem was defined.

CHINITZ: In running the training department for three years in New York [with an enrollment of what] must have been well over a thousand people [I believe], the bulk of those people that came from the business prospects or customers seemed to me to be of the age group where they had already [been employed by] the company and were selected to be trained as programmers and/or as systems analysts. How many of those had a previous background in tabulating machines, I'm not certain. I don't think that a predominant percentage of them did just judging from my recollection of how difficult [it was for them to] grasp the principle of the stored program.

DELVES: I think in response to what Betty said, and along the lines [of what Paul said] too, is that the tabulating people were a curse. You didn't want them on the project if you could avoid it because of what you said. They only could think in terms of doing things in a transaction-oriented way.

MATTER: ... the sorter and the collator.

DELVES: Right. So the preferable type of persons were the people who really knew customer accounting or who really knew material control area.

F. WOLTMAN: They had procedure analysts in some places.

DELVES: Yes, that's exactly right. And not the people who had wired the boards.

NORBERG: I'd like to go back to what Betty said for a moment, if we can. That is, who wouldn't take a look and how did you people go about trying to convince them to take a look.

HOLBERTON: Since I worked on sorting for so long and I knew it was going to be very expensive, I knew that it was much cheaper to rent a sorter than it was to sort on UNIVAC. We had to avoid sorting, which meant that you may

even have had to go to the top of the company to change the procedure for how they run the company. This was a very delicate thing, to change the way in which they were doing business. I think it took some companies a long time to come to that realization. I know that Prudential had some wild ideas that you would have a computer available all day long with five hundred reels of tape lining up on the ceiling, which would drop down automatically to come through and [locate records of] a man who had a policy -- who was on the phone -- and in three minutes get an answer to him. All of the policies. For years they had that kind of philosophy. I doubt if they hardly would have had an answering service now.

NORBERG: Considering what some of the women said yesterday about how they were not listened to, who was trying to do the convincing? Was it you, or...

HOLBERTON: Well, at Franklin Life it took me a year to convince them to go to a single file.

F. WOLTMAN: We had people like Steve Wright who acted as trouble shooters who went out. I remember talking with Steve after he came back from, I think it was from GE, and the payroll was taking so much longer than GE had anticipated. He introduced the concept of exception processing. Not dragging one hundred percent of the transactions through all the routines, when many of those routines only affected five percent of those employees. That apparently was a new concept.

SWEARINGEN: At General Electric I think we avoided using the term programmer for a great length of time. We used analyst or something in front of it -- systems analyst, program analyst, procedures analyst. Eventually I believe we did begin to use programmer for a lower level, almost an entry level. After the initial group was hired, the people then began coming from the subject areas. Most of them related to accounting, typically they were people who had been through the business training program at General Electric, which was kind of an MBA-like in-house training program; people who, through the course of our work in their department, had been our contact, our liaison, and who showed a strong interest and support for it. So we captured those people, in effect, and brought them into computer activity. I don't know if I could say that we ever had anybody who was a coder. Maybe a trainee was in that style of

operation for a while until they metamorphosed to full responsibility.

HOLBERTON: It's a stigma associated with it; you had to put on an extra little adjective in front of all these things to make people feel better.

SWEARINGEN: It also had to do with their responsibility. They were given a task which was defined in what the area of coverage in an office was. It was up to them to define it in terms of how to put it on the computer and then program it to make it work on the computer. So, they were not given a block diagram and told to write code for it.

MAHONEY: If I can follow that up a second John. That would seem to mean that one took programming a computer as another technique that would be added to one's training, just as statistical analysis would be, or accounting. One would view that programming as part of a job. There was no career as a programmer; programming was simply a tool that one had in various career tracks in the company. Did that change, and if so, when?

SWEARINGEN: I left Major Appliance in 1960 and went to the Nuclear Energy Division which, because of General Rickover's influence, was using a Philco computer and FORTRAN, and there we programmed a payroll and a general accounting system in FORTRAN. I had programmers because I had systems analysts who laid out the program and handed it to the FORTRAN programmers who then wrote the code for it. That was in a different division and it was an extremely different culture because it was driven by the scientific side of the house.
DANEHOWER: But apparently that person was really a coder although you indicate...

SWEARINGEN: Yes, at that location.

MAHONEY: So the different divisions would create the career track as they felt the need to.

SWEA RINGEN: Yes.

DIXON: I think the two points that Betty raised -- on one hand the inclination of internal people to automate the status quo, and at the other extreme the expectation of miracles by management -- created the role for people like Arthur Andersen and others to bring in that objectivity and independence and to act as a catalyst. It created a whole industry -- not as a consultant, but as an implementer involved in detailed design and installation of major commercial systems.

MAHONEY: Did Andersen, then, create a role of programmer, in the extended sense of someone who understood computers?

DIXON: All of our people who worked in what we called the administrative services division received detailed programming training and did work as a programmer as a prerequisite for doing design work -- just for a skill level. Except for that type of thing, the main thrust of the work was not to provide programming but more the design, project management, implementation and testing -- you know, the whole broad scope. We looked to the client and the manufacturer to do more of the coding, if you would.

DELVES: As far as I know, and I've been gone for several years, but everybody in Arthur Andersen Consulting and Company -- how many are there, fifty thousand or something like that -- has to be a programmer first. That is still the rule.

CHINITZ: You mean has to have the skill?

DIXON: You had to have spent some time in writing code and making it work, as opposed to concepts.

MATTER: Don't do it anymore.

MAHONEY: We've got a consistent question coming over from the left. IBM marketed computers on the principle that you could just use your tab people, and that's how you used computers. I take it UNIVAC did not follow that.

F. WOLTMAN: I didn't understand what you said.

MAHONEY: IBM marketed their computer, when they went to companies it said, "Look, just take your tab people, and move them onto the computer. The way you use your tab equipment is the way you will now use the computer."

F. WOLTMAN: Yes, we ran into that. In many places where I or people on my staff went to do surveys and prepare a proposal, IBM would also have representatives there, Honeywell, and other companies later on then, too. IBM always was trying to keep as much of the equipment that they already had there if it was an IBM installation. So it was to their advantage to change the procedures less and to our advantage to get away from that and get people to think of a more efficient way of doing things, getting away from sorting and all that kind of thing wherever you could. We stressed specifying the requirements of output. We asked what documents they had to produce to send out bills, invoices, statements, paychecks depending on the application. We asked questions like, "What kind of records must you maintain and have visually available -- a master file in some form to answer customer inquiries or for internal inquiries.?" [We] put the emphasis there, and then asked where this information came from, how is it maintained. We were trying to establish basic requirements independently from the way these requirements were met in existing procedures.

MAHONEY: If I'm hearing things correctly, when the customer talked to someone from UNIVAC, the advice was "use the computers as an opportunity to rethink how you do your business." If you talked to somebody from IBM, IBM said "Look we have this machine for you, you can continue business as usual." Which sold? Or was that a problem?

SWEARINGEN: IBM was upgrading their present customers. In the 1960s I was an officer in the Data Processing Management Association -- twenty-five or thirty thousand members -- and I would go to chapters as a dinner speaker. I concluded that that organization consisted of twenty-five thousand people who used IBM, and me using a UNIVAC computer. [laugh] Invariably at a chapter meeting, unless it was in a large city (a hundred and fifty

chapters scattered around the country), someone during the course of the evening and probably more than one would come up and ask me some things about computers -- how do you do it, what were we doing, that sort of thing. They would inevitably stand up and say, "It really sounds good, but my little company will never be able to afford one." The thing that changed that conversation was the 1401, because that went into that same room under that same supervisor. It was just an expansion of his present equipment, and he learned how to program it. He programmed it because he was the manager, they made programmers out of them. I do believe the 1401 is the watershed event that separates UNIVAC from IBM. Because at that stage IBM capitalized on all their installed base tab equipment.

DANEHOWER: At that time, what you say is correct on the surface, I think. Many of the IBM sales people were saying, "Hey, you can just use your existing tab people." But as a practical matter, and I think maybe as far as IBM's corporate thrust, what they meant was that the tabulating supervisor, as opposed to your tabulating operators because the typical operator didn't know anything about the system. I mean, he knew his particular role. He sorted these particular columns, he didn't know why, but he sorted these columns. However the typical tab supervisor knew the entire process, from the input, from the source document, all the way through. So, when IBM was talking about using your existing people, I think they were really talking about (and did use) primarily the supervisory personnel as opposed to the [tab operator].

CHINITZ: Ones that did the plug board wire.

DANEHOWER: Yes, okay, that's another good way of saying it.

DELVES: I think that, maybe this shouldn't be on the tape, but there was also rather a cozy relationship between most IBM salesman and most tabulating installation managers. Since the tabulating installation manager was generally the one who ordered the equipment, it was certainly to the advantage of the IBM salesman to maintain a very good relationship and not put the guy out of a job.

CHINITZ: But I think that was true also in the Rem-Rand tab installation. There just weren't that many, and the salesman were not that interested in selling UNIVAC. In fact generally, those installations as an average were much lower in equipment size, and therefore the step up to a million dollar UNIVAC was beyond their capacity. I agree that the 1401 was a watershed in the industry, but don't you feel that the 650 had also prepared a great many of those users? It slipped right in to the existing punched card processing scheme. It was punched cards in, it was punched cards out, and it was just like it was a bigger calculator for them. You didn't go to this difficult concept of the non-visible record, where you could not go and pick out an individual or an account and look at the thing. You had to go through the computer to do that, and that forced on you a change in your system.

SWEARINGEN: I don't think the 650 had that big an impact. It did some places but it wasn't much of a machine to begin with. It was kind of a big calculator.

HOLBERTON: A lot of people were looking for a big calculator, certainly in the scientific area.

SWEARINGEN: But that was scientific. That's not the bulk of the tab jobs. They were working on inventory and payroll.

MAHONEY: One more question before we shift to other areas. I'm not sure after a day and a half whether anyone wants to talk about the UNIVAC marketing strategy. [laugh] But nonetheless, there was a role created (this was mentioned yesterday) there for a mediating group. That is, if getting UNIVAC is an invitation to rethink the way you are running your business, then there are companies like Arthur Andersen and others who are ready to help you rethink how you run your company, in ways that IBM and their cozy relationship doesn't open up. Was Andersen aware of this aspect of it?

DELVES: Oh, sure. That's why we were there really.

CHINITZ: Didn't it affect the public consultant? Because a great number of them were the auditing accountants, and

when [their clients] went to magnetic tape and things, they had to have an important role to play in that planning. How were they going to audit those accounts and procedures?

DELVES: That really didn't change much for a long, long time because auditors worked with output, you know. It was a subject of endless discussion, you audit around the computer, through the computer, and of course auditors forever and ever, still audit around the computer.

HOLBERTON: The insurance business was mighty uptight about putting their records on magnetic tape because they weren't sure it was going to hold up in court. That went on for years.

SWEARINGEN: In terms of consulting, another reason why I wish Roddy was here, but he at one time told me that "When we finish this installation, our group could be consultants to General Electric, and go through the company installing computers for other General Electric divisions and departments. Then maybe we would even go out and become outside consultants either company sponsored, or independently." So even during that very early stage when Roddy was involved with these things, he was thinking in terms of consultants. He knew what bills he was paying you, and what rates you got, so he saw the better side [laugh] of him being a consultant.

NORBERG: George, could we get you to amplify your comment please. It was not quite clear. You said, "That's why we were there." You were where and doing what?

DANEHOWER: Well, that's why Arthur Andersen was there, in that there were those people at the management level in Arthur Andersen that saw the future much clearer than others in Arthur Andersen. Gene can probably give you more background on how Arthur Andersen got the GE contract, how they sold the contract. But they were foresighted, that is my point. I don't know if that clarifies it.

NORBERG: I'd like to rephrase my question then, and it will get to that point because you've led us right into the next area that Mike and I were interested in pursuing. That is, yesterday afternoon an apparent contradiction arose in

what we were hearing from participants around the table. At one point a gentlemen made a comment that "machines were not sold, machines were bought." At the same time people from the machine manufacturer/designer side were claiming that it was necessary for them to get people to move from tabulating cards to tape or to digital machinery. In other words, there was a need to create a market. The question that you raised now, and that you sort of tried to pass on to someone else, is how that sale of computation was made. We would like to ask both sides of this group to address the question of how did you sell computation. How did the people from UNIVAC in this case sell computation to a potential user outside, the surveys, and so on? Secondly, how did you people sell it to management inside, or how did management sell it to you inside Arthur Andersen or GE?

MATTER: I'd like to offer an opinion on that. The opinion is based on my own personal beliefs and not any real factual knowledge. But if I put myself in the position of Roddy Osborn at General Electric who had this wild concept that we ought to have a computer processing data at Major Appliance Division, I would want all the help I could get. Arthur Andersen had made some preparations to these ends. Yes, there are some of us who actually learned how to write some computer code and those kinds of things. To my knowledge you didn't have any alternative. If you want help from an outside, independent organization, Arthur Andersen is your choice. There wasn't anybody else. If you wanted a computer to process the data, you had one choice -- you could buy a UNIVAC. So it really wasn't very difficult to make alternative decisions. You either decided yes or no. I would suspect that's how Roddy Osborn, as a driving force in all this, was kind of impelled or compelled to make the decisions that were made.

HOLBERTON: Well, that didn't influence the sale though did it?

MATTER: If you want to buy one -- that's where you got it.

HOLBERTON: I mean was the decision to buy made before Arthur Andersen was brought in?

DELVES: I think the decision to have a computer, if it was feasible, was made. Wasn't that right, John?

SWEARINGEN: Oh, yes.

DELVES: That was part of Roddy's idea that we were going to start everything new and this is a fully automated factory.

HOLBERTON: It is too bad there is nobody from Metropolitan Life here because it seemed to me they did the longest, deepest study and running of a system before they signed off on it. And I don't know whether they had any outside help or not.

DELVES: I would say that in most cases subsequent to General Electric, that no, there was no decision made in advance; that, yes, we're going to get a computer. There was "a feasibility study;" there was always a feasibility study that determined whether this was something that was feasible. Usually that was economically feasible, rather than physically feasible.

HOLBERTON: Franklin Life bought it from the local salesman. He sold it. He was a tab man.

NORBERG: But you said you spent a year there to convince them that they should buy it.

HOLBERTON: That's right, but they knew they needed a machine. They were getting beyond themselves in the building size, and the employees.

SWEARINGEN: Well, Franklin Life had come down to see us as part of their feasibility study to see whether a computer would actually do things like that.

DANEHOWER: I would question your point there about the tab salesman selling Franklin Life.

SWEARINGEN: I suspect he took the order.

DANEHOWER: I would question that.

CHINITZ: The insurance industry had a forum, early, for the use of large computers. They had the actuarial society committee studying that for many years so that the concept and the results of that evaluation spread out on all the insurance companies. So I think that the concept of the computer as an important [tool] by the insurance industry was generated from within on that. I rather suspect that for a large number of other industrial companies, the concept of going to a computer, or at least investigating the thing, came by an osmosis from the publicity that was generated not only by the election, but also by major insurance companies acquiring systems and [using them successfully].

DANEHOWER: Having been on both sides here, by that I mean UNIVAC at one point and Arthur Andersen on the other, I might be able to address your question. I'm over simplifying greatly here. I'm talking 1950 through 1956, thereabouts. One the UNIVAC side, as we have indicated I think many times yesterday, the machines were not really sold. Certain companies had certain kinds of problems, and they were basically two. On the commercial side, they had technically large data processing applications and that application in terms of input was growing. So they saw future problems, and they heard about the computers, so they made inquiries. UNIVAC basically responded to those inquiries. On the scientific side, typically, they had a problem that they would love to solve somehow, but were unable to because they didn't have the tools. They heard about the machine and they made inquiries. So, on the UNIVAC side I think, typically the ultimate sale was actually made through a process of responding to inquiries of those two basic types. On the Arthur Andersen side (Arthur Andersen having been at GE and even prior to going to GE) as Bill said, the people at Arthur Andersen were already programming. Right?

DELVES: Right.

DANEHOWER: So Arthur Andersen was at GE, actually worked on putting one in. The same thing happened with Arthur Andersen's clients and non-clients. That is, as general business began to learn and hear more about computers they began to make inquiries of Arthur Andersen. So, once again, in this 1950 to 1956 period, I think that

early Arthur Andersen sales were mainly, at that point at least, in response to inquiries from clients that had these two kinds of problems.

MAHONEY: Follow-up. I have here... I feel like Joe McCarthy. [laugh] I have here an article by John Higgens and Joseph Glickauf, *Electronics Down to Earth*, published in Harvard Business Review, February 1954. I have a note at the bottom of the page. Was this article picked up as a promotional brochure by UNIVAC?

CHINITZ: Was it issued?

DELVES: Oh, yes.

MAHONEY: Was it picked up as a brochure, too? What was the response to this article?

R. WOLTMAN: What was the title of that?

MAHONEY: *Electronics Down to Earth*. Essentially about why you should get a computer to run your company.

R. WOLTMAN: I think that was an article I gave to the archives section yesterday, and that particular one was published by the Harvard Business Review, reprinted. Remington Rand, I think, paid for the reprinting of it and distributed it as a sales piece.

NORBERG: Can we come back to the question George is elaborating. That is, the only client we've heard about from Arthur Andersen is General Electric. Who are the other clients in the same period?

DELVES: The second client which followed right away in 1954 was Commonwealth Edison in Chicago, and that was a 702. Edison engaged Andersen to do an evaluation, although Edison had a team, which is where the Andersen task force really got indoctrinated in computers was on the Commonwealth Edison team, led by Bill Ellingson. They had

been studying the UNIVAC versus the IBM 702. I frankly don't know all the ins and outs of that one, but Edison had a very, very strong inclination to IBM. So they chose a 702, which of course didn't work. But ultimately it did work. So that was simultaneous with General Electric. The next one after that was International Shoe Company, which was a 705. And Pure Oil which was a 705.

DANEHOWER: Right.

UNIDENTIFIED: You were at Pure Oil when we were at Shoe.

DELVES: Talking about the insurance and electric industries... The utility industry also has its own forum within their industry.

F. WOLTMAN: Edison Electric Institute and then there was one for the gas companies.

R. WOLTMAN: They were very active in pursuing and studying this whole area and every utility knew what every other utility was doing, what they were studying, what they were thinking. We worked [with many utilities], doing studies -- mostly revenue accounting, sometimes with payroll. And Con Edison was one of the more successful ones.

Somebody asked yesterday if there was anything good that anybody could say about Remington Rand management [in the corporate industry]. They did have one department there which was very useful and helpful to both the UNIVAC sales effort and the tabulating sales effort. They were independent of both groups. It was called the Industry Marketing Group, I believe, a [vocational sales department]. They had specialists primarily in utilities and in insurance. They covered the nation, and were there to assist salesmen in any activity that they wanted. They were very helpful in pursuing both the insurance and the utility fields.

F. WOLTMAN: That Con Edison project was the first survey I did. Harry Berger was the man from the Vocational

Sales Group. He and I together worked with the Con Edison study group for almost a year in defining the revenue accounting and billing application, and the payroll application, and then preparing a proposal. From there we went on to many others: Boston Edison, Detroit Edison, Baltimore Gas and Electric, Arizona Public Service, Houston Light and Power, Pacific Gas & Electric -- all over the country. We used to go to the annual meetings of the Edison Electric Institute and make presentations there. We went to Toronto to make a study and present a proposal to the Ontario Hydroelectric Power Company. Carl Hammer and Harry Berger and I went to Water Resources in Puerto Rico and prepared a proposal.

NORBERG: Do you have any recollection of what the success rate was in these various surveys that you did with these companies?

F. WOLTMAN: My staff and I did some thirty surveys from 1954 through 1956. These resulted in orders for twenty UNIVAC systems.

DANEHOWER: Picking up on the Arthur Andersen side -- starting around 1955 or 1956, as we indicated, IBM began to enter the picture quite a bit. So many of the Arthur Andersen clients then were hearing from IBM. Some of them were also hearing from UNIVAC. I forget who at that time, but other manufacturers were beginning to enter the picture. The point is that Arthur Andersen was very well situated at that point in time because the clients were themselves getting interested, but they were also learning more about the field from the manufacturers. One manufacturer, or one sales person would tell them one thing, and another sales person or manufacturer would tell them another thing and they knew that they were going to have to justify this thing to their management somehow. "Hey we need some help." We were in a wonderful, wonderful spot because we were about the only people, I think, who had any experience. Plus we were independent auditors, therefore we had this little halo over our head. We were very marketable.

MATTER: Also, to put it in context, at this particular time, Arthur Andersen had previously continued and went on doing much more assistance with clients and installing punched card systems than they did computers. There was a

lot more revenue generated installing IBM punched card stuff. Now that changed over time. At this particular time, you had a client, General Electric. At the same time there were an awful lot of punched card [installations].

MAHONEY: How did you make the case for a computer? For example, what should a computer cost? How did you decide what a computer should cost?

DANEHOWER: How did you decide how much it should cost?

MAHONEY: Yes. As a brand new item.

DANEHOWER: I don't think we ever asked ourselves, my friends here can help me out, but I don't think we every asked ourselves that particular question. The primary question that came from clients was "Can I use one of these things to either do what I'm doing now plus something, or to do what I'm doing now plus a lot more things? And if so, what is it going to cost me?" At that point they had not decided. I don't think the question was ever asked "What should it cost?"

F. WOLTMAN: Are you asking how Remington Rand decided how much to charge for the UNIVAC system?

MAHONEY: That's part of my question.

F. WOLTMAN: Maybe some of the engineers can answer that. I don't know.

CHINITZ: I don't know. Once there were several of us programmers at the Eckert-Mauchly plant in Philadelphia who got paid overtime to work in the evenings to total up the purchase orders for equipment for the UNIVACs so that a cost could be established from which a price was made. How realistic that price ever turned out to be, I don't know because all my recollections are that in every case it was indicated that the UNIVAC was a money-losing proposition.

HOLBERTON: Herman Lukoff's book covers that area.

SWEARINGEN: Regardless of how badly we estimated it, the thing that drove the General Electric installation was cost savings. When you are in a commodity market like major appliances where you cannot raise prices, the only choice you have against competition is to reduce cost. That is going on there still today: automation is there to reduce cost to produce a new product. We spent a great deal of time analyzing what we thought we could do, or somebody told us what we could do, and what effect it would have on the payroll offices and the accounting office. That gave us some justification and some money to spend on a computer. In effect, that's what it boiled down to. Now, I know that it was a long time before we began having that impact on those operations, and it was a long time before we got the computer performing at the level we had anticipated when we made those tradeoffs. But that was the justification. We were willing to save costs of operating the Major Appliance Division by putting in a computer. There was nothing going for glory.

MAHONEY: How did you figure out what the computer was going to cost? Did you have an idea of what...

SWEARINGEN: Well, we said "Here's what we can save. Now is there a computer that we can get for less than that?"

F. WOLTMAN: I think that part about how much the computer is going to cost...

MAHONEY: Yes.

F. WOLTMAN: That was the purpose of these surveys -- to work out a set of procedures, flow charts, for the basic application or applications. Then to estimate the amount of time that was going to be required on the central processor, how many shifts would you have to operate, how many servos would you need, what other peripheral equipment would you need and so forth. Then to cost all of that out, we even estimated the number of people who would be required, space, air conditioning, etc.

CHINITZ: ... installation costs.

F. WOLTMAN: ... all of the installation costs, the whole works. Many of the companies where I went had no clear idea what it was costing them to process data under their existing equipment. So it was necessary to come up with costs and compare the two and show a cost savings. It runs in my mind that we usually wound up with an estimated pay-out time of about seven years.

SWEARINGEN: I recall long and intensive conversations with Bill Matter over how many key punch operators we would have to have. He said "Two is plenty" -I had in mind fourteen to twenty. [Laughter] That debate went on until we got to twenty. [Laughter]

SBERRO: From the manufacturing side there were a couple of considerations. I think either or both Cecil and some of the people from Arthur Andersen could address this. In addition to the normal business practice (your item costs this much to manufacture and so forth) there were a couple of driving factors at the time that revolved around the existing amortization rules. How long could you spread the cost over, and at some point in this period it seems to me a lot of people came up with a magic number of fifty months as a lease period. Do any of you remember that?

HOLBERTON: Yes, I remember something like that.

SBERRO: I don't know where it came from. Maybe it came from the tax law [?].

CHINITZ: You mean fifty months as the minimum rental period?

SBERRO: No. Fifty months was a magic number. You could rent for fifty months or buy... there was something...

F. WOLTMAN: Oh, yes.

CHINITZ: It was lease with option to purchase, I think. Based on three times the manufacturing cost I believe; that's what sticks in my mind.

SBERRO: There were a series of magic numbers that came up to arrive at what I think you are asking. "How did the machine price get arrived at" and [it was partly derived] from the same manufacturing base you had for the card puncher.

SHULER: That was the only records that we kept. We had our manufacturing costs, and then you had all your other [overhead] to add to the thing, and they did use a three hundred percent mark up over manufacturing costs to arrive at "our costs". Then usually we always did an exhaustive proposal -- PML -- to determine how many of these units we were going to have to sell to make a break even. For instance, as I remember with the 1108 we projected we had to sell forty-seven 1108s for our break-even point, at the price we had established. Of course, in all these calculations by that time you had competition you always had to weigh your total price against. So, it wasn't a simple matter to get to the price based upon somebody's cost.

HAMMER: I recall many of these proposals that we worked on together at the time, and I had the impression then, and that never changed really, that the cost of the machine was somewhat inflexible. We were always running like 1.2 to 1.4 million dollars, and did have the job to justify this to the customer or prospect. This is before we really had any competition.

The other thing I wanted to say is that there is one thing that has been forgotten in everything, we had a real service bureau of course in New York at the time, (315 Fourth Avenue; Arthur Katz was director). But that was after, essentially, we had used what I considered a virtual service bureau operation on the floor of Allegheny Avenue. Every machine that stood there was constantly used for demonstrations and for testing programs, for writing software, and for exploring new applications. Some of the most remarkable things I have seen going on there... I think the greatest contribution that management made at the time was that they established the concept of a service

bureau where they could do that in a more controlled environment than on the manufacturing floor. Obviously we had one in Los Angeles, and then we established one in New York.

WILSON: You asked the question of how did the manufacturer arrive at the prices. In the early Eckert-Mauchly days they had an outstanding record of estimating ultimate costs. The original contract to build UNIVAC I for the Census Bureau was for two hundred thousand dollars. It cost a million or more to develop it, and on a later machine Pres Eckert asked each of his engineering managers to come up with quotes on their part of building the LARC system. And he looked at the total of those figures and said, "That's totally unrealistic. We could never sell that. Go back and reduce your estimates by half." [Laughter] When we said, "This is unrealistic." He said, "Well, it doesn't matter. Once they get the taste of it, we can then talk about a new price." [Laughter]

MAHONEY: Just hooking back for a second. What about the cost of programs? Did you see that as a cost in the beginning?

F. WOLTMAN: Oh, absolutely.

MAHONEY: How did you go about estimating that?

SWEARINGEN: How many people it would take. And, of course, we fatally underestimated it. [laugh]

MAHONEY: As I say, some things don't change. [laugh]

SWEARINGEN: There literally were going to be some number like four or five of us working on that project, getting the programming done, and getting those different facilities. That's too low a number. I take that back. Perhaps a dozen; more than that. Then we began hiring more people, Arthur Andersen came in. What was your peak at the Park? Seventy?

DELVES: Oh, no. Twenty or something.

DANEHOWER: I was going to say twenty-three.

SWEARINGEN: Then our peak was seventy including twenty Arthur Andersen people. But cost of manpower, cost of space for housing them, all of these went into our initial estimates. We were being very conservative, we were including everything. We just didn't have enough of everything. [Laughter]

MAHONEY: Earlier you made the remark, and then you laughed. You said "Roddy Osborn had thought when we got this job done." Which suggests that it turned out that you were the men who came to dinner. This became a current operating expense instead of a one-time investment to be written off and amortized. Did that realization come early?

SWEARINGEN: No, it's the business of maintenance programming. We assumed that we could write a payroll system that would last forever and in a very short time, and [then write] a materials control system. We would go on to these other projects, one after the other, and in a few months each we would finish them and get everything done in Appliance Park and go elsewhere.

MAHONEY: Well, how did management respond when they found out that you had come to stay?

SWEARINGEN: They were not very pleasant. [laughter] I'll say this now, as a part of the computer facilities at Appliance Park, we were a centralized function serving five independent departments. Each had their own general manager, finance manager, engineering and manufacturing. They ran their own factories and their own sales. We were an outside service bureau for them. We were a cost to them. Every year it was a negotiation to them on how much of our cost they would absorb. There was a period when it kept increasing, but at some point it began decreasing. They just would not accept it.

CHINITZ: Speaking from the manufacturer's point of view and a personal one, it came to me as an awful shock early on that the problem of programming, even when the application was done, never disappeared. [laugh]

MAHONEY: Arthur Andersen, when did you become aware of that, and when did you make a virtue out of it?

CHINITZ: Virtue, they got paid. [laughter]

DELVES: Oh, I guess we were certainly well aware of it by the time the General Electric project ended, because we had a hell of a time getting out of there. The money stopped but we still were there. I know I was the last one to leave. I think it was March...

MAHONEY: ? [laughter] Tied on a rail.

DELVES: Well, the condition was that I didn't have to do anything to change any program for a week. And if that happened, then I could leave. So I left in March of 1956. Just as John says, we were certainly well aware of it by that time that it's an on-going thing. You must be up front with your client at that point, and that the department will be there forever, not just for new things, but for maintenance. We never really made much of a virtue out of it because it was not our desire ever to stay on. Our desire was to work with the conversion team, get it done, converted and out of there, and leave them to maintain it.

MAHONEY: What I meant by virtue is that at some point, when you went in and advised about how you computerized, that you were now telling companies that you were going to have to create something like a data processing department...

DELVES: Sure. Right.

MAHONEY: ... going to have to have professional programmers who would be engaged full-time in keeping that

machine running.

MATTER: We were frequently at odds in that sense with the manufacturer who was really trying to take the other point of view. Not Univac, the *other* manufacturer.

SWEARINGEN: There really were two stages of this process. We paid the price of pioneers by this payroll system thing -- 44 hours of good time. Immediately there was an effort to reprogram, to cut it down to 40 hours. We kept chiseling away at it over the years, and finally, several years later I put a "tiger team" on it of two programmers. We got it down to 20 hours, and we felt then that we were running very close to the machine limits and we quit worrying about that kind of efficiency. But all this time the payroll people wanted us to do more, and that's the story of why you never finish a job. When we started out, we did not put addresses on payroll checks, because they were handed out in the factories. But that was the kind of thing you did for...

F. WOLTMAN: It was along about 1955 or '56 that we began hearing about that. One of the problems was to freeze the specifications. While you were in the midst of doing the initial programming, people kept thinking of other bells and whistles that they wanted to incorporate. So this was one of the things that made it difficult to actually get to the point of conversion in the first place, and you immediately then started to put in these modifications. It went on from there. It just evolved.

CHINITZ: The curse of magnetic tapes. When you were restricted to 80 columns on the card, it forced a discipline on you not to put the bells and whistles in.

F. WOLTMAN: That's right. The other thing I wanted to mention, going back to estimating the cost of programming. I ran across in a book that I gave to archives yesterday. It was a survey procedures manual, which I wrote in 1955; it came out in 1956, primarily to train a staff of 25 people that we had at that time going around and doing these surveys. There were all kinds of formulas in there for estimating just everything you can imagine -- computer time, programming time. I ran across one whole statement that said that to modify a sort, allow two man-

weeks; to modify a generalized merge, maybe three weeks (I don't remember -- something like that; I am probably not quoting it exactly)... and a minor run, whatever a minor run was [laugh] was so many man-weeks, and a major run was so many man-weeks. It was that kind of thing that we used to build these things up. Also, as these various installations went in where I had done the survey, I made it a point to go back. For example, I went back to Arizona Public Service and spent a couple weeks there collecting information and comparing with what we had estimated and trying to get better information for estimating in the future, because some of our estimates were miles off. [laugh]

MAHONEY: I want to pursue this a little bit farther. At what time did various did various projects start to think about the next machine and what that was going to involve?

CHINITZ: At Univac, that was pretty early... 1953, yes.

F. WOLTMAN: We were already estimating on UNIVAC II by 1955.

MAHONEY: How about the installations? When did they start to think about the next one? That must have come also as a surprise, that you had gone and bought this $1.2 million piece of equipment and now, several years later someone is telling you that you need a new one.

SWEARINGEN: I said earlier that I never was sold a computer; that any decision I participated in was made by us, the customer. We made a choice from proposals from manufacturers. But the UNIVAC II was something that was brought to us by the manufacturer. We didn't question whether that was the brand we wanted; we wanted more capacity. That was the only way we could get more capacity within our time horizon. We had the usual General Electric cost analysis that iterates at every level, all the way up in the million dollars. One million dollar expenditures goes to the board of directors at the time. So when we could say that there was a saving that justified the cost of removing the old one, bringing in the new one, and paying the higher costs for this machine, and when Remington Rand could deliver it, we brought it in. We were deep into looking at UNIVAC III, and I suspect that UNIVAC III would have come in under the same auspices if it had ever been delivered. But it didn't and other events overtook it.

You seem puzzled by that.

MAHONEY: When you said UNIVAC III, if it had ever been delivered?

DIXON: UNIVAC III?

CHINITZ: Yes, I thought he meant to GE.

SWEARINGEN: Oh, yes. They could never just get it to us and to justify...

DIXON: Oh, to justify it.

CHINITZ: Well, you had to reprogram it.

DIXON: Because the UNIVAC III was delivered and a very cost-effective machine.

MAHONEY: Okay, we'll pick up on that in the next point about the reprogramming. You knew that the UNIVA C III was going to require reprogramming.

CHINITZ: It was the different design...

MAHONEY: Did you think about what that was going to mean for all Univac installations?

F. WOLTMAN: Oh, yes.

MAHONEY: You were going to have to now go back and tell John and his group they were going to have to reprogram after the experience they had the first time?

CHINITZ: Actually, the company had not much choice. You could not pursue the UNIVAC I, II design concept and remain competitive. That architecture was just too restrictive for it to be...

UNIDENTIFIED: Based upon the old kind of memory.

TONIK: Well, I was on part of the design team for UNIVAC III. When we met in closed conference to decide what to do, we were aware that in order to cut costs we really could not carry on the design of the architecture of the UNIVAC I and II. We just had to squeeze so much into the machine to reduce the cost. We came up with something that was similar, but really a different design.

MAHONEY: Now, did you find that that hurt your sales?

AL TONIK: Well, I guess we really didn't consider the impact on the customer's reprogramming when we did the design of UNIVAC III. That was not part of our criteria when we designed the UNIVAC III.

F. WOLTMAN: Well, there were other groups that were worrying about that, and SALT was one of the automatic programming systems developed about that time.

CHINITZ: Yes, but it didn't really make any difference because the users had no other way to go. If they needed more capacity, they either went to a UNIVAC III and reprogrammed or they went to IBM and reprogrammed. There was no alternative for them to do it.

HUFF: At that time.

CHINITZ: At that time, and probably still is.

HUFF: I found a simulator. Yes, and it was easily done. It came out of the mother of invention, and that was the Carborundum Company. Carborundum had two UNIVAC Is. They bought a 360/40 while the first OS and DOS did not work. They had cut their maintenance contract with Remington Rand for the UNIVACs. They were going downhill. They were two to three weeks behind on their production. Ed Squish, an IBM systems analyst, came up and coded a UNIVAC I simulator that ran on a 360/40.

CHINITZ: He did an interpreter. Right, and it was fortunate that the application that you had gave you the amount of time. Right, that's the difference.

UNIDENTIFIED: 25 to 1 ratio.

HUFF: As it developed, I did not recode a single UNIVAC I program, because that simulator ran on a 360/40, it ran on a 155; and it ran on a 3033. So, it was done. We were trying to solve this reprogramming problem early in the 1960s -- about 1964, '65. And Bo [?] Farrington ran an IBM and said it was impossible.

CHINITZ: Well, they were right, and you were right. [laughter] You paid a lot of money on the 360 for speed and capacity that you lost when you did the simulation.

WILSON: There seems to be an implication that the decision to go to a UNIVAC III was based on a logical analysis of the market and so forth. This is utter nonsense. John Mauchly and I served on the engineering committee within the company to decide what was the next step. There were two competing factions. There was a Philadelphia faction that wanted to go to UNIVAC III, and a St. Paul faction that wanted to go with the successor to the 1103A. They were competing for the development money that was available within the company, and the decisions were not based on any logic. The committee's recommendation, after deep consideration, was that there was a tremendous market for either machine. It's hard to get off your rears and make a decision. After two years they finally made a decision -- two years too late. The decision was based on how well Chuan Chu in Philadelphia could infight versus the corresponding guy in St. Paul -- not on any logic.

DELVES: That's the story of [?] ... [laughter]

CHINITZ: But the UNIVAC III was successful by Univac standards -- very successful.

WILSON: So would the successor to the 1103 have been successful, had it been done at the time.

UNIDENTIFIED: Yes.

NORBERG: Okay, perhaps it's time to declare this portion of the morning at an end and to move into our last and closing questions from 11 to 11:30. In discussing the various things that have gone on now in three sessions -- in the two sessions yesterday afternoon and now that we have been through this one, reflecting on that -- Mike and I thought that we would like to start out by asking a question from our side again, but posing an open-ended question to the group in the room. Please feel free, anyone around the room, to respond to these questions if you feel a need to do so. In preparing for this conference, a number of questions were proposed in relation to the topics in the three sessions. We would like to ask you now, what are we missing? What are the people who designed the conference missing in directing the questions to you the way we have? We have been proposing questions of interest to historians and others, but not necessarily focusing on what you people may think of some of the more important things that we have overlooked? Jean, do you want to begin?

SAMMET: Two things. One, I don't understand why there was such a preponderance of people from a single consulting firm and only one early user. I know Metropolitan Life... I was not there, but I know that they were a major early user. I think the major absolute omission has been any discussion of software. Mike stopped it yesterday afternoon in the session where I thought it was supposed to occur, and unless it happened when I walked out of the room, it hasn't come up at all. There were major things that came [from the Univac]. For example, when one got into the late 1950s, almost everyone involved in the COBOL committee had been influenced in some way by the software on UNIVAC even if they had worked for IBM or for other manufacturers. So the omission in software, I think, was a

gross omission.

HOLBERTON: I thought it was going to be the major thing here.

MAHONEY: Yes, I am sorry.

CHINITZ: Well, the period stopped here literally. It was 1955.

SAMMET: Yes, but there was software that was beginning to come out by then.

UNIDENTIFIED: Oh, yes.

CHINITZ: Well, yes, if it comes up as a question, I would like to address it.

NORBERG: Please do.

CHINITZ: Okay, now a question about COBOL or its forerunner...

SAMMET: I didn't ask a question about COBOL because that was not until 1959; Betty and I will guarantee it.

CHINITZ: Yes, Jean, you didn't let me finish. ... or its predecessor, FLOW-MATIC, or the B-2 compiler and...

SAMMET: B-0.

CHINITZ: and BIOR, all right.

DANEHOWER: General Run, which is Arthur Andersen.

UNIDENTIFIED: GP.

HOLBERTON: Every installation had its own assembler -- period. That's the reason they didn't speak to each other.

CHINITZ: I was a director of training for UNIVAC from 1953 through 1956, when we had more than a thousand customer, personnel, and prospects, as well as the Univac new hires that were to be trained as programmers. We charged a fee, and trained management people for introduction to computers adequate to do surveys and systems analysis, and then ? programmers and computer operators. [Considering this expertise], the question came up, raised by Dr. Hopper, as to why we didn't start training in the B-2 compiler and the FLOW-MATIC.

SAMMET: B-0.

CHINITZ: B-0, sorry. And FLOW-MATIC, as it was retitled. The issue was, "Is it ready to be installed in an installation now and made running?" And the answer was, "No, not yet," and therefore, "We did not teach it." So there was no point in teaching a programming system that the customer could not use. So, it was not taught. And if it wasn't taught, it wasn't used.

DANEHOWER: I don't know if this area I'm about to talk about is of interest to you historically or not. First, I concur with the points about the software -- that this period we are talking about was a significant point in time, I think. Another area that might also be of interest to historians is that during this period of time, from the point of view of both the manufacturers and Arthur Andersen, there were a vast array of brand new techniques being conceived and developed. For example, there were the techniques of designing a data processing [application] for a computer. That turned out to be considerably different than designing [an application] for punched cards. That's one area. Also, being auditors, there was this whole area of designing controls on computers for data processing installations. The tabulating people (re: controls, to oversimplify) were interested only in totals. However, with computers, one of the major considerations was hard copy; we just can't rely on the stuff on metal tape that we can't really see. So, there

were techniques of control that were developed during this period -- not just by Arthur Andersen; I don't mean to imply that. The third area was techniques of debugging, but really what I am referring to is testing the entire system. How do you prove that the [application] that you designed your program really works for "all conditions?" All conditions of processing and all conditions of buying? So that's a whole area that I think we sort of have...

MAHONEY: Well, someone suggested that this had been left largely up to the customer. Is that the case?

CHINITZ: Yes, the conversion and the verification process.

MAHONEY: Well, if I could use an anachronistic term to describe it, I think I was describing something like systems software for your installation search [?].

DELVES: Well, when you bought a UNIVAC you got some sorts and some merges. I am talking from a commercial point of view. That was all you got. And you got an analyzer...[11]

HOLBERTON: You got a very good service routine library. I would like to address this one program that Steve Wright did because it was probably the biggest help that we ever had. It was called an analyzer which gave a cross-reference.

DELVES: I mentioned the analyzer.

HOLBERTON: And let me say this. I followed that because I had the flow charts, and I handed those flow charts out

[11] According to information from the Woltmans:

"Gene's statement is correct with regard to software, because software had simply not evolved beyond that point in 1954 -- we didn't even use the expression *software packages* until later. But recognizing the early users' plight, Univac did the next best thing -- we sent out a team of experienced programmers to help the user design and program his major applications. That is how George Danehower got to G.E. along with Dick Peterson and Bill Mandel. Glenn Halliday headed a team of four (including Morgan Huff) at Arizona Public Service, etc."

"Dick supervised a staff of programmers assigned to the various installations from 1953 to 1956, when Vince Newhart succeeded him as director of Sales Support. There were 65 installation programmers on his staff at that transition point. In most cases, their role was a major one and they were often hired away by IBM, RCA and Honeywell. By 1956, there was considerable concern over the fact that 'we seem to be training programmers for the whole computer industry,' as one Univac executive put it. But the point is, the user was ~~not~~ left on his own to design and implement his applications without help from Univac."

to any number of users of different machines and manufacturers. I traced that thing for 20 years, and no user in industry had a tool like that until they finally came out with what they called a cross-reference listing.

DELVES: But that was a systems development tool. What we did not get...

HOLBERTON: But it allowed you to find out whether your program worked or not.

DELVES: But it was worthless when it came to making a system.

HOLBERTON: I agree.

DELVES: That was missing. The only thing you got from Univac was sorts, as I remember anyway. As far as the stream of runs that made a system, I mentioned yesterday that one of the most imp ortant things that came out of the GE installation from a commercial point of view was this whole group of automated pieces of a complete system. In the end it was called the System Service Library, as I remember that. That was a name that was hung onto it. But rather than get all hung up in this big debate about generalized programming... because it was Herb Mitchell who was trying to invent BIOR but it never got invented. But what we did at General Electric was say, "Well, let's not bother with that, but instead we will write once and for all, a shell. This is a shell for a particular kind of a run. This is a run which processes a file.

MATTER: Two, three... [?]

DELVES: That's right. So a run that processes a file, with maybe two transactions coming in, a file coming in, a file coming out, and a transaction tape coming out. It was a kind of a run. And there was another kind of a run which was a validity check run. We did a shell, so all the programmer had to do was put in the sub-routines which were specific to those transactions that were being processed. Since the programmer didn't have to be concerned with any of the rest of it, the main line was all coded.

CHINITZ: You fixed the item sizes for them.

DELVES: We fixed everything.

CHINITZ: That's why you didn't get one from us. [laugh]

DELVES: Yes, well, that's right. But if it was your own installation you could do that. You could say, "Okay, the item size is two words; the item size is ten words," or whatever.

HOLBERTON: At the very beginning we at Eckert and Mauchly -- this goes back to 1947 and 8 and 9 -- felt that we did not have enough experience to establish standards of how the industry should be forced to look at all the controls that surrounds [a computer operation]. I know when I did that sort/generator, there was no standard for a label. So I made it an option, whether you have a label and a blank block was supplied, and you had to supply the coding, but there was no way for which we could establish that.

DELVES: But when you had your own installation you could say, "This is the way it's going to be."

SWEARINGEN: Didn't our first sorts come from other installations? I want to say US Steel and I would like somebody to tell me the name.

DELVES: Well, it was the Pratt sort.[12]

SWEARINGEN: They had programmers' names attached to them, and there was a sort that sorted two-word records, another that sorted ten-word records. Those were our most popular ones before Univac supplied them.

[12] written by Dick Pratt of Univac

HOLBERTON: We supplied a two-volume book of every possible combination of all sizes and what not to all industries -- 75 copies of those things that were written.

SWEARINGEN: But in the early days we used those non-proprietary packages and it became a burden on the guy who originally programmed them because he became the guy everyone was calling. [laughter] I wish I could remember their names because they do deserve to go down in history, and I hope somebody supplies them before that record is closed.

SBERRO: A minor comment on that and then I would like to make another. On sorting, as I recall, the first software patent was granted for Marty... (he was one of your students) ... for a sort routine. He was the first...

CHINITZ: Yes, the name will come to me.

Many: Marty Goetz.

SBERRO: It was for a sort routine. From a historical perspective, what we have been talking about in the period of 1950 to '56 I think saw another kind of transition. All the work that had been going on in all of the major engineering fields of the period -- atomic energy, jet engine, communications, and computers -- was derived from World War II research. During the period that we are addressing here, that coasting gave out and there was a new impetus, because they used up the basic technology that was available in all fields and went into broader, newer areas during that period of time. Until then we were coasting on what had been done in 1946 and 1947. It was based on research in radar and atomic energy, jet engines -- each of these engineering disciplines.

HOLBERTON: Can we talk about the nuclear codes group that ran so many of their programs around the country on UNIVACs?

SBERRO: What?

HOLBERTON: The nuclear codes group, I remember, was a group that...

SBERRO: Oh, yes!

HOLBERTON: Tremendous users who came from everywhere to run on UNIVACs, because they had programs that ran on UNIVAC and they had programs that ran on 701s...

MAHONEY: Did programming ever become an area of research at Eckert-Mauchly at this time? The attempts...?

CHINITZ: Oh, yes.

MAHONEY: How?

CHINITZ: Well, there was Grace Hopper and Dr. Mauchly -- two competing research groups. I don't reference anybody out at St. Paul. They must have had some because they had the binary machine which would have required all that stuff, which we didn't.

SAMMET: It did, but in some cases they picked up the material that was being done in Philadelphia and they simply implemented it on the 1100 computers.

CHINITZ: Oh, good; some of it didn't go to waste. [laughter]

NORBERG: In 1957, Mauchly listed six groups active in the company in software. There was the group that he was running in the research center...

CHINITZ: Yes.

NORBERG: ... which was dealing with new applications and program methods -- 45 staff members. Hopper was running a program systems, program development operation in Philadelphia with 60 people. Emil Schell in New York was running a commercial and service applications group with 15. Stutzman in St. Paul was running an R&D group on math research and program R&D with 20 people. Fitzgerald was running something on making programs available to customers, which was 100% to support sales -- five people.

CHINITZ: Yes. Where, in New York?

MANY: Yes, in New York.

NORBERG: And then, another sales support determining performance for sales information with 30 people in St. Paul by Crow -- a total of 140 on R&D and 35 people in sales support.

F. WOLTMAN: And Herb Mitchell...

CHINITZ: Yes.

NORBERG: We tried to find that and...

CHINITZ: Well, I think he had two people, didn't he?

GALLER: My impression was very parochial. I visited somebody in Minneapolis in the early 1960s, and someone was introduced to me as one of the top four assistant programmers in the company. When I asked a comparison with IBJOB, which was *the* system on the 7094, the fellow knew nothing about it.

CHINITZ: Oh, that's quite true, because Mitchell never got it finished. But what he was aiming to do was a more

generalized version of what you could do with a basic run, which was to take the input and the output side of the program and the rerun procedures and parameterize them so that the programmer had to worry only about the guts of the computation. The rest of the stuff was standardized, which seemed to be the problem that bothered most of the people.

HOLBERTON: The last request I had made of Herb Mitchell before I left Eckert-Mauchly was, could he please do what you people did. "Don't put any bells and whistles on it or you will never get it done, but just put together something that they can draw out in a very simple way." It just kept on going and going into a language and all kinds of things.

CHINITZ: Well, yes, but that was the Herb Mitchell story.

DOROTHY ARMSTRONG: In the St. Paul group, where they had these binary machines, there was no assembler for them by the time they got to the 1103, 1103A. The first assembler, called the USE compiler, was made by the users; I think it was Lockheed, Ramo-Wooldridge and quite a few others. So there obviously was not that much support at that time, and that was in late 1955 and in 1956.

CHINITZ: You mean they coded in binary?

DOROTHY ARMSTRONG: I don't know how they coded. [laughter] I know the USE compiler was made by the users.

MARQUARDT: I mentioned yesterday that the installation was primarily focused on the scientific applications and engineering calculations. [It was] characterized in many ways by a large number of small jobs that needed to be analyzed, coded, and developed on a one-time basis to get an answer, and rather than as a system that would be used for months and years into the future for processing a large amount of data. There were colleagues of mine who looked heavily at interpretive systems, which also were understood at some level in those early days. There was a

paper by John Beasley that had been given at one of the early UNIVAC users' conferences on interpretive programming.[13] Then in 1957, a colleague of mine, John Beutler, along with a mathematician that worked with him, introduced an interpretive system within our organization that turned out to be a real work horse in the sense that large numbers of engineers and scientists could take this relatively easy system to approach and create from it workable programs in a brief period of time and get an answer to a scientific problem. That interpretive system I don't think was ever published, although it may have been and was in fact introduced chronologically ? because the Hopper mathematics work in FORTRAN language was introduced. ? And some of the timing that was done indicated that despite the interpretive mode, problems ran almost as fast as they did coming out of the compiler.

NORBERG: It seems to me we have a topic for another conference. [laughter] Rather than continue that at the moment, I would like to ask, are there other issues that have not been raised, perhaps of similar magnitudes of software, perhaps of other areas.

CHINITZ: Well, I don't think that we adequately went into the whole issue of the service bureaus, the type of customers and applications that they had, which I think should be important to the history because it involved a lot more companies and varieties of applications than [represented by] those big enough to afford computers. Unfortunately we had no representatives here other than Carl.

NORBERG: The gentleman in the back.

UNIDENTIFIED: I think that one of the things that should be of interest to historians is (and we have touched on it, but very briefly) [the question of] what was the various sequence of managements doing about all of these problems? [We have] criticized upper management in Eckert-Mauchly and a whole series of companies up to Unisys -- not really to Unisys. But somehow or other they were responsible for a lot of the problems at the engineering level. I happen to be an engineer, but I feel we have skipped a little bit of that, because I think there was a tremendous

[13] Beutler, J.A. and Beasley, J.K. *An Interpretive Coding System for the UNIVAC*. (Du Pont, ca. 1956).

influence of what was happening at that level. I think how the engineers saw that is perhaps not the way history will show it. I think it would be worth looking at some of that.

SAMMET: Well, I have another question. There was a mention of UNIVAC III and Al made some comments. It would be interesting to pursue at another time why they made a drastic change to binary from a decimal machine.

TONIK: Because of the high cost of memory, period.

SAMMET: But there were to be other decimal machines, not fixed word length -- variable word length machines.

CHINITZ: It was decimal.

JEAN: UNIVAC III was binary.

CHINITZ: No, it was decimal.

TONIK: It was a mixture of binary and decimal and alphabetic.

HOLBERTON: That's right.

SWEARINGEN: The absence of Roddy Osborn is really a loss to this conference. So many of us on this side of the table tell you what we think he said and what we think he thought. I hope there is some follow-up directly with Roddy. On another side of it, I have always felt he has not received the attention and gratitude that he should have. I believe it was self-imposed. He left Louisville not under the best circumstances; he was not treated fairly there. I think there were a lot of people who wanted to talk to him more. A complete record really needs to examine what he said he was going to do, what he thought he was going to do. I just recommend that kind of follow-up.

NORBERG: Bruce Bruemmer and I talked about that last night, and we will follow it up.

RICHARD WOLTMAN: I think along that same line, we really have missed other users. Metropolitan Life, Con-Edison, John Hancock, US Steel, Carborundum -- any of the users. Including more of them would certainly be worthwhile on getting a perspective on how this thing...

NORBERG: ... ? number two.

HOLBERTON: Well, certainly Metropolitan Life, since they were in it very early and they stayed with it. And I think that they influenced a lot of the other insurance companies.

NORBERG: Some years ago I met with Metropolitan, Equitable and Prudential to see whether or not we could establish something, but it didn't happen at that time. We may try again.

HOLBERTON: Do you have a group of names of people who were there at the time?

NORBERG: Yes.

SWEARINGEN: Wasn't there a situation where Metropolitan might have gotten the computer before General Electric, but something happened and we got ours first?

NORBERG: There's one short question that is worth asking, I think, as a last one, and that is, how long did it take to get the machine producing useful work at General Electric?

SWEARINGEN: We did the first payroll of October of 1954. Somebody ?

MATTER: I don't remember the month and year. I remember the decade. [laughter]

SWEARINGEN: But you also remember the emergencies at Christmas time.

MATTER: You had two Christmases in a row.

SWEARINGEN: So we were in operation, I believe, in October of 1954. The first payroll we did was a real payroll. It was not for all the factories; it was some part of that. But it was for, I would guess, 2,000, 4,000 employees. While people were desperately trying to reduce the run times, there were others of us then who were going to the other departments and bringing those records in and expanding the problem. The material control system started in 1955? It was sometime in 1955 that the materials people were willing to say that they had, on an annual basis, reduced the raw material inventory by a million dollars. That was in, I believe, 1955, perhaps 1956. Do I have time for an anecdote?

NORBERG: Yes.

SWEARINGEN: The reduction in inventory was good tidings to me on material control, but there was an even better one. We learned (one department started it and then others picked it up), that the materials manager told his buyers that he would measure them henceforth on the amount of inventory they showed in the end of the month inventory report for which he would calculate turnover in inventory. So the buyers then began playing the game of running inventory down to the lowest level they dared. If they ran out of material they were fired, so you know, there was a limit. [laughter] The pickup was scheduled for Monday morning after the end of the month. I thought, well, you know, that's a game we can play; maybe we ought to start running the thing in the middle of the month and get some other measurement. Even so, you did know that there was less inventory. But others weren't on to the game until one time a year or so later when the vice president of the division arrived on Monday morning and three miles from the plant he got in a line of steel trucks. [laughter] And from there all the way the plant he was passing steel trucks. You can imagine what that did at the loading dock. No one can unload three miles of steel trucks in a day or two days. So he asked, "Where in the hell did all these steel trucks come from going into my plant?" And the answer

was, you know, "This is Monday, first of the month." [laughter] The criteria was changed slightly, but it proves that our system had taken hold and was being used. Gene Delves was part of the development of the system, and [they made] it work, and it worked enormously. It was a management tool.

NORBERG: Last comments around the room.

UNIDENTIFIED: Just for the record. October of 1954 was how long after the machine had been delivered?

RICHARD WOLTMAN: According to my list here, the machine was delivered in January of 1954.

DELVES: The project started in -- what did you say, John? September of 1953?

SWEARINGEN: Maybe the summer or August of 1953.

[disjointed discussion on the precise date]

NORBERG: Before I call on Anne Frantilla to bring this conference to a close, Mike and I would like to take the moderator's prerogative to thank you all for participating with us in this conference, to thank Unisys for its support of such activities, which have now extended over quite a number of years and a number of conferences and a number of organizations, and also to the Smithsonian for hosting us in such a fine environment. This is what makes these conferences rather interesting for us, not only to be in a good environment, but also to be with generous people who are willing to give their time to talk about issues which they find interesting, but which we would rather probe on somewhat of a different level. Anne, would you like to make a few remarks?

FRANTILLA: I mostly just wanted to thank you for coming -- both the participants and the moderators who put a lot of time into preparation. Well, thank you all. [applause]

END OF CONFERENCE