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Interviewee: Eldred Nelson
Interviewer: Robina Mapstone
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MAPSTONE:

This is Bobbi Mapstone and I'm talking with Dr. Eldred Nelson at TR&W in Redondo Beach, California. And maybe we can start off by you telling me just a little bit about how you got into the computer business and what were some of the influencing factors, maybe, that led you into it.

NELSON:

During World War II, I worked at the Atomic Bomb Project at Los Alamos and there got involved in making numerical calculations relating to the project. We first began to use hand calculating machines to solve the numerical problems, and then acquired a set of IBM punch card machines to do further work on this problem. While working on those within, John Von Neumann, who was a consultant on the project, told us about the development of the first electronic computer, the ENIAC, a project which he was also a consultant. And he told us about their ideas on electronic computers. To further develop this interest, he spent two weeks working with our punch card installations, wiring boards and putting cards into machines.

MAPSTONE:

What kind of machines did you have at that time?

NELSON:

Well, we had several multipliers. I believe they were of the 601 variety, a tabulator, that would be 405?

MAPSTONE:

405, probably is.

NELSON:

And a sorter. And we had some specially built multipliers that would also divide.

MAPSTONE:

Had IBM built these for you?

NELSON:

They built them to special orders for us.

MAPSTONE:

Oh, that's the first time I've heard about that. IBM didn't actually put them on the production line, did they?

NELSON:

I believe not.

MAPSTONE:

How about a CPC? Was this before the Card Programmed Calculator?

NELSON:

Yes. This was before the Card Programmed Calculator.

MAPSTONE:

We're talking then about 1946?

NELSON:

About 1943-44. 1944.

MAPSTONE:

1944, okay. That's good.

NELSON:

Then Von Neumann told us about the work on the ENIAC and about Eckert and Mauchly and also his reading of the Merrill Wentworth theories of the [?] and fifths. Apparently he was much influenced by this. After the end of the War, in 1947, Dr. Stanley Frankel and I formed a partnership in consulting, and one of our early clients was the Northrop Aircraft Company.

MAPSTONE:

All right. Just before we get onto Northrop, some--are any of the problems you worked on at Los Alamos still classified or can you just give me an idea of the kinds of projects you were using the punch card machines to do?

NELSON:

Well, they were--the primary problems the punch cards were used were in development of the mechanics of the Atomic Bomb detonation.

MAPSTONE:

Oh, the super.

NELSON:

Not the super.

MAPSTONE:

Not the super.

NELSON:

Of the bomb that was used.

MAPSTONE:

So that was really the prime mission of what was happening at Los Alamos at that time?

NELSON:

Yes, right.

MAPSTONE:

Do you have any recall about how you felt or what were some of your thoughts when you heard about Von Neumann's machine and, you know, did you have visions of what it might be able to do for you and your field?

NELSON:

Of course, we were all very excited about it because of the possibilities it held for increasing the computing power of it. We thought it would be very useful in solving many of the problems of physics in which there are always large amounts of calculation involved.

MAPSTONE:

Did you go and see the machine?

NELSON:

No, I never saw it.

MAPSTONE:

You didn't.

NELSON:

No. Stan Frankel did go and program some problems for it and ran them on it.

MAPSTONE:

And this, of course, was before Los Alamos was into doing their own, got the idea of building their own machine.

NELSON:

Yes.

MAPSTONE:

Were you a tool instrument in that phase?

NELSON:

No, I wasn't. I believe Nicholas Metropolis, who worked for us at that time, later got interested in developing a machine for them.

MAPSTONE:

Right. And we have talked to Nick Metropolis--I haven't, but Herb Tropp has. So I think that has probably been covered. How did--when you and Dr. Frankel got together, did you move out to California at the time?

NELSON:

Yes. Well, we first spent approximately a year at the institute for nuclear studies at the University of Chicago. And we went from there to California in the spring of '47.

MAPSTONE:

And set yourself up as consultants?

NELSON:

Yes, uh-huh.

MAPSTONE:

In what areas?

NELSON:

We called it mathematical physics.

MAPSTONE:

[Laughter]. Okay. So this is where you got into Northrop.

NELSON:

Right. One of our clients was Northrop and they were developing the SNARK Missile. They had a group who were interested looking into methods of calculating navigational problems. And one of the problems they had was in calculating trigonometric functions of sines and cosines. And Stanley Frankel pointed out to them that for a navigational system in which they would be calculating the angles continually, there was a simple way of doing it using the difference equations for the sines and cosines. And the basis that his method of doing that stimulated Floyd Steele, who was there, to develop this digital differential analyzer.

MAPSTONE:

The MADDIDA?

NELSON:

Yes. The MADDIDA, as they called it.

MAPSTONE:

That's interesting. I hadn't got this out yet. But it was actually Frankel's suggestion—

NELSON:

Right, of using the differential equation in a difference equation form for computing sines

and cosines. Got him thinking and he generalized it to solving other differential equations.

MAPSTONE:

Uh-hum. And this is how he came up with the Boolean approach to design a computer?

NELSON:

Right, uh-hum.

MAPSTONE:

So, but now you yourself, what was your role at Hughes? I'm sorry, at Northrop.

NELSON:

Well, in Northrop I mostly worked on mathematical methods for the guidance systems, for inertial guidance systems, rather than computing methods.

MAPSTONE:

I see. And were you using machines to support the work?

NELSON:

No, we were not.

MAPSTONE:

It was all done mathematically.

NELSON:

Pencil and .

MAPSTONE:

Paper and pencil [laughter]. Can you tell me a little bit about Steele and how you feel his contribution ties in with this?

NELSON:

Well, he and the group working with him at Northrop then began to develop and expand on those ideas, and so he developed the design of the digital differential analyzer employing a magnetic drum memory. And he got a very enthusiastic group and got

Northrop Air Craft company interested in backing him. I'm not sure I know all the details, though, of their relations there. At one point, then, the group broke away and left Northrop and set up their own company, Computer Research Corporation.

MAPSTONE:

Right, right, yeah. That's right. I was trying to get a feel for what it looked like--how's the work that was being done, the Boolean approach, how it might have impacted the industry, and maybe what was going on between the East-West relationship or non-relationship, as the case may be.

NELSON:

Well, the way it impacted, I guess, was mostly through the people who learn about it, the techniques and design, and who then various ones moved to different parts of the country and so forth. In 1948, then I joined Hughes Air Craft Company and was assigned to investigate what opportunities for Hughes were in this digital area. I bumped into various techniques and applications and also at that time Hughes had got a contract for a tactical bombing system called "DIGITAC" for which they proposed to use a digital computer to do the navigation and bombing calculations.

MAPSTONE:

This was in 1948?

NELSON:

'48.

MAPSTONE:

And this was an Air Force contract?

NELSON:

Right.

MAPSTONE:

So was the contract already in-house when you joined or—

NELSON:

Well, I'm not sure whether it was or not, but it was gotten by people other than myself and it was gotten in-house very close to the time that I joined. Dr. Eugene Rabbi was one of the primary starters in that project.

MAPSTONE:

And he's in Hawaii.

NELSON:

He's now in Hawaii.

MAPSTONE:

[?] far away.

NELSON:

Sometime later in 1949 I was put in charge of a group which included the effort on the digitac project and also some efforts developed towards commercial directions. I began to look into various techniques for designing circuits and applied the Boolean Algebra to these diodes, to circuits composed of diodes and flip-flops. And developed that into a fairly effective design technique which I taught to the people at Hughes Aircraft Company. In parallel with this, Floyd Steele apparently had been developing the Boolean Algebra techniques, computers down at Northrop.

MAPSTONE:

Did you know about each other's work?

NELSON:

Not at the time we started it, no. I didn't know that he was working on--I knew that he--told about this differential technique and I was interested in that, but I didn't know about his developing it into, further into a whole technique of computer design until they had a working model, which they came and talked about.

MAPSTONE:

So actually, the two companies within a very short distance of each other were both heading off down the same track.

NELSON:

That's right.

MAPSTONE:

And--but not working together.

NELSON:

That's right.

MAPSTONE:

And you were coming up with the same thing--what were the differences between, maybe, your approach and Steele's approach or what they ended with.

NELSON:

Well, his initial emphasis was on a digital differential analyzer while ours was on a general purpose computer. And so I think that was the main difference. We apparently were led to similar mathematical techniques. The techniques I developed were also able to take into account the time differences between events within the computer. I don't know whether Floyd's did that or not since I don't believe he published in detail on his work.

MAPSTONE:

Did you?

NELSON:

Yes, uh-hum.

MAPSTONE:

Good. Maybe you can find your publications.

NELSON:

The paper on this was published in 1954 in the transactions of the IRE professional group on the electronic computer.

MAPSTONE:

Do you know the title?

NELSON:

Something like "An Algebraic Theory of Computer Design."

MAPSTONE:

That was the basic paper?

NELSON:

Yes.

MAPSTONE:

Did you talk--um, then your first machine to incorporate the algebraic-

NELSON:

No, no. That was designed with earlier techniques.

MAPSTONE:

Ah, okay.

NELSON:

It was the first airborne digital computer, though. It was the first one to be designed for controlling an airplane and actually did fly in an airplane and actually navigated.

MAPSTONE:

It actually went through the door of the plane.

NELSON:

Yes, uh-huh.

MAPSTONE:

What was the technology you were using—

NELSON:

Well, we were using vacuum tubes and, well, it had a few diodes and magnetic drum memory.

MAPSTONE:

How did you get it small enough to go through the door? That's the—

NELSON:

They used miniature tubes and quite an economy in design so there was a good design team working on it.

MAPSTONE:

Without using the Boolean approach.

NELSON:

That's right.

MAPSTONE:

But still sharing of the parts? Was that part of it?

NELSON:

Yes, still we used some sharing of the parts, uh-hum.

MAPSTONE:

You told about small tube. Is this just literally the same technique of tube but just got put into a smaller area?

NELSON:

Yes, into a smaller glass envelope, yes.

MAPSTONE:

What's interesting is that the East Coast which was developing house-size monsters didn't go to the smaller type tubes. Have you any feeling about why they didn't?

NELSON:

Well, I think the difference was here out on the Coast we did work with air craft electronics and where wanted small size and weight and minimum power and the--so miniature tubes were more expensive than the larger tubes, so, but we were interested in air craft models, so we used the miniature tubes.

MAPSTONE:

How about reliability.

NELSON:

Actually I believe they were as reliable as the others. Because one of the requirements of these complex-avionics systems was for reliable operation.

MAPSTONE:

It would seem that that's—

NELSON:

Whereas some of the larger tubes, more interest was in low cost.

MAPSTONE:

Yeah. Probably because of quantity, too.

NELSON:

Yes.

MAPSTONE:

One thought that occurs is the down time with tubes machines was pretty high. And I would imagine when you've got a computer that's flying, one of the things you can't afford to have is down time.

NELSON:

That's right.

MAPSTONE:

What kinds of ways--how did you go about this, about assuring that down time would not happen while the machine was up in the air?

NELSON:

Well, one of the ways, of course, was to keep the number of tubes at a minimum.

MAPSTONE:

Yeah, right. [Laughter].

NELSON:

But also do design in--well, there were a few error checking circuits put into the computers and not too many will expand the size and weight of it. And in the programs

also were programmed to check on the results and to detect whether or not possibly an error occurred.

MAPSTONE:

Was there any kind of backup system in the ground so that if something went wrong you still had—

NELSON:

Well, in the case of the DIGITAC System, there was a manual override so that the pilot could take over.

MAPSTONE:

I see, okay. DIGITAC actually went through--when did DIGITAC first take off? I mean in the air?

NELSON:

In 1952.

MAPSTONE:

1952. And what were some of the other air borne computers. Do you know that the other companies came up with any during that same period?

NELSON:

Let's see, I believe the others did come along a little bit later. At Hughes we had the next--we made a model for what is now called the MA1 Fire Control System which was then called the MX1179. And the computer for that was developed using this Boolean Algebra technique. And so out of that a somewhat more powerful and yet smaller computer than the digitac was designed. And that later went into production and into actual use by the Air Force.

MAPSTONE:

Do you know which planes it flew?

NELSON:

It would be F104.

MAPSTONE:

F104. And did you have competition—

NELSON:

No, the F102, I believe it was. Correction, the F102.

MAPSTONE:

And did you have competition from the other companies?

NELSON:

Not from the point of view of an airborne digital computer at that time, because at that time most people thought that was an impractical thing to do. In fact, Howard Aiken, shortly before we flight tested it, Howard Aiken came out as a consultant to the air Force and looked over things and went back and filed a report that it would never fly.

MAPSTONE:

[Laughter]. That figures. None of his machines would have ever flown. He was a little wild on that one, wasn't he?

NELSON:

Yeah.

MAPSTONE:

Did you have any dealings with Aiken, other than that?

NELSON:

Well, that's about the only one other than I met him occasionally at computer conferences and so forth.

MAPSTONE:

He's an interesting man.

NELSON:

Yes, he is.

MAPSTONE:

We haven't been able to get to him.

NELSON:

Oh, yes.

MAPSTONE:

I think he's--well, he's not in hiding, but he doesn't seem to want to talk.

NELSON:

I see. I'm surprised at that because he used to be very talkative.

MAPSTONE:

Yes. I don't know why. It's really--well, Hal feels that if he doesn't talk to Howard Aiken his whole project has been a failure because, you know, with Howard Aiken I have not got a full 360 degree look at the history.

NELSON:

Surely, uh-huh.

MAPSTONE:

Okay. So DIGITAC flew in 1952. But it was a small tube machine not using the Boolean approach. However, before DIGITAC flew, I presume you had already started the work on MX1179.

NELSON:

That's right.

MAPSTONE:

No name for that machine?

NELSON:

No, no name for that computer.

MAPSTONE:

And this had come out of the developments with Frankel and Frankel's philosophy which you had then followed through.

NELSON:

Right, uh-huh.

MAPSTONE:

How did you end up getting into the building of computers when you really were not in--that wasn't really your bag, was it?

NELSON:

Well, they needed to be designed and built and so we just went ahead and built it, I guess. That's all. I was assigned the responsibility for the group there at Hughes for which we were charged with both the DIGITAC project, this MX1179 project and then a commercial development that Hughes worked on. A commercial computer was actually designed and the model I guess was essentially put together before they decided not to go into the business.

MAPSTONE:

Oh, they did almost complete a machine.

NELSON:

Yes.

MAPSTONE:

And this would have been Hughes' entry into the commercial market?

NELSON:

That's right, uh-huh.

MAPSTONE:

And something happened then.

NELSON:

Well, as you may recall, there was all the big problems with Ramo, Woolridge, and General George and those left Hughes.

MAPSTONE:

I'm not too familiar with it.

NELSON:

In 19-- I guess--'53, a set of management problems arose between the management of Hughes Air Craft and Howard Hughes which led to the management of Hughes Air Craft Company resigning and leaving. And out of that came two companies: One, the Ramo-Woolridge Corporation formed by Ramo and Woolridge, and Litton Industries formed by Thornton and Roy Ash.

MAPSTONE:

Litton started right there. That was it?

NELSON:

Yeah.

MAPSTONE:

Okay. I'd always thought Litton had come down from somewhere else.

NELSON:

Well, they bought the company called "Litton" but it was a microwave tube manufacturing company and they kept the name Litton so it does have historical antecedents from that. Thornton and Ash used that as the basis for building up their large electronics company.

MAPSTONE:

Did Litton go into computer building or did they stay with?

NELSON:

Yes, they went into computer building in some specialized ways related, I guess, first their navigation system and they apparently are building some military computers.

MAPSTONE:

Again, still to do with guidance and things like that? And then Ramo and Woolridge split and they went off on their side. And what were they doing? What was their ?

NELSON:

Well, initially, they designed an airborne digital computer, this time using transistors, completely solid state machines.

MAPSTONE:

We're now well into the '50's?

NELSON:

Yes. This would be in the period '54, '55, '56.

MAPSTONE:

Then the split took place in '54?

NELSON:

Ramo Woolridge corporation, I think, got established on September l5, 1953. And I joined them in May of 1954.

MAPSTONE:

And so they were--I'm sorry, I interrupted you.

NELSON:

That's all right.

MAPSTONE:

What was their--what were they building?

NELSON:

Well, in the computer field, computer hardware area, they set out to develop an airborne digital computer, employing the transistors in place of tubes. And one called the RW 40 was developed under a contract from Westington House Corporation which wanted to use it in its avionic systems. So I believe this was the first airborne digital computer using transistors. A parallel development at the Bell Telephone lab using transistors was carried out. But I understand it wasn't very successful. Then secondly Ramo-Woolridge Corporation again developed a computer for industrial process control and the RW300 was developed and it was first exhibited in the meeting of the National Instrument Society of America in September of 1957. And that was a -- and the first computer for that was installed at the Texas Company's Port Arthur Refinery. I think it was sometime in '58 or thereabouts. And that was the first industrial processing control computer. As I understand, it has been delivered to the Smithsonian Institute that's back there in Washington, although I haven't seen it there. But I've talked to people who have.

MAPSTONE:

It must be there. I didn't know about that.

NELSON:

Business Week magazine also says that this was the first commercial transistorized computer to go on the market.

MAPSTONE:

I'm not in a position to [?] you. [Laughter].

NELSON:

Well, I say, I haven't made a careful--except dated in an article ascribed to.

MAPSTONE:

So, is this a recent article?

NELSON:

No, it's back, probably, ten years ago.

MAPSTONE:

Um, it would be very interesting to read it. In Business Week sometime. Did you have anything to do with this machine?

NELSON:

Well, I was overall responsible for it and directed the activity.

MAPSTONE:

Did you work on its design?

NELSON:

I didn't do much of the detail design, myself. That was done by other people. And let's see, I probably should mention some of the people who were involved in this. There was Don Burbeck and Pete Bowles who were--and Bill Freety, who had all been involved on the DIGITAC project at Hughes.

MAPSTONE:

Do you know where any of these people are now?

NELSON:

I believe Don Burbeck--we went to work for General Electric in Phoenix a number of years ago, and I'm not sure where he is now. Pete Bowles wasn't at Bunker-Ramo until fairly recently. But I don't know where he is now. And Bill Freety, I haven't had contact with him for several years.

MAPSTONE:

Okay. And these three people also worked on the Ramo-Woolridge machine we were talking about?

NELSON:

Yes. And Montgomery, Dr. Montgomery Phister, who had also worked at Hughes and who was responsible, I think, for propagating a lot of this Boolean Technique by writing a book on the subject.

MAPSTONE:

Yes, I've heard about that. Do you happen to know the name of it?

NELSON:

No, I don't.

MAPSTONE:

All right. I'll ask him [laughter]. He'll probably know.

NELSON:

He was, oh, he worked on the application side of this process control. And of course, contribute to things on the overall design and fitting it to the application.

MAPSTONE:

How did the--how did this idea evolve of using a computer in this way? Were you instrumental in this at all?

NELSON:

Well, based on my work with the airborne digital computers, in looking for applications

of that technology, it appeared that technical processes were similar from a control point of view to the control of air craft and system. So in the early days at Ramo-Woolridge Corporation I set about to make a study about that. And looked into some applications and outlined how they would be used and then we made a market study and concluded that it was an area where the marketing was opening up. And the company decided that they would go into business.

MAPSTONE:

They were really marching ahead, weren't they?

NELSON:

Yes.

MAPSTONE:

There's quite a great deal of foresight there. Did you publish it?

NELSON:

Well, I gave the paper at the meeting of the Institute of Management Sciences, I think, in either '55 or '56.

MAPSTONE:

On the machine?

NELSON:

On the Industrial Process Control. The general philosophy of approach to that. Our approach was different from most of the places which seemed to be working at the dynamics of a processes. But we noted that from those--that was terribly hard to work out because the dynamics of chemical processes are not very well known. If you take just the simple aspects of a conservation of energy and mass and things like that and work out the equations for that, there was a big payoff to be obtained by taking that simple approach. That's what made it practical to use the computers.

MAPSTONE:

In other words, less is more, right?

NELSON:

Yeah.

MAPSTONE:

I'd like to just back track a little bit. We sort of skipped over MX1179.

NELSON:

Yes.

MAPSTONE:

Maybe you can tell me a little more about the machine, what it really did and if it advanced the technology in any ways.

NELSON:

Well, let's see, it had about--it was the first computer that we built at Hughes using this logic design and basing most of it's switching network on a logical--on a diode network so we were able to reduce the number of vacuum tubes by a substantial amount. There were only about 100 tubes in the initial model of the computer. It used a magnetic drum memory and it had, of course, analog digital conversion equipment to take the analog signals from the air craft instrumentation, convert them into digital format.

MAPSTONE:

That was a point I wanted to bring up. Harry also mentioned that he thought that some very pioneering work had been done at Hughes in this analog digital conversion technique. Would you agree? And if so, maybe substantiate it.

NELSON:

Yes, uh-huh. Well, one--in the voltage dig--I guess there were two pioneering things. One was in the voltage--reading of an analog voltage. A man named Sigfried Hanson invented a voltage latter conversion in which the--what it did was generate a voltage to compare it with by digital format and on comparison they would--it would signal that they were equal and then the digital number in the flip-flop register was recorded as a voltage value. Previous techniques like that had used switching of currents and which the volts used much more power and were not as accurate as these voltage latter's that he developed. A second technique developed by Dale Scarborrow for the conversion of an angle, it used the reading off of the angular position when the points of two contacts, if you just used the ordinary binary code, there is a chance of an ambiguity in reading when the angular position was just passing from one digital to the next. And he worked out a code which turned out wasn't unique to him but it had been had been invented by some mathematicians years ago, which had no such ambiguities. Or that the ambiguity could be localized to the smallest digit, and so at the most the uncertainty of one binary digit in the lowest significant position would result.

MAPSTONE:

And taking these two theories, you incorporated them into your device.

NELSON:

Into the device, yes. One of them for measuring angular positions of instruments and the other for measuring both these signals.

MAPSTONE:

And this puts your conversion method way ahead and—

NELSON:

One other feature, I think, on that was that also in designing the computer, had the reading of the inputs--of the instrument inputs to go on and parallel with the computing whereas, I think, most other computers approach had that go on in serial. That they'd reached a point where they wanted a reading, and as one of the instructions they would go and read the instrument and then go onto computing and then go on and read it. Whereas in this, we tied the instrumentation of this into a portion of the storage so that each instrument reading went into a particular storage location, and that storage location always contained the most up-to-date reading of that instrument, and so whenever they needed it in a computation, they would just read it out of that storage position.

MAPSTONE:

Oh, yeah. That's really a great time saver. I think you're right. I think most of the other machines did serially. The other thought is then the magnetic drum. Did you do any work--did you again advance the technology at all or did you just use standard—

NELSON:

Well, I think we were probably one of the first to use a type of recording called the non-return to zero.

MAPSTONE:

I've heard of that before. I'm not really sure what it means. Can you explain?

NELSON:

Well, what it means is that you--there are two states of magnetization in which--well, we can call one plus magnetization and one negative magnetization. And you would represent the binary digit by zero, see, by the negative magnetization and the binary digit one by a positive magnetization. And the--so in recording on the magnetic drum, you

would record a series of zeros as just a continuous set of the negative magnetization. And then when you came to a one you would rise to a positive magnetization and you would remain there for the entire time interval. See, this corresponded with what earlier techniques recorded a magnetic pulse in which was a rise from a zero negative magnetization to a positive magnetization and it returned back to negative magnetization all within the same time interval. So that's what that pulse return to zero, on the non-return to zero you would just go—

MAPSTONE:

So if you'd actually sent [?] in some visual way you'd have had--because this would have been happening all the time instead of running assumed [?] until the change. And then you'd go up and stay in that part until that changed. I see. Okay. Now I understand. Otherwise it would have been--this sort of would have kept on returning.

NELSON:

That's right.

MAPSTONE:

Okay. Now you [?] it makes good sense. How was this--was this accomplished in any sort of specific way that was you and—

NELSON:

Well, there was one technique that was used there in the--on the DIGITAC computer which I don't believe has been used on any further ones which was to use a magnetic recording which was perpendicular to the magnetic surface of the drum as opposed most others--most recording used magnetic recording that is parallel to the surface of the drum. So there was a difference--it used then an iron drum rather than a non-magnetic one so that the magnetization was from a thin piece of magnetic material through the magnetic coding onto the iron, to the soft iron drum. And it had a vertical magnetization across it.

MAPSTONE:

Was there any reason to go this way?

NELSON:

Well, it--at the time they thought it might be easier and might produce a sharper or a more precise signal. And it also--it did have potentialities for becoming even--for further improvement, but somehow further engineering work didn't get carried out on it. And who did you build--did Hughes build their own drums?

NELSON:

Yes, they built their own drums.

MAPSTONE:

They did. Was all their hardware built within the corporation?

NELSON:

Just about all of it. We got motors and things like that outside.

MAPSTONE:

How about tubes?

NELSON:

Tubes we bought outside.

MAPSTONE:

Uh-hum. And did you actually design the logic for MX1179?

NELSON:

Well, I did some of the preliminary work on it, but then Howard Angle and Philip Adamson and Robert Johnson did the detail work for the logic. And on successive refinements to it, a fellow named Claude Lane, who did all the revisions to it, and the successive models that we built.

MAPSTONE:

Would you suggest I talk to any of these gentlemen?

NELSON:

Well, I think Phil Adamson might be one and possibly Howard Angle.

MAPSTONE:

Do you know where either of them are?

NELSON:

I think Phil Adamson is still at Hughes. And I'm not sure where Howard Angle is.

MAPSTONE:

Okay, but maybe Hughes is a good contact. So you actually conceptualized the MX1179 I wish you had another name for it. [Laughter].

NELSON:

Yes.

MAPSTONE:

And then you were in charge of the project, were you?

NELSON:

Yes, uh-hum.

MAPSTONE:

And did you stay with it all the way through?

NELSON:

Well, I stayed with it through the building of the, what, the bottom three version of it. And--but then I left to go to Ramo-Woolridge and it was carried on by Phil Adamson and others there.

MAPSTONE:

And they carried this through till it was flying.

NELSON:

Till it was flying as an operational computer.

MAPSTONE:

And, now, somewhere in here we've got this other machine. The commercial one.

NELSON:

Oh, yes, yes.

MAPSTONE:

Who's concept was that?

NELSON:

Well it was, again, it was a team work on this. We set out to study the commercial applications. And we had a group Harry Larson was involved in that. And Andrew Voganee was another one that was involved in that and Donald Swanson. And from the study of those applications, the requirements and specifications for a computer were made and then that was detailed and worked up into design. Phil Adamson was involved somewhat on that. Michael May was probably the principal architect of the circuits.

MAPSTONE:

I haven't run across this name. Is he—

NELSON:

Last I heard, he was working with--at Hughes. But I don't know. I haven't had any contact with him for a number of years.

MAPSTONE:

But Hughes as a company or certainly this division of Hughes was genuinely interested in becoming a commercial computer company.

NELSON:

That's right.

MAPSTONE:

And somewhere along the line, this didn't happen.

NELSON:

Right. The--well, this happened after the decision to abandon the field happened after I left Hughes. But I understand that at one point then they had a management review and the management decided there were better opportunities to apply their technology in the military market than in the--than to go into the commercial market.

MAPSTONE:

That's interesting. Who knows, they might have been a genuine competitor to the auto company. (Laughter)

NELSON:

Possibly, yeah.

MAPSTONE:

This commercial machine, when did the work start on it, or when did the design concepts up, do you know?

NELSON:

Well, the studies on it actually began, I think, around l950.

MAPSTONE:

Ooh, very early.

NELSON:

Yes.

MAPSTONE:

Was it planned as a small machine?

NELSON:

No, it was planned to be one--well, it was a fairly substantial size, I think. It's power was, let's see, equivalent to the--at least equal to the UNIVAC I on the market at that time.

MAPSTONE:

Uh-hum. And I presume it was a Von Neumann concept machine. Stored program, anyway.

NELSON:

It was a stored programming, but unlike his approach, which was the single address approach, this was a multiple address machine.

MAPSTONE:

Let's--I'm really kind of curious about why it didn't go and look further into that one. Did you have much to do with the machine?

NELSON:

I was in charge of it and had to be involved in it.

MAPSTONE:

Can you tell me about some of the plan technologies for it, how it was--the concept for it.

NELSON:

Well, it was--I think one of its unique features was that it looked on the auxiliary storage, the magnetic tapes as the basis for a data base rather than just an input,-output. And so that way, it was ahead of its time. Where most computers at that time with the magnetic tapes was just input-output. The tapes were looked as the medium for storing the data base of all business operations. And it had in--each instruction had the capability not only to perform the arithmetic operations but to given a computer word then it extracted from memory would be to extract a portion of it and shift it into position as an integral part of instruction, which in business data was quite important because since in business a lot of the numbers are small numbers instead of large numbers, to fill the whole word, you wanted to pack several numbers into a word and then be able to pick them out and so instead of having to use a subroutine to extract the number, it was extracted as part of the operation.

MAPSTONE:

So, was this variable length? This same tech—

NELSON:

Well, it's not as variable length. It gives a kind of equivalence to variable length, but it's not quite exactly the same.

MAPSTONE:

And what was the main storage?

NELSON:

The main storage in that was the magnetic drum.

MAPSTONE:

Magnetic drum.

NELSON:

Uh-hum.

MAPSTONE:

This would, I presume, be quite a large drum.

NELSON:

It would have been substantially larger than we use in the air borne computers, of course

MAPSTONE:

What was the planned wordage for these machine,

NELSON:

I don't recall the number of words that were planned words. Probably not large by current standards.

MAPSTONE:

Oh, right.

NELSON:

Uh-hum.

MAPSTONE:

Let me see, UNIVAC I was on the market and of course, the university machines.

NELSON:

Yes.

MAPSTONE:

Had you taken this swing around the country and looked at these machines?

NELSON:

Yes, uh-hum.

MAPSTONE:

And what were some of the machines you saw?

NELSON:

Well, of course, there was the Univac I, the MARK III at Harvard. And the IBM--well, let's see, the IBM 701 didn't come along until a little later.

MAPSTONE:

That's right.

NELSON:

And there was the Engineering Research Associates, the ERA, which was then building an ll0l or something like that.

MAPSTONE:

Yes, that's right, that's right.

NELSON:

And of course, you are familiar with the Computer Research Corp. that Floyd Steele worked on. Was it l02 or something--201 or-

MAPSTONE:

Something--I think 102 was the general purpose machine. That's right. 101 was the MADDIDA-type machine.

NELSON:

Oh, yes.

MAPSTONE:

Did you see the Princeton machine?

NELSON:

Yeah, uh-hum, uh-hum. Right. That was probably around l950 or so, we went by Princeton.

MAPSTONE:

Yeah. I don't think it was running then, was it?

NELSON:

No, it wasn't.

MAPSTONE:

It was still the longest machine in the building. Looking at these machines, I presume you got some pretty good ideas of things you didn't want to do. And other ideas about what you did. What were some of the engineering concepts of some of these machines that you felt were really very good and that you might have wanted to incorporate?

NELSON:

Well, of course, all of them worked on a base of the same general principles, the stored program. Although, there was--did some controversy exist of whether there should be a stored program, particularly for things like control applications. Air Borne computers should be a wired program. But concluded that the stored program was by far the most efficient state of the art. The use of conductors, of course, as much as possible and to keep tubes down to a minimum. We concentrated on the magnetic drum, because we thought at that time it was the most reliable type of memory. The storage tubes which were getting to be used more, the Mercury delay lines would not be as efficient or reliable. The magnetic cord technique began to be developed but it was in the still, I think, too primitive stage at that time.

MAPSTONE:

It must have been pretty primitive then.

NELSON:

So that is the reason for concentrating on that.

MAPSTONE:

Did you see Whirlwind?

NELSON:

Yes, we did go by Whirlwind.

MAPSTONE:

Do you have any sort of thoughts about--did you have any thoughts about Whirlwind at the time?

NELSON:

Well, I think we walked through there where there was a--they had a whole floor full of equipment. You walked by it and the scale on which they worked was quite different

from ours where the chassis for one flip-flop was almost as large as the chassis for a whole unit. [Laughter].

MAPSTONE:

Dick Sprague, in one of his tapes, said that he always had this great urge to go back, pick up MADDIDA, bring it East and he said just walk it up and down through all the corridors of Whirlwind and say, "See." And you know, it's a crazy machine, it really is. I believe that one of these days this is going to end up in the Smithsonian too.

NELSON:

It probably should, yes.

MAPSTONE:

They'll have to build a building for that one. [Laughter].

NELSON:

Oh, yes, yes.

MAPSTONE:

How about when you got to Ramo-Woolridge. I jumped a little. I back-tracked on you and then we seemed to have gotten up to the talking a little about Ramo-Woolridge. I'd sort of like to follow that line a little bit.

NELSON:

All right, uh-hum.

MAPSTONE:

Let me see, when did you join them?

NELSON:

In May, 1954.

MAPSTONE:

Okay, and what was the first project that you got into there?

NELSON:

Well, at first, we had started a consulting service on the application of electronic computers to business operations. So I guess that was one of the first things I got involved with. Second, they were beginning to do some work on this Ballistic Missile project and they had need for computing there and I worked with setting up--arranging for the acquisition of computer time and then selection of a computer to be acquired by TRW which required an--well, the UNIVAC 1103 in the summer of '55. And third was getting started on this work of the RW40 air borne digital computer and then the process control work. So it was kind of all of these things got going somewhat in parallel. I guess the process control work didn't get started until late '54 and early '55. Late '54, I believe.

MAPSTONE:

And the machine, itself, was not working and in [?] until '50—

NELSON:

No, we didn't--let's see, we didn't go into the specific development of a machine, commit the development of that until the fall of '66.

MAPSTONE:

So you were really just analyzing the situation?

NELSON:

We were studying the applications. We did some work with the Riverside Cement company and want and looked at some oil companies, for the Texas Company. We made a study of a process down at their Port Arthur Refinery. And studies for Union Carbide and some chemical companies.

MAPSTONE:

Would any of these kind of documents be available?

NELSON:

I don't have any in my files.

MAPSTONE:

Did you--I mean, was anything published on it?

NELSON:

There was a paper published by Gene Grabby and Montgomery Phister. And again, I

don't think it was on specific processes, but it was detailing some of the ideas I had set forth in my talk to the institute to the Management of Sciences that I'd mentioned earlier.

MAPSTONE:

Yes.

NELSON:

And there were some articles published later on the Texas Company process. But I don't have in mind what they were.

MAPSTONE:

Uh-hum. You mentioned that one of the first things was applications for business.

NELSON:

Yes.

NELSON:

What were some of the avenues that you looked at?

NELSON:

One of our clients was a Bankers Trust Company in New York, and we looked conducted a study of their special technical account to see its appropriateness for electronics. And then worked with them to design a system which they then put into effect. It's probably one of the first computers in the banking business. They used an IBM 650 for that first application.

MAPSTONE:

So at this point, Ramo-Woolridge Corp.--was that the name of it? Ramo-Woolridge—

NELSON:

Yes, Ramo-Woolridge Corporation.

MAPSTONE:

--Corporation. Was acting in a consulting capacity.

NELSON:

That's right, uh-hum.

NELSON:

And during this time were you trying to determine what type of machine your company should build?

NELSON:

Well, we felt that going into the commercial market would probably be far too expensive for a small company to undertake. And so we felt we'd have this consulting service where we could pay our way and study and learn about it and see if there were any potential markets for hardware.

MAPSTONE:

That's--at that time, that's a pretty unusual way to go, wasn't it?

NELSON:

I think it was, uh-hum.

MAPSTONE:

Seems that most people went in feet first and built their computers and then looked for a customer.

NELSON:

Yes.

MAPSTONE:

And what seems to be happening in this mid '50's maybe RamoWoolridge is one of the pioneers in this was looking at what the customer needed first.

NELSON:

Yes.

MAPSTONE:

I'm not aware of other companies doing this. Do you, yourself?

NELSON:

No, it wasn't too common, although I'm sure there were others that did it.

MAPSTONE:

Yeah, but it seems to have been a switch in philosophy. And at the time did you see this as a switch? Did you—

NELSON:

Well, of course, back at Hughes in our commercial development there, we had again engaged first in studies of applications and trying to find out what were the customer needs before sitting down to build the hardware.

MAPSTONE:

This was on the big machine?

NELSON:

Yes, uh-hum.

MAPSTONE:

Ah, and—

NELSON:

And the others, of course, were designed to meet specific military requirements, so again there was a customer saying, "I want this kind of machine."

MAPSTONE:

Yes, as a matter of fact, that--so much of the western developments came out of military contracts. So in a way they were pretty much a customer demand.

NELSON:

Yes.

MAPSTONE:

I have a feeling that the East was operating quite differently. They were going more on the convincing the university or government concern that they should have one of these machines.

NELSON:

Yes. Yes.

MAPSTONE:

And going that route. By the way, have you seen Herman Goldstine's new book?

NELSON:

No, I haven't.

MAPSTONE:

It's just come out and it's an interesting book. He covers, goes from--it's called, From Pascal to Von Neumann.

NELSON:

Oh, yeah.

MAPSTONE:

And, well, there's a loss of omission. There's a tremendous amount of omission. But it's still a very good book.

NELSON:

Sounds like it would be interesting.

MAPSTONE:

Of course, you know, he has his own theory about Germany.

NELSON:

Yes.

MAPSTONE:

And I think he's sort of started to stand a little on his own ideas. Because he says that John Von Neumann was the man, you know, the person who came up with the stored program concept.

NELSON:

Oh, yes.

MAPSTONE:

And did you know Von Neumann personally?

NELSON:

Yes, uh-hum.

MAPSTONE:

Did you have any feel about, you know.

NELSON:

Well, he, in my conversations with Von Neumann at Los Alamos, I got the impression that the stored program concept originated out of Eckert and Mauchly.

MAPSTONE:

Yes.

NELSON:

That he did elaborations on that, rather then inventing the storage program. What he did invent was the single address approach. Which interestingly he was influenced in developing it by the work he did on the punch card machines because on the tabulator it does many things in parallel and you have to be concerned with timing relationships. So it's quite a job to design the plug boards for it. And he found that kind of frustrating to work out them he felt. So he said in designing for a computer, he was going to have one that you wouldn't have to worry about the timing relationships and deal with one quantity at a time. So that's how the single address originated. So the ENIAC was a multiple address machine and the--it was my impression that the stored program process originated with Eckert and Mauchly and not Von Neumann as it was alleged in several publications that I've seen.

MAPSTONE:

Right. It seems to be coming through from so many people who have been talked to that it is [?] that Von Neumann's authority in his [?] just the fact that he was who he was really helped sell the idea.

NELSON:

That's right.

MAPSTONE:

And probably if it had just been Eckert and Mauchly maybe it would not have proliferated the way it did.

NELSON:

I think that's right.

MAPSTONE:

But Von Neumann was a great salesman.

NELSON:

Yes, he was.

MAPSTONE:

And everybody loved him. And you know, everybody knew him and admired him and thought--when words that meant this is coming from Von Neumann, I suspect that everybody did stop and listen. And anyway, in Goldstine's book, he's the great supporter of Von Neumann.

NELSON:

Yes, uh-hum. Well, he worked closely with Johnny at Princeton in the early days.

MAPSTONE:

Yes. And I think he sort of appointed himself as champion of Johnny Von Neumann. Although, I don't think there's too much champion in him. [Laughter] anyway.

NELSON:

No.

MAPSTONE:

In retrospect, and this is sort of a very general question, but let me try it on you anyway: Looking back, what do you feel were some of the key philosophies and technologies that maybe have come out of the western development of computers?

NELSON:

Well, one, of course, was the use of the Boolean Algebra for design of computers which,

I believe, took a while to get established and used elsewhere. The other was a kind of economy in machine design in terms of, well, the computers that were designed out here all seem to have much fewer parts than the ones designed in the East.

MAPSTONE:

Was this because of the Boolean approach?

NELSON:

I think it was because through that you can lay out the design so much easier and clearer, you can explore alternative designs and there were techniques for simplifying them whereas in laying out in an ordinary block diagram, it's hard enough to do it once, let alone try it several times.

MAPSTONE:

Yes. Any other areas?

NELSON:

For things I guess that have permanent effect on it [?] of course, the, let's say, the process control ideas got started and the air borne digital computers got started and, of course, both of those have gone on so they are now commonly used in military aircraft and commonly used in the industrial processes. I think for now today, of course, technology has advanced along so that most of the design techniques have been superceded now.

MAPSTONE:

Do you think that any of the--I'm not quite sure if I--well, let me just try it, anyway--any of the philosophical approaches towards computers have--that might have come up this late forties to fifties period influenced today, today's development, today's marker.

NELSON:

Well, the--some of those people who worked on our business data processing project at Hughes went to work at National Cash Register and some of the points in the design of the Hughes machine did show up in the early MCR computers. And, well, now I'm talking about some later things, but which I believe did originate at TRW the--in getting toward the late '50's, Lowell Landowel was there at TRW, developed the idea of putting the logic design in the computer in the memory instead of in the circuitry. And making a very, what's a simpler type of computer. Or putting into a simple computer the power of a large computer only much smaller and the TRW 130 which was also built for the NAVY under the ANUYK1 designation employed that concept in which they call stored logic In the IBM 360 computers, they achieved compatibility up and down the line from the top down to the small by storing the logic in what they called the read only memory

of the computer. That principle there came out of there. The second thing TRW--a multiple processor system, this was the RW400 design and tested [?] using multi-processing and multi programming and connecting this ready display tubes to which was developed and tested in '60, '6l first began to show up in the computers, the Burroughs 500 or something like that. And then, of course, showed up in the G635 and the Control Data 6500 machines.

MAPSTONE:

While we're talking about TRW, can you just trace for me what--I'm trying to do sort of a family tree. [Laughter]. It's very complicated.

NELSON:

Yes.

MAPSTONE:

It sure is. I keep starting and chucking reams of paper in the garbage because I get bogged down, but where do we go from Ramo-Woolridge. Let's start from there. What was the next corporate structural move?

NELSON:

Well, Ramo-Woolridge merged with Thompson products in 1958 to form Thompson-Ramo-Woolridge.

MAPSTONE:

Which was TRW.

NELSON:

Yes. We shortened its name to TRW some years later. And that stayed status quo. And then Litton became Litton Industries.

NELSON:

Yes, uh-hum.

MAPSTONE:

And both companies are in the computer business to some—

NELSON:

To some degree. TRW's in the computer business fairly limited at the present time.

MAPSTONE:

Is the limitation tied in with contractual work or is it a commercial endeavor?

NELSON:

Well, their computer hardware business is a commercial endeavor which has been related to their credit information business where they developed some special hardware for handling credit checking which turned out to have other applications in checking air line tickets and in the fast food business.

MAPSTONE:

You don't think of the two being related, do you?

NELSON:

No, uh-hum.

MAPSTONE:

I don't like to think of myself as being a piece of food going down a production line. [Laughter].

NELSON:

Well, this is not food production, but fast serving.

MAPSTONE:

Fast serving?

NELSON:

Like McDonald's hamburgers and things like that.

MAPSTONE:

I was looking through my notes to see if I've got anything else I'd like to cover with you. Maybe any suggestions that you would have for me, people to see, maybe areas that we should be covering.

NELSON:

Let's see, Bill Adamson at Hughes is probably someone to talk to. Montgomery Phister. Let's see, Dale Scarborough, I think, is still up at Bunker-Ramo corporation in the valley.

MAPSTONE:

In San Fernando Valley?

NELSON:

Yes, uh-hum.

MAPSTONE:

And what was—

NELSON:

Oh, he was involved in that early DIGITAC project.

MAPSTONE:

DIGITAC. Did I get some--any other names on MX1179?

NELSON:

Let's see, Phil Adamson would be a key man on that. There was, let's see, on the developing, Dan Curtis, I think, should be mentioned. He developed the memory system, the magnetic drum

MAPSTONE:

Do you know where he is?

NELSON:

No, I don't know where he is.

MAPSTONE:

Any thoughts about how I might be able to track him?

NELSON:

Well, he last was at Litton. But I had heard that he left there a couple of years ago.

MAPSTONE:

People have a habit of leaving just as I think I've got them. I think I mentioned to you earlier, I'm trying to find Floyd Steele. I don't suppose—

NELSON:

He used to be down in the La Jolla region. Did you look around there?

MAPSTONE:

Well, I've checked through information, and of course, if he's there, he has an unlisted number. I have an address: Polos Verdes. I just have Palos Verdes Estates.

NELSON:

Well, that, of course, is here. Palos Verdes Estates is just--you mean—

MAPSTONE:

Oh? It's not in Palos Verdes?

NELSON:

Palos Verdes is not in La Jolla.

MAPSTONE:

I'm sorry. I'm sorry. It's not La Jolla, I mean it's not Palos Verdes Estates. That's someone else. It's Green Dragon Colony in La Jolla, is the address I have.

NELSON:

I see. I'm not familiar with that.

MAPSTONE:

I came up with another source just the other day looking at some newspaper clippings of 1951 announcing the Maddida.

NELSON:

Oh, yes.

MAPSTONE:

And one newspaper which struck me very funny, maybe it was the Boulder Paper that

said, "Son of Mr. and Mrs.--whatever his initials are--had invented a, you know, thinking machine."

NELSON:

Oh, yes. Oh, yes.

MAPSTONE:

And it suddenly struck me so I checked for information and they do still live in the Boulder area.

NELSON:

Oh, yes. Very good.

MAPSTONE:

So I think I've got my little clue there. But did you ever know Glen Hagen?

NELSON:

Yes, uh-hum. Not very well, though.

MAPSTONE:

Unless you can think of some points that you think should be inclusive in what we've been talking about, I seem pretty much run out for the moment.

NELSON:

I think probably I've run dry, too.

MAPSTONE:

Have you? Okay. Why don't I turn this off.

NELSON:

All right.

[Recorder off]

NELSON:

Well, I was reminded of it by John Mauchly when I was at the 25th anniversary

celebration of the Association of Computing Machinery that on a visit of his to the West Coast in 1947, he and Stanley Frankel and I sat around one evening discussing possible names for the computer he was developing. And at that--finally the name UNIVAC was decided on. And John Mauchly says he ascribes it to me, although I don't recall whether I suggested it first or not.

MAPSTONE:

And what did UNIVAC stand for?

NELSON:

Well, he thought it for Universal Variable Computer, Automatic Computer.

MAPSTONE:

Okay. That's a pretty good name, isn't it?

NELSON:

Yes.

MAPSTONE:

Yes.

MAPSTONE:

Covers--I mean, it's so large and wide sweeping. I think people must have had a lot of fun with computer names, you know.

NELSON:

Yes.

MAPSTONE:

Jerry Mendelson's machine QUAC, Quadratic Arc Computer. And there's a couple of others that are rather delicious. There's the SILIAC. Have you run across that one?

NELSON:

No, I haven't.

MAPSTONE:

Must be one of the ILLIACS. But it's got an "S" stuck on the front of it and became a SILIAC. And, I know there's some strange names. Yes, that's right. Mauchly came and gave a series of lectures at Northrop, did he not, in that 1947 period?

NELSON:

I think he did, yes.

MAPSTONE:

Did you happen to be in on this?

NELSON:

No, I wasn't in on it.

MAPSTONE:

And what about Stan Frankel's machine. Did you have anything to do with him? His working?

NELSON:

No, he developed that independently when he was at Cal Tech. He developed the--a small fairly efficient computer, the rights to which were bought by Librascope. And became the LMGP 30, is it?

MAPSTONE:

LGP 30, I think it is.

NELSON:

LGP 30.

MAPSTONE:

LGP. Did you have a--Frankel was very interested in developing small computers.

NELSON:

Yes.

MAPSTONE:

He'll bring them to the schools. Was this an area that you were interested in yourself

or—

NELSON:

Not in the same way he was, no.

MAPSTONE:

You were much more involved because you were with the corporation and following that path.

NELSON:

Yes.

MAPSTONE:

Okay.

[End of Interview]