Interviewee: Robert R. Everett
Interviewer: Richard R. Mertz
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EVERETT:

Well, I guess I would suggest putting in the arithmetic element. Well, how many are you looking for? Three or four or something like that?

MERTZ:

Yes. Weren't there subsequent versions of these in later summary reports produced?

EVERETT:

Not that I recall. You know they were up to date block diagrams. The machines were maintained or changed so you could always get an up to date version of it just sort of, you know, evolved.

MERTZ:

Mhm.

EVERETT:

A fellow named Ron Mayer, who still worked for us in Washington –

MERTZ:

M-e-y-e-r?

EVERETT:

M-a-y-e-r. We used to call him "Mayer," but he preferred to be called "Myer". Worked on the block diagrams for a long time. This was after this, and he used to be able to put block diagram including all the timing for all of Whirlwind on one sheet of paper. He used to maintain that. The kind of guy who writes the Lord's prayer on the head of a pin.

MERTZ:

Yeah. I don't know how his resolution would be in terms of being reproduced in a report.

EVERETT:

It was readable with the naked eye.

MERTZ:

It was?

EVERETT:

Oh, yes. It was scrunched in, but he spent a lot of time melting out anything that wasn't absolutely necessary, but you could figure things out from it. Nobody ever really used it except for, you know, to get some feeling for what was going on. People who were working on the machine used the articles, but I don't recall that we used to regularly publish the block diagrams. There wouldn't be very much point in it. Probably subsequent summary reports included special things that came out. You know, when we finally got the storage ... there's probably a report around someplace with the block diagrams for storage tube control. I have no idea what number it is or anything of that sort. When something like that came up, we usually wrote a report on that subject, but we wouldn't issue a report on the whole machine.

As far as the system block diagram, we chose the major pieces--29, 46--and there's the control. Other people might have done it before, but as far as I know this was the first time anybody had published a detailed block diagram for machine control; one that said where all the pulses came from and so on. Takes a lot of -- [Chuckle] [Looking at documentation] I don't know why they bound these upside down. One of these operation maintenance forms perhaps --that would be sort of the kind of thing I would think sort of would give a guy a feeling of what was done.

MERTZ:

Was that Number 54?

EVERETT:

Yeah….was when we built the switch to look like that.

…the idea was that here was a control switch that picked one of the instructions. There were sixteen. This just shows the ones that were listed at the time. And there were thirty-two, actually, and then you read in the five binary digits and picked the instruction that set up one of these lines that went out across the line. And then there were vertical lines. Down at the bottom of each was a gate tube, and then there were also these control time pulses, and the machine would put a pulse on one and then a pulse on two, a pulse on three and so on.

Then if you wanted to make an instruction, you'd pick one of these lines that wasn't used. These were all control lines going out ... and you'd say, "Well, I want to put that one first." So you'd take that one and hook it to the line with a diode up here and you'd hook it to the control pulse. And it would produce then a pulse to that place at that time for that instruction. If you wanted to change it, you know, you'd get your little soldering iron and change it. There was no fundamental reason why it had to be built this way. It's just the guys who designed it thought that was kind of a nice way to do it, so they built it that way.

MERTZ:

Just looked like it.

EVERETT:

Yeah.

MERTZ:

The thought that was kind of a nice way to do it so built it that way. It looked like that. [Laugh] looked like it.

MERTZ:

The--let's see. Would you care to just make a sort of a brief comment and evaluation of this device? RF-12, which refers to the frequency modulated servo that you worked on prior to the abandonment of the analog approach to –

EVERETT:

Well, the high-performance servos were certainly an important part of an analog computer at that time. This was being done in the Servo Mechanisms Laboratory. One of the reasons that it was there was that presumably we knew something about servos. And servo art wasn't as far developed then as it is now, of course. Forrester and I had been working on hydraulic servos, and other people had been working on various kinds of DC electric motor servos. And it was Forrester's idea that if you used a squirrel cage AC motor which, if you recall, works by gating a rotating field--you have a three-phase motor and you create a rotating field which rotates at the synchronous speed. And then, as this goes across the squirrel cage, it creates currents in the squirrel cage so that the rotor then turns. And it turns at a speed which is slightly different from the synchronous speed--enough to create this current flow and it's called slip. So, his idea was that there wasn't any reason why this rotating field shouldn't go at 60 cycles or any--at any speed you want. And then the motor would try to run at that speed. That could be any speed at all, including DC. If you put DC on it, that would create a DC field and then you would have a squirrel cage motor that wanted to stand still, and it would go one direction or the other depending on how much torque you wanted. And this enabled you then to make an electric servo which was sort of like a hydraulic servo. That is, its output was reasonably close to a constant velocity. If you put a signal into it, you could get a velocity out, and now that would be the equivalent hydraulic servo. There are acceleration effects and is different from most of the electric servos.

So, he did work on that for a while. He used some electric motors. We got a deal, in fact, to make some special motors. We built some amplifiers. We actually built some servos and we ran some tests on them and it would work. But -- that theoretically there was no necessary moving condition?

EVERETT:

Well, the problem is that, you know, you can make a servo out of almost anything. The problem is to get the gain high enough so it's got a decent response and kinds of correction circuits. And it just -- my recollection, I'm trying to think now, is that it would work all right and it had certain desirable characteristics under certain circumstances. It was partly overtaken by events -- that is, our conversion to the digital. And it was also partly overtaken by the fact that looking back on it, I think, probably it was not as useful an idea as we had thought at the beginning. I'm not aware that anybody has done anything like that since, maybe there are. I'm not up on the servo business anymore, but the motors that essentially gave you acceleration rather than velocity because they created torque were the appropriate kinds of stabilizing circuits really, I think, gave you a better way. I'm not sure what would have come of it if we hadn't been stuck to the analog. We might have started making servos.

MERTZ:

And that was fairly far along, I gather, at the time.

EVERETT:

See, one of the advantages of this motor was that it didn't have any slip-rings, brushes are a curse, and this obviously didn't have any. The motor had only one moving part. The poly-phase squirrel cage motor is really a beautiful thing. That was one of the things we were after. We hoped that it would make, in particular, a highly reliable servo. Once you made it, it would keep right on working and you wouldn't have to worry about replacing brushes and things.

EVERETT:

Well, it lowered maintenance, and if there were going…

MERTZ:

…at least at that time, was a fairly serious matter anyway. A lot of mechanical stuff. Mechanical stuff was always hard to maintain. Do you happen to recall the first time you met John Von Neumann?

EVERETT:

No, I don't. I say Jay got interested in the digital business, as I recall, in the fall of '45. Was it fall of '45? I can't keep the years straight. That's the analog?

MERTZ:

Yeah.

EVERETT:

And it was in '45, as I recall, that Jay heard about the digital computers and went to some meeting that was held at MIT. And, you know, it wasn't a case of where we all sat down and argued about it. He sort of came back and said, "We're going to build a digital computer." So, it sounded like fun, so we all started working on a digital computer. And I can't recall whether I first saw Von Neumann when he came to visit us at MIT or when we went down to visit him at IAS.

One of the first things we did was we toured around and went to see the work that was going on at the Moore School. Went up and saw Aiken, saw Von Neumann.

MERTZ:

Do you recall what kinds of -- was this more -- had you fixed in mind an approach that you all wanted to take or were you just sort of informing yourself about

EVERETT:

Well, the ENIAC, which was almost running at that time --of course, it was really quite a specialized machine --and the EDVAC proposals that the Moore School people were working on were serial type machines using mercury delay lines for storage. And the original work we did was also on a serial type machine except we were pro-posing to use storage tubes. These were ordinary cathode ray tubes using the work that was developed at the Radiation Lab during the war for MIT. And we hired a couple of the people out of the Radiation Laboratory who were familiar with it, and eventually that technique was developed. It was dev eloped by the English -- was the Williams tube. Whether we would have come up with the same thing if we'd continued working on it I don't know, but we didn't work on it very long.

The machine was supposed to have two kinds of storage in it. That was for erasable storage, and then there was supposed to be un-erasable or nondestructive, as it's called these days, I guess, in which it was proposed once again to use ordinary cathode ray tubes for the mask in front in which you would punch holes where you wanted ones and not where you wanted zeroes, for the multiplier pick-up. And the idea was that the program and the constants -- we're still talking about a machine for the airplane stability control analyzer -- that the program and the constants would be punched in these cards, and that's the way smaller amount of erasable storage. And we went so the general timing, sizing, put together an instruction for it. We were proposing a three-address machine. And in the summer of '46, I actually wrote a computer program based on that machine at that level of detail to solve the airplane stability control analyzer equations. It's probably in one of those notebooks. I remember it was a couple of thousand instructions, and there were a lot of non-linear things, a lot of table look-up and so on.

I'm sure that the program itself would never have worked, there were just all kinds of things that were left out and one thing or another, but it was my first crack at writing anything more than, you know. We all sat down and inverted matrices, interpolated, looked up sines and so on, just sort of for fun. There are a lot of those around. This was my first attempt to write a program to solve a problem. It took quite a while to do it, and it was done seriously. And the…be and to get information on sizing and timing, to find out instruction rates and if they were necessary the solution times. It was a design activity. I believe I came across it.

EVERETT:

There were a couple of thousand instructions. These were three address instructions.

Well, Von Neumann and his group were going off to Princeton. They were proposing a parallel type machine. And in the course of the summer of '46, I guess it was, I came to the conclusion that a parallel type machine was far better than the serial type machine and sold that idea to Jay. So, in the fall of '46 we switched over from the serial machine to the parallel machine which meant a fairly major upheaval, if you can imagine the ' organization and so on.

I started then, and that led to this set of block diagrams for a parallel type machine which was not the machine, as you probably know, which was intended to solve the airplane stability control problem, which was a very much larger machine. But it was a small machine we proposed to build first to test and check out the concepts, circuits and everything else. Then we were going to build a larger one to do this air-plane stability control.

MERTZ:

Was work also simultaneously going on in connection with the cockpit simulation?

EVERETT:

Yeah, that actually started in '44, I guess, and it went on certainly in '45. I think by the time '46 rolled around, we obviously weren't going to need that for a long time, and we put it off to one side. It sat out in Building 32 in the corner for a long time. [Laugh] You've probably seen pictures of it -- a monster.

MERTZ:

Well, do you recall one of the earlier meetings with Von Neumann? Well, he did give, I believe, a lecture --perhaps only one, I don't know -- at that summer course at the Moore School.

EVERETT:

He was there, and I assume you've seen the notes on that. There are not only the notes that were issued by the Moore School, but there were the notes that we took. You know we rotated people through, and each guy was supposed to come back and prepare a set of notes for the lectures.

MERTZ:

And I also have the Von Neumann manuscript of the lecture that he gave, that I assume he gave ...

EVERETT:

I'm sure he did. I don't remember any of the details.

MERTZ:

I think it was in August of 1946 if it had been given. But it was from talking to him and to Goldstine and Bigelow, and those fellows that I became convinced that the parallel solution was a far better solution than –

MERTZ:

Excuse me, did you say at the Moore School that you –

EVERETT:

It was that summer that I came to that conclusion, and I spent two weeks -- I went to the first two weeks, as I recall, of the Moore School and I decided I really couldn't afford the time to go to all of it.

MERTZ:

Was that a fairly large course, fairly well attended, do you recall?

EVERETT:

It was like a roomful of people -- 30, 40, 50, somewhere in that vicinity.

MERTZ:

From all over or –

EVERETT:

Yeah. All over. People, you know, it was sort of the size of the group in the country who were interested in electronic digital computers at the time. I remember Claude Shannon was there. I don't know whether he stayed through it. He was there while I was there.

MERTZ:

Oh, yeah? As an auditor rather than a lecturer?

EVERETT:

Yeah. Represented Bell Labs, I guess, at that time.

MERTZ:

He didn't give any –

EVERETT:

Not that I know of.

MERTZ:

Do you happen to recall whether Perry Crawford went to that?

EVERETT:

I can't recall.

MERTZ:

Because he was an alumnus of MIT and then Princeton ...

EVERETT:

MERTZ:

I had the impression, from talking to some people, that Von Neumann was quite intrigued and fascinated by the idea of the speed of -- such things as the number of multiplications that it could perform.

EVERETT:

There are really two differences between Whirlwind and most of the other machines that were being worked. And that is that it was intended -- we began with the airplane stability control analyzer. We always looked at it as a machine for real time applications, and this put a slightly different emphasis on it. It put an emphasis on increased speed, reduced the emphasis on word length and put great emphasis on reliability. Now everybody had some emphasis on reliabilities. It's hard to look back on it but, you know, in 1945 that would work at all. The tube manufacturers guarantee a vacuum tube for 500 hours propose to make a machine with 5000 vacuum tubes in it. And then people say it would break down every six minutes.

Howard Aiken used to have a calculation that he would put on the blackboard at the drop of a hat which said that if a machine made a mistake every X operation, like 10,000 or something, and it took you 15 minutes to fix it or something, and then he would stuff the that there was an ultimate upper speed at which you all of your time fixing it.

MERTZ:

I believe, perhaps this is a little later, but that time Von Neumann was concerned with the worst, worst situations of parts -- the reliability, under which you could still get good results, under – perhaps this was implicitly in response to Aiken's –

EVERETT:

You're talking about his famous article on, you know, about making machines out of very bad components in large numbers.

MERTZ:

That's right. That even with very bad components, he believed you could get useful results.

EVERETT:

Yeah. That's apparently the way the mind works. [Laugh] Or usually works. There was no practical way of doing it. That came out sort of about the time we were beginning the design of the machine for SAGE, and that was really a horrendous problem. We did a great deal of work, and particularly did a great deal of work on ways of getting reliability --duplexing, multiplexing. In fact, I wrote a paper on the subject.

MERTZ:

Of reliability -- yes.

EVERETT:

"The Reliability of a Multiple Computer" or something, which essentially said you did best if you bought two. [Laugh]

MERTZ:

I was wondering: Was it during this time when you visited some of the other computer facilities that the idea of the Whirlwind was viewed at least with a certain degree of skepticism by some people, such as the Aiken group, or was that later when –

EVERETT:

Oh, Aiken viewed everybody with skepticism, especially in the electronic business. He'd built the Mark I. At that time, you see, he was building Mark II which was largely a lot of relays. He just didn't think these things were going to work at all.

Didn't I tell you that story about when he came to visit us when he had the five-digit multiplier working? Well, we built this five-digit multiplier to test out our reliability techniques and marginal checking and things. And he came down to see us. We were in the Barta Building and Jay, of course, proudly took him up it had run for something like 68 days without making a

You know it was a very substantial thing -- 10 feet long and hundreds of vacuum tubes in it and it had run for a couple of months without making a mistake. Fabulous. So, Aiken looks at it. You know -- do you know Aiken?

MERTZ:

No, I don't know him.

EVERETT:

Interesting character. Anyway, on the way out, he says, “Well," he says, "five binary digits, that's about one decimal digit." He says, "You take a machine with reasonable register length like 20 digits. Trouble goes to the square of the number of digits. That's a factor of 400." He says, "That's equivalent to about five hours." He says, "That's not bad." And off he goes. [Laugh] He'd torn our 68 days down to five hours -- what-ever number it was [laughing].

We sent one of our guys up from the lab and he went up and took Aiken's course. And he came back and he says, "You know what that guy did? He put a drawing of a flip-flop on the board and he said, 'Now this is a trigger circuit. It's very unreliable -- suitable only for very low performance applications.’”He said, "He had the diagram of our flip-flop."

MERTZ & EVERETT:

[Laugh]

MERTZ:

He didn't think of the basic ... joining, he picked a modified version.

EVERETT:

Oh, I don't know. Yeah.

MERTZ:

I would imagine that you had a somewhat different response at the Moore School because they were obviously committed much more to the idea of using vacuum tubes.

EVERETT:

Yeah, what really happened at the Moore School, of course, was Eckert and Mauchly went off and started their company, and they were in the commercial business and that reduced the amount of communication. It wasn't as great as it was amongst the various university and government supported activities. But, you remember, these were pioneering days and you know what pioneers were like. The individualists. [Laugh] As we used to say, they never on anything except the use of Allen Bradley resistors, but they never agreed on anything else. [Laugh]

MERTZ:

Well, in one sense Von Neumann is sort of an odd person to find in a group of this sort since he's not an engineer, and I suppose one could say the work of the IAS computer does, to some degree, reflect this from an engineering viewpoint. So, his preoccupations might very well be a bit different than what you would normally expect from an electrical engineer per se.

EVERETT:

Sure. Well, yeah, obviously. He had a very different outlook; although he was a remarkable engineer for a mathematician. [Laugh] Yeah, the concept of computers is something that engineers built. Computers tended to come out of the -- out of the mathematicians. They had the usual user problem. A picture of how you built a computer in which you put a theoretical mathematician in charge and hire a few engineers and draftsmen and one thing or another to carry out his ideas. Our attitude, of course, was that computers were things built by engineers. Maybe you'd have a mathematician off in a corner someplace in case you wanted him for some reason. [Laugh] Most of the things we were concerned about, you know, they weren't that complicated mathematically. It all depends on what you want to do.

MERTZ:

Well, in one sense, there is some – perhaps one could say the area of subtlety in the designing of the Machine.

EVERETT:

From a mathematician's point of view is in the idea of the stored program and the logic of the machine, which is not necessarily quite as trivial as, say, what one would think of in terms of the mathematics and the arithmetic of the machine which is fundamental.

EVERETT:

When we came on the scene, you know, the concept of a machine with stored program in it, it was there. You know, it's still the concept that most machines are made of today so we didn't invent that concept.

[END OF TAPE I, SIDE I]

[START OF TAPE I, SIDE II]

MERTZ:

One of the peculiarities of Whirlwind was its very short register length, there're only 16 bits. That drove everybody else in the business crazy. But you did have very early on though, a double word ...

EVERETT:

Oh, yeah. We put some convenience in it for double words and you could program anything you wanted, but you slowed the machine way down and used up various and sundry things. It was selected obviously as the minimum register length which would give you a workable instruction. The strange thing today, you know, there are probably a lot more machines built with short word register

There might be another kind of thing, in terms of applications which comes to mind and that is: the type of length of accuracy that the Aiken machine, say, would be called upon to solve is not a hidebound problem; it's a scientific problem or a table.

EVERETT:

Well, for what he wanted the machine for, which was to compute tables, he chose the right register [length]. That's fine. I don't object to his register length, but it's absurd to carry 26 decimals around when you're tracking airplanes.

MERTZ:

That's it. It's not the purpose of many of the machines, including Whirlwind, to compute tables.

EVERETT:

In fact, Whirlwind would be very inefficient for computing tables. You can. It's just that, you know, they are optimized for the kind of thing you want to do with them. Fortunately they are flexible enough so that you don't have to be very accurate at it, thank God, because you almost invariably end up doing something very different from what you started.

MERTZ:

One of the things that, correct me if my impression is wrong, but at that period in the development of computers, was that there were relatively few mathematicians actually, who were interested in computers. If you look around at math departments, there was not all that much responsiveness.

EVERETT:

That's true. Mathematics departments went pure after the war.

MERTZ:

Which again makes Von Neumann something of an odd person, as a mathematician, because he was interested in computers.

EVERETT:

Well, he was interested in computing. He was a very good mental arithmetician and obviously got pleasure out of it. They tend to go together in some ways. He liked to compute…back in the middle forties some time, I think; it's d in the Annals of the Computation Laboratory.

Somebody, I can't remember who it was, told the story about how people looked at computers. You remember ways of looking at them. One was the woman who gets married, and that's fine, and she looks ahead to a lifetime of 3 meals a day, 365 days a year, and dishes to wash after each one of them. Her husband brings her home from the honeymoon, and she discovers he's bought her an automatic dishwasher. That's one way. The other buys all the rope, pitons, and one thing and another, and he goes to the mountain and he finds that somebody has built a funicular railway. [Laughter]

One of the areas that I was interested in exploring a little bit, was the order of development of block diagrams.

MERTZ:

Was the arithmetic element and control the first thing that was tackled when you were working out the –

EVERETT:

I can't really recall. You could probably find out by going through the notebooks, and that probably shows how it was done. My recollection is that you sort of begin at the highest level, you know, as a storage device to control arithmetic elements -- input/output stuff. We decided to have a bus, we decided to put in the check register, so that sort of gave you the general organization. My recollection is I started with the arithmetic element, because there wasn't any point in designing a control until you had the arithmetic element, because you wouldn't know what pulses you wanted. So first of all, I laid out the arithmetic element. That gave me some feeling for what kind of control I needed, and then I laid out the control.

MERTZ:

I was wondering what relationship this had to the 5-digit multiplier as such. Prototype, pre-prototype?

EVERETT:

Well, the purpose of the 5-digit multiplier was to check out the circuits and the reliability and particularly the marginal checking. It was not to check out the block diagrams. I don't recall that it even had a shift and carry in it. Maybe it did, but I don't believe so.

You know, that wasn't a very complicated thing to design. As far as the block diagrams and the 5-digit multiplier were concerned, that was rather quickly done. You did have a special control with it to make it do these things, and that was more trouble than the arithmetic part. We had people who were working on circuits, people who were working on storage, and people working on input/output.

MERTZ:

This leads into one other question in connection with test equipment, on the development of test equipment. I understand there were two members of the Whirlwind staff who were involved in the development of test.

EVERETT:

Harry Kenousian.

MERTZ:

Another one whose first name was Dick; he went to Burroughs.

EVERETT:

I've forgotten who the other guy was, but Harry was the guy we eventually chose to be in charge and design the standardized test equipment, and he did go to Burroughs. I haven't heard from him in years. I don't know where. One of the parts of the history of the development of the Whirlwind computer, of course, is the development of the test equipment which ran more or less contemporary with the development of the machine itself.

Well, you couldn't buy any test equipment in those days. We used some old radar synchroscopes and things like that. What happened was, we went around the place and found, discovered to our horror that almost everybody was busy building test equipment, and nobody was building the computer. They were all building different test equipment and they were all building special purpose stuff, and it was obvious that you couldn't make it work together. So, it was decided that we should put

We set up a test equipment committee of which I was chairman, and had various and sundry other people, and of course the first thing was a big fight about what kind of test equipment. There was the blocking oscillator group, the flip-flop group, the counting group, gate and delay group, and what not. [Laughter] So it was necessary eventually to make some fairly arbitrary choices amongst these, and the choice was signalized by selecting the guys who were going to build it. The group that won got to build the test equipment. It was really quite a successful venture. It really saved a great deal of time and gave us very -- we were able to put together very complicated things in fairly short order. We had a lot of trouble with some of the early stuff, but after we learned how to make it, particularly after we invented the pulse standardizer, it got to be pretty good stuff and you could really throw it together and it really worked.

MERTZ:

You could even make a computer out of it.

EVERETT:

Burroughs did make a computer out of it, and the control for the memory test computer was made out of it. Of course, its descendant now is a lot of this stuff that DEC and others make, little portable units. Now they are little tiny things, of course, made out of transistors, but those are the linear descendants of the old standard test equipment that we started back in the Computer Lab.

MERTZ:

Speaking of descendants and cross-fertilization of different machines, ERA I gather, was influenced by similar circuit design work done –

EVERETT:

I recall having heard that they were influenced by the circuit design and also by some of the logical organi-on some fairly highly classified stuff and it tended to…we didn't know what they were doing. …some of the entries in the Archive holdings, that there were or was one or possibly two Whirlwind 1 who did hold clearances which enabled them to at least brief and go to certain other facilities to discuss the developments. With one group in the government at least which was extremely active in the computer technology very early and perhaps extremely efficient later –

EVERETT:

Yep.

MERTZ:

…in the pre-digital computing days. There are some references to trips made. There was a committee, I gather, that was set up, called the MIT Committee on Machine Methods of Computation, which were either a participant of or active on at some point. You did participate in the group that at one point had roots in mathematics, which is the very early group before Adams.

EVERETT:

I'm not sure which one you're talking about. There was a committee, as I recall, whose purpose was to Try to…between the work that Forrester was doing on general purpose calculation, and the work that the differential analyzer people were doing, on essentially ended, I guess, more or less with the death of the digital differential analyzer work at MIT. Although it turned out, of them have been built and used; although at the time, I couldn't see that they had a future at all. It turned out they did, but they didn't of the kind that the MIT group was building the computer. They were all building different test equipment and they were all building special purpose stuff, and it was obvious that you couldn't make it work together. So, it was decided that we should put a stop to this and develop a standard line, and had various and sundry other people, and of course the first thing was a big fight about what kind of test equipment. There was the blocking oscilla what not. [Laughter]

So, it was necessary eventually to make some fairly arbitrary choices amongst these, and the choice was signalized by selecting the guys who were going to build it. The group that won got to build the test equipment. It was really quite a successful venture. It really saved a great deal of time and gave us very --we were able to put together very complicated things in fairly short order. We had a lot of trouble with some of the early stuff, but after we learned how to make it, particularly after we invented the pulse standardizer, it got to be pretty good stuff and you could really throw it together and it really worked.

MERTZ:

You could even make a computer out of it.

EVERETT:

Burroughs did make a computer out of it, and the control

MERTZ:

Was Caldwell involved in this?

EVERETT:

Yes, he was, he was clearly a leader at that time.

MERTZ:

He also was active, I believe, in certain ways working in a rather sensitive area of computer applications for the government. At least he had a rather modest contact related to certain mathematical efforts.

EVERETT:

There were several groups at the Institute. There was a group that was doing numerical calculation using the desk calculators, the Caldwell group, and the Forrester group.

MERTZ:

Do you happen to recall -- well, if you recall any sort of historically interesting anecdotal material kind of a rather ambivalent feeling there, because on the one hand, the Institute computer was considered by some people at least, to be cast in the role of father of the Whirlwind computer.

EVERETT:

Yes, there was that. I don't know how much Von Neumann contributed to that. Certainly, he always seemed to me at least, when he came to Whirlwind, that he was obviously very interested and open and treated us like colleagues, which a lot of people in his position would not. I remember he was very interested in random numbers. Of course, random numbers are always cropping up in computer applications.

MERTZ:

Yes, indeed.

EVERETT:

In 1947, I guess it was, we wrote a couple of reports, one of which was on a Naval task force on anti-sub warfare. And this included a flow diagram of a program for dropping depth charges, and you follow the depth charge down, and computed the distance between where the thing went off and the submarine. And then, you know, nobody knew exactly what happened, so I threw in a random number to multiply the PK by. So he came around and we showed him this, of course. He sort of said, "Aha," until he got to that and then his eyes lit up. "How'd you get your random number?" It turned out I got the random number that I didn't think was related to this problem at all. It was stored in the machine, you know, some variable, and I took the middle digits out of it or something. Well, there are worse ways of doing it. [Laugh]

I remember he came back a while later and he was talking about random numbers again. One of the pro…numbers in various ways. What you really want are repeatable random numbers, random numbers that every time you do the problem, you get the same set of random numbers. It seems to be a contradiction in terms, but that's what you want. So, he said, "You start out with this number and you take its double length. You take the middle half and you multiply the two things together and do something else to it, which gives you a new number, and you throw the ends away.

MERTZ:

You can do that by squaring it, or you can do all sorts of things.

EVERETT:

Yeah, you square it. So, I remember –

MERTZ:

It's not truly a random number.

EVERETT:

No, it's not. So I remember listening to him and, you know, one of those things happens in your mind. I said to myself, "That doesn't seem right, because after all, if you start getting zeros in the middle and you keep squaring the thing, you'll get more and more zeros in the middle." But I was so in awe of Von Neumann, I wasn't --I mean, I was 26 years old. I had been through differential equations in engineering school, and to tell the great Von Neumann that there was something wrong with his way of calculating, it never crossed my mind to open my mouth. I said, "I must be wrong."

I didn't think about it again until the next time he came to see us, and he said, "Oh, by the way, that way we had of generating random numbers doesn't work. If you start getting zeros in the middle, they expand." I said to myself, "Here I had the chance to be famous by telling Von Neumann he was wrong, and I blew it." Once in a lifetime, you know. [Laughter] ... I know he would have listened to me with great consideration and I should have done it. I usually kept my mouth shut when he was around. He was a marvelous person, so full of life and vigor and interest. He was interested.

MERTZ:

This is one impression I gained from talking to former colleagues of his, and that in a way was a compliment on his part, because he could very easily have not been interested if he didn't think it was worthwhile.

EVERETT:

Well, the computers were very dear to him.

MERTZ:

He has been known to be quite abrupt –

EVERETT:

Oh, I imagine, yes.

MERTZ:

with someone if he didn't think they had anything of interest or contributory.

EVERETT:

I never knew him to do that. My contacts with him were relatively limited. We obviously thought of ourselves in competition with him. We obviously didn't think very much of the engineering that was going on down at IAS. [Laughter]

MERTZ:

Perhaps in a way, he was aware of that ... but he did yes, he came up a goodly number of times. Which in itself, means that he was obviously very interested in the machines. But the scheme was something that quite early on a number of mathematicians talked about. I find it very intriguing, for example, that Wiener never visited, to my knowledge, Whirlwind, and he was on the campus at MIT. Whereas Von Neumann, a mathematician of roughly comparable stature at that time, made the trek from Princeton up.

EVERETT:

But Wiener was never an engineer. At least I never thought he was.

MERTZ:

Well, Von Neumann never really was either

EVERETT:

Oh, but he was interested in the things.

MERTZ:

How they worked, and the circuits, ...?

EVERETT:

How you used them and so on. Wiener was not. We had a number of meetings with Wiener back in the early computer days, a number of meetings with him and people in the math department and so on. I went through the experience many people have gone through, of giving a talk and having Wiener sit in the front row and snore. It's very demoralizing. [Laughter]

I remember I was addressing this group and we had just gotten into the business, and I had written a Program for multiplying two matrices together using a stored program in which you modified the instructions. It was a generalized program which multiplied two matrices that you could multiply together of any size. Wiener looks…do you have to say where you're going to put the numbers? Why don't you let the computer do it?"

I thought he was crazy. I didn't even understand what he was talking about. It turns out, of course, just off the top of his head, he'd invented relative address programming. I was still in the machine language. Hell's bells, the first program I ever wrote, I never even heard of a program until about two weeks before that, you know. And he says, "Why don't you let the machine assign the memory location?" You know, he's right. Nobody writes down memory locations anymore. Explain that remark. I'm not sure he could have explained it. It seemed so obvious to him. [Laughter]

MERTZ:

One thought though, would be, it would seem that someone who was as interested in the analogs to brains or at least something which he got interested in later on in his career, he would have been intrigued by the machine, in the way that someone would be intrigued by the incredible, at that time, and still relatively impressive speed with which the 5-digit multiplier could carry out multiplication ...

EVERETT:

He was very interested in computers but only on the level of abstraction with which he dealt. It didn't involve being concerned about how many digits were in the multiplier and so on.

In the sense that he was on the fringes. He did visit Cambridge, he was interested in what was going on at Whirlwind. I gather from speaking to Charles Adams that he -- well, his textbook was one which was early on used and then later modified in training people to use the machine. Do you happen to recall any meetings with him? Or activities? ....conversation. [Pause] Lots of nice things about the computer business in the early days. There were relatively few people, relatively few organizations, it was perfectly possible with a reasonably small investment of your time, to keep track of what everybody was doing.

MERTZ:

Do you remember any particularly humorous anecdotes involving Von Neumann or any of the other people, Whirlwind personnel, in this era of the late forties?

EVERETT:

I considered Aiken's visit to our 5-digit multiplier humorous, but I don't know if you'll consider it humorous. I remember also at this Moore School session in the summer of '46, that in one of the very first sessions, Aiken spoke; and he was a tall, dignified, statesman-like type. Press Eckert was there and Press was sitting in the front row. He was sitting like I am now, sort of on the base of his spine, his feet up on the – there was a dais -- his feet up on the railing or something. Aiken was standing up on the dais giving his talk, and Eckert starts to probe him. Of course, Aiken: "Electronics, phooey; stored program, phooey." So Eckert starts asking him leading questions and it was an amazing experience for me, because Eckert had him cold. You know, Aiken was wrong. He was in the dark ages, really. What Eckert was saying was right. Yet, because Aiken had so much stage presence and was standing on a stage three feet above this floor, and Eckert, who doesn't come across as that kind of a personality, and he was down below lying down practically with his feet up, Aiken won the exchange. One of the things that happened, was that Eckert would ask him a leading question in kind of a mumble and Aiken wouldn't dive right in, but would sort of stand there for a moment gazing out over the audience with a sort of look that said, "Good lord, you know, do I really have to deal with idiocies of this sort?" Then after a carefully calculated delay, long enough not so long that anybody would get nervous, he then delivered some beautifully phrased reply that had nothing to do with the question at all. [Laughter]

MERTZ:

Eckert or Mauchly come up to see the, to see Whirlwind?

EVERETT:

Oh yes, I guess so. Everybody saw everybody else; you know. And everybody in the business would go to computer meetings in those days. You'd get them all in one room. [Laughter] They all knew each other, you know. It was great. Now, my God, they held downtown last year, and it was just terrible, a mob scene, ten thousand people, and I don't know any of them. I feel like the old guy in a coonskin hat who comes back to town and finds they've built a railroad station, schools, churches, and one thing or another and people looking at him askance as he goes down the street in his coonskin hat.

MERTZ:

There are still, I gather, some of the, shall I call them, old-timers who are still around, but I guess they have been inundated by the subsequent generation.

EVERETT:

Oh yeah, most of the old timers around are still ... put out to pasture in the administrative business or gone into schools or taken up something else, or become a short order cook some place.

MERTZ:

That, incidentally, is another role that is perhaps worth mentioning in connection with the history of Whirlwind, and that is the fact that quite a few people did go through, got their training in the program as graduate students, and went on into all sorts of facets of the computer business, and there are still quite a few who are still quite active.

EVERETT:

That's true. People came out of the Digital Computer Lab and went all over the industry. I remember being shocked when told by one of the deans at MIT that one of the concerns they had about the Digital Computer Laboratory was its lack of connection with the educational process. I was shocked because I thought that we had been educating people right and left. As it turned out, what he meant was that we had not contributed to the faculty.

MERTZ:

The MIT faculty itself?

EVERETT:

Yeah. What I mean is, although the Laboratory was doing good work and was training people, it wasn't building any permanent structure inside of the Institute, for carrying this on, and that's true. There is something though that I believe did initiate with Whirlwind, for which there is a tradition now inside MIT, and that is an actual course of instruction of computer applications and programming, which was initiated things like that, and we eventually got some of our connected with the Institute, at first by teaching courses, etc. The problem was that the people in the Laboratory, the ones that tended to become important and influential in the Laboratory, tended to be those who were oriented toward getting the machine done and working on its application. They weren't particularly oriented toward seeing their future in the Institute as a professor.

Eventually, a fairly significant number of people in the Digital Computer Lab ended up in the universities like Forrester himself. A goodly number of others ended up on the faculties of universities. There are quite a few professors, not just of computers, but of various related matters, that went through the Digital Computer Laboratory.

MERTZ:

That's something I haven't looked into, and that is the current faculty at MIT, and whether or not there are any who came to MIT faculty by way of either Lincoln or –

EVERETT:

I couldn't tell you. I don't even know who they are.

MERTZ:

I would think that I would have encountered them in my looking for personnel who were associated with Whirlwind.

EVERETT:

I'm not sure that I'm giving you what you want. I'm going to have to break this off in about ten minutes or so. In the summer of '51, when the Lincoln Laboratory who were working in the air defense area, transferred to Lincoln and became Division 6, with Forrester as the head. I was the associate head. The Laboratory itself continued to exist as primarily concerned with applications still supported by the Navy, and was fairly small. Somewhere in the middle fifties, I guess, it eventually was shut down and stopped functioning. The work was transferred to, I guess, under the cognizance of Morse's committee.

In '56, when Forrester went back to the Institute as a professor, I was made head of the division. In '58, when Mitre was formed, I came to Mitre first as Technical Director, and then in '59, was made Vice-President for Technical Operations, which I was until a year ago, then President.

…involvement with computers as such, either [in a] substantive way, technical way or administrative way, continued on in the Lincoln period.

MERTZ:

Did it in the Mitre…period? Perhaps rather than make it a statement, let me ask: in what respects did it continue on in the Lincoln period? Was it essentially administrative or did you get into substantive involvements?

EVERETT:

Well, it didn't change overnight, but in the early Lincoln period, I was responsible for the design of the SAGE computer and the memory test computer, development for actual use in core memory, and things of that sort. Then as we got the machines out, I became more and more concerned about the programming and the operational design, and things of that sort. But we still carried on a fairly substantial hardware development program in Division 6 in, first of all, larger memories, then transistor driven memories and transistorized machines and things of that sort. We had a substantial group doing that. And I kept up with it. I wasn't really contributing to it or working on it, but I at least fifties, I think, was still leading the field. Mitre has done relatively little of that, although our earlier years, we did have some fairly effective data processing hardware development work. We still do a small amount of it in more or less specialized areas, and I think we've also done a fair amount of software generalized programming, and things of that sort. I spend most of my time on administration. I keep up with, insofar as I'm able, what's going on in the computer business. Most of the things that Mitre works on, are computer-based systems. But computers are a component.

MERTZ:

No more important than the applications.

EVERETT:

It's important to know what's happening to their capability and cost, reliability, size, weight, and things of that sort, but the art of making computers, the art of programming, and so on has long ago passed me by.

MERTZ:

How about the problem of evaluation of computer technology today, such as in such specialized problems as the ABM. Mitre does things of that sort and Mitre has within it people who are right up-to-date and knowledgeable about computers and software and data processing, displays, and everything. They're working in the field, and enough to know in general and hopefully to know I'm being snowed, but if I want to know something I call up the right guy and he tells me. “You know, just to read all of the data processing literature these days is a full-time job.” Mitre is interested in many other things: communications, radar, all kind of problems, aircraft, and so on. To be an expert in all those things is beyond my capabilities.

MERTZ:

One possible postscript and that is, does an interest in or involvement with computers run in the family?

EVERETT:

I have five sons and not an engineer in the lot. It's pretty hard to get through college these days without being exposed to a computer. You know, they come home and say that they're doing a project or a thesis or something, in the course of which they had to write a computer program. So, they do it these days. They are taught some simplified and higher order language that I never even heard of. They write their programs and punch their cards and get their print-outs. It's a business, you know.

MERTZ:

But is there any, do you detect any specific interest? Wanting to get involved?

EVERETT:

No. As I say, there is not an engineer in the lot! They seem to go in for international law, psychology, conservation, and God knows what these days.

MERTZ:

Thank you very much.

EVERETT:

I hope it's been helpful. It's always fun to reminisce.

[END OF INTERVIEW]