Computer Oral History Collection, 1969-1973, 1977

Interviewees: Roy Kaufold and Walt Edwards
Interviewer: Robina Mapstone
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MAPSTONE:

This is February the 2nd and this is Bobbi Mapstone. I'm at Northrop. What's the full title of the division I'm with?

KAUFOLD:

The Avionics Department, the Electronics Division.

MAPSTONE:

Okay. And I'm with Mr. Roy Kaufold and Walt, is it?

EDWARDS:

Walt Edwards.

MAPSTONE:

And Walt Edwards. And I think so that the tape will pick up the difference in voices if you will both introduce yourselves and maybe just give us a brief background of what--maybe first you, Roy and then you Walt--of how you got into the business and what led up to your early beginnings.

KAUFOLD:

I'm Roy Kaufold, Vice-President and Manager of the Avionics Department of Northrop. The question I'm supposed to answer is how I got into the computer business. [laughter] I think most of us all got into it because we were working with some of the early forms of logic, multi-vibrators, this type of thing. And it started to evolve into the computer area and you just got more and more involved in it. Specifically, the acts that occurred was that I had been associated with digital technology up till about '50 and then I left and went to work at National Cash. Worked at National Cash in the checkout area for six months there and then returned to head the computer group here at Northrop, which has been active since that time. I don't know how interested in that you are.

MAPSTONE:

Just to backtrack, you mentioned that you had been working in digital technology. Maybe be just a little specific about what you were doing.

KAUFOLD:

Yes. The big thing at that time was star trackers. We were trying to track stars in the daytime sky, and to track stars in the daytime sky requires video amplifiers and all sorts of circuitry to turn things on and off, high speed counters, this type of thing. And this is the way it evolved.

MAPSTONE:

You joined Northrop the first time when?

KAUFOLD:

Joined Northrop in 1947.

MAPSTONE:

And into which division and which department?

KAUFOLD:

Well, it was called Project 20 then. It was the SNARK group. There were no departments or divisions. It was just Northrop.

MAPSTONE:

It was the SNARK. And who did you work for, with?

KAUFOLD:

I started out working for Dr. Phil Taylor who headed the star tracking group. Then from him I worked for a man by the name of Dr. Kindle who was part of the computer group there in that period. But he's dead also. And then I worked for George Finn and then Fred Stevens.

MAPSTONE:

Okay. I think maybe this is a good point to just talk a little about what you were doing with Finn and be a little more specific.

KAUFOLD:

About what period?

MAPSTONE:

When you started working with Finn. When was this?

KAUFOLD:

Well, see, I worked with Finn from '47 on. Not for him, but we worked together. He did all the math work on the star tracking and I was sort of the hardware man. That was the relationship. Finn had the most fantastic capability I've ever known. To take physical phenomenon and convert it to math, you know? He was the sharpest guy I have ever seen in this area. Probably the best that ever hit this. Great mathematician. Just tremendous. And it's gathered, you know, all the patents on it. We evolved all the principles that have been used since that day forward in star-tracking.

MAPSTONE:

Are these patents still part of Northrop.

KAUFOLD:

Yes, they're still here.

MAPSTONE:

Do you think that there are any that really tie into these computer developments that would be key for this [?]

KAUFOLD:

No.

MAPSTONE:

No. Okay. I guess the last question in this area would be was Steele and his group separate from the work that you were doing?

KAUFOLD:

Yes.

MAPSTONE:

Did it tie in at all at any point?

KAUFOLD:

Well, we were all working on the same missile.

MAPSTONE:

Yes.

KAUFOLD:

Their work stemmed from the position of the telescope, how to point the telescope so that the craft would follow pre-determined paths. My work was once the telescope's pointed to close the servo loops and track the stars so we could figure positions. I didn't make that clear, maybe, but that's basically the way it was. So we were close. We were--our labs were adjacent to each other, but I was never a part of that group.

MAPSTONE:

In other words, you weren't working--you weren't both working on the same piece of projects coming up with two different ways to do it. You were actually working--you were at one point in the total project they were in another point.

KAUFOLD:

Right.

MAPSTONE:

Okay, I think that's all, brings it up to the point. Do you want to tell us a little about you now?

EDWARDS:

Sure. My name is Walt Edwards. I guess I first got in this business when I graduated from Cal Tech in 1951. I went to work for a small company called Bill Jet Scientific Instrument Company. They were in the aerial camera business. So they were doing primarily analog work but a little bit of digital. After I had been there about six months, a fellow by the name of Bill Carlson sold the management of the company on the concept of developing a computer. So in a process of about three or four months while they worked on this computer, while I didn't work on that program, I was exposed to it and became quite interested in it. Based on that, I decided to look around and find a job. The company abandoned the program. I decided to find a job in the computer program. And

I answered an ad out of the paper in March of '52 and went to work for CRC. So I started there as a junior engineer working for Harold Sarkissian, a great engineer at that time. And during that period they were building a DDA, what they called the CRC 105.

MAPSTONE:

Which was, I think, an improvement, more sophisticated 101.

EDWARDS:

That's right. It was based on the 101. Eric Weiss had done it and it was decimal.

KAUFOLD:

Decimal DDA.

EDWARDS:

Decimal DDA, a flexowriter output and so on. And during that period I became interested in it and went through the logic and learned it. About that time, I guess I'd been out there about eight or nine months, why Eric left the company and it turned out I was the only one that knew how the machine worked and they were just ready to turn it on. So I went through and brought that check out. And then worked on the 102 machine. In fact, the 105, I guess, was the one you were—

KAUFOLD:

Yeah, that's where I went in.

EDWARDS:

How I got involved in the test area was after we tested the first couple, then we had problems in checking them out so I went to work for the test area helping to get those out. Then they developed the 102 which was their first general purpose machine. And I was involved in the checkout of that.

MAPSTONE:

Now, the 102 was already developed, I presume, by this time or in development.

EDWARDS:

Now the 105 actually proceeded the 102.

MAPSTONE:

Oh, did it?

EDWARDS:

--because it--the 105 was started after the 102 but the 102 was in design for quite a while and there was quite a bit of problem getting it tested and checked out.

MAPSTONE:

That was the one that went to the--the initial one went to Cambridge?

EDWARDS:

That's right. And then they built many of them and that was the financial problem and it brought NCR into the pictures. They were just overran their back.

MAPSTONE:

Was it a reliable machine?

EDWARDS:

It worked out pretty well, yes.

KAUFOLD:

I remember it very well when I met Walt. Nobody that designed that machine really owned it when we were out there. Remember? So Walt said, "I'll go learn the logic and he started redoing the logic and I started redoing the circuits. And we made it work. But it was very interesting. Lot of fun.

MAPSTONE:

Why--okay, this is another interesting statement. Why had it--you know, what had happened. You said nobody really owned it. You mean somebody wasn't interested. Was it too many in-fights going on? Was that the problem?

EDWARDS:

The 105--in fact, it takes a little bit of background to understand it--what had happened at CRC was the Sprague and Eckdahl and Sarkissian were really inventors. And as Sprague indicated in his article, you know, they were getting wild ideas of how to do all these wonderful things and all that. About the time I came with the company, they had kind of taken a step up to become managers. Okay? And in a small company like that where

there's a difference that Eckdahl, I think, from the stories I heard was pretty much a stabilizing influence of the company instead. He kind of accepted the business responsibility, realized they had to get on with what they were doing. And so at that time they knew how the machines worked and they were still influencing it, but they were not technically responsible. In other words, they weren't sitting there doing the checkout like they had on the very first one.

MAPSTONE:

Yes.

EDWARDS:

Okay. In the case of the 105, [?] __ had done the logic and then he left the company right at the crucial time before the machine was checked out. So it was matter of taking that design and seeing it through, getting it put together.

MAPSTONE:

And so the same thing happened with the CRC, the 102.

EDWARDS:

The 102 was designed by a fellow by the name of Will Dobbins.

MAPSTONE:

Right.

EDWARDS:

He's still around, and Will had designed the first machine and was in the process of checking it out and I was brought in to help him with it. And then before that got through the checkout, he had some sort of a breakdown, kind of an illness sort of thing and so a fellow by the name of Ed Kline and myself saw the 102 to the checkout and we actually both of us were in and worked on the production line for a period of time, I guess eight or nine.

MAPSTONE:

When it went to Cambridge, did somebody go along with it? I mean, was somebody [?] go along to set it up.

EDWARDS:

Okay, what I'm trying to think of now and what bothers me is the machine I'm talking about is the 102A and the 102 that went to Cambridge is the one that was [?] back with the 101. Okay?

MAPSTONE:

All right. That's what I was--now I understand.

EDWARDS:

It's the 102A I'm talking about.

MAPSTONE:

You two went the production line model.

EDWARDS:

Which was the 102A. That's right.

MAPSTONE:

Which was the 102A which was [?]

EDWARDS:

It was based on the 102 but it was quite different.

MAPSTONE:

But it was quite different.

EDWARDS:

It was a different machine.

MAPSTONE:

And so, yes, because the 102—

EDWARDS:

I think they only built one 102.

MAPSTONE:

That's right. They called the CADAC.

EDWARDS:

Right.

MAPSTONE:

And that was [?] type.

EDWARDS:

That's right. They had a 104 machine which was a squirrel computer. It was built like a squirrel cage. [laughter] It takes a long time to pull all of this back out.

MAPSTONE:

Yes.

EDWARDS:

Okay. So that's right and that must have been done in about '50, I think.

MAPSTONE:

'51, right.

EDWARDS:

Okay, that was before I was involved. In fact, it may have been in the last stages when I came to work for the company, I'm not sure. March of '51. Could have been.

MAPSTONE:

Yes. Okay.

EDWARDS:

Okay. And then the 105 was essentially the production version made decimal and change of the 101, the 102S was the production version of the 102.

MAPSTONE:

Right. Okay. So after you two checked out the 105, what happened after that. What did

you get involved in?

EDWARDS:

Well, the 102A came after the 105.

MAPSTONE:

Okay.

EDWARDS:

Okay?

MAPSTONE:

Right. And that was the machine that was quite--so quite—

EDWARDS:

I believe they built maybe 30 or something like that. In fact, we had many of those built when we were still checking out the first one. This is a case where they had sold quite a few and that was when the financial problems starting getting tougher.

MAPSTONE:

Now, somewhere in this period the 304's, what later became the 304's is in design. Is that correct?

EDWARDS:

Yes, we were looking very briefly before I got into the 102A, we had looked at what became the 304. We were really talking about what the next machine would be like.

MAPSTONE:

What were some of the plans, let's say, the planned sky ideas? Well, the idea was that, you know, they'd gone through this first wave and now we had decided we were probably going to go to a core memory or something like that which we finally did. And essentially the concept was to go beyond the drum machines that we had and really get into the computer business.

MAPSTONE:

Were you looking at tapes at this point?

EDWARDS:

They were considering them. Of course, we were developing tapes on our 102A. We had 126, I think, taping them, like [?] Burns who's still with the company, who was responsible for that.

MAPSTONE:

He's still with NCR.

EDWARDS:

He's still in. In fact, [?] So what was happening while he was with one of the two A's they were trying to get [?] other people had. And then they were looking at the 304 as really being a super big machine that they would go attack the world with. [laughter]

MAPSTONE:

Something went wrong thee. What was--so you were project engineer.

EDWARDS:

I was on the 304, right.

MAPSTONE:

What--as project engineer, what did that mean that you did?

EDWARDS:

Okay. At that time, and I'd have to sort out the time sequence of things, but I started at project engineer on the computer which meant I was responsible for the architecture and the hardware and the packaging and those sort of things. There were other groups. There was a fellow by the name of Dan Dougherty who ran the engineering group at that time. As it got bigger and started developing the peripherals, then I became what they called the chief assistant engineer, I think. Essentially, I had the 304 60-minute project which I was responsible for the peripheral and all of that. And then finally about the time we got the 304 system together, Dan left the company and I became Chief Engineer.

MAPSTONE:

And as far as the peripherals were concerned, were you developing all your own stuff or—

EDWARDS:

Everything. We did everything from scratch. In fact, if you've heard of the Crams wonderful, it's a magnetic card unit that was developed there and that went on the 315. It's a wonderful thing to behold. It has magnetic cards that stick up here and a drum that comes around back here, you know, the right card will drop and it will go on the drum and come back. So it's hard in this day and age, you know, it's kind of hard for me looking how business is to got back and reconstruct the feelings. But in those days, you know, you just invented everything yourself.

MAPSTONE:

It's amazing.

EDWARDS:

Yes, it's a--and I think that's one thing that probably separates the so-called Eastern from the Western philosophy a little bit. The people out here, everybody was turning out their own computers and we were talking about the peripheral development at CRC and later in NCR we just did everything ourselves.

MAPSTONE:

If you needed a device, then you would go into your own shop and make it yourself.

EDWARDS:

Just go do it.

MAPSTONE:

In a way, you might have done some reinventing of some wheels along the way.

EDWARDS:

Well, of course.

MAPSTONE:

But that was in an important time.

EDWARDS:

Well, again, it's hard to go back and reconstruct what the rules of the game were because if you look [?], I know, that I was quite involved in what we were doing inventing all of

this wonderful stuff and there wasn't a good correlation to the business plan and this sort of thing.

KAUFOLD:

No.

EDWARDS:

We were trying to make it work, okay, and I think in the long run that's one of the reasons why so much was developed. In fact, if you look at the integrated circuit houses in the early days, they were about the same way. And how you got such a fantastic quantum jump in development was a lot of people just doing things that were impossible to do.

KAUFOLD:

Freedom.

EDWARDS:

Yes, that's right. Now, unfortunately, many of those things cost people money and didn't amount to anything because of the --but at the same time, if you look at the advance in technology, it's pretty impressive.

KAUFOLD:

Everybody did everything. Painted their drums—

EDWARDS:

Oh, yeah. [laughter]

KAUFOLD:

Everything. No kidding, they just did whatever you wanted to, like he just mentioned Williams going off with these tubes, cathoraid tube storage and everybody played with everything. It was complete permissiveness.

MAPSTONE:

I presume you read what was in the literature and then found out what you could about it and then took off from there.

EDWARDS:

An interesting thing, though, you look in those days, there wasn't an awful lot of literature. In fact, if you -- it was a very non-academic environment. And the thing is, what really happened if you look from the War, certain digital techniques had been developed basically out of MIT and radar work allowed a whole class of wild young people to take this new technology and go apply it. You know, it's like, it isn't, I think, that everybody was so smart, it's just that one of the few times in history that technology was just there. There's a whole class of problems that people wanted to do like the star track and things that the computer came into it and some of it and people just did it. And so there wasn't the regimentation or the -- a lot of publishing of papers or things like that. That came a little bit later.

MAPSTONE:

Right. And I suspect, you know, this end of the war and the sudden, as you said, availability of technology, a lot of people had learned about it during the war, too, radar, became familiar with it.

EDWARDS:

Yes, uh-hum.

MAPSTONE:

And it was now a case of wanting to get in and get your hands dirty.

KAUFOLD:

See, I think that to me, is equally important part of the impact was that almost everybody that was in that field was ex-service personnel who had been associated with equipment during the war and all came back and were willing to design new equipment. That's where [?] and almost all of the people. And we were all young. We are all old now, but we were young then and we were all very dedicated to technology. Technology was everything; money, programs, market, nobody cared about that. That was not important. It was just to prove you could do your thing, right?

EDWARDS:

Yes, in fact, it's been interesting to me in the last few years, well, I think you got that out of your [?] at MIT there, but in those days there was a feeling that the computer was going to kind of run everything, you know, and run companies and really be able to control things much better than any human being.

MAPSTONE:

You really felt this back as early as the early fifties?

EDWARDS:

Now, I don't mean this in the sense of the road block or that kind of thing. I don't mean that at all. I have a very strong diversion to those kinds of things. But a feeling that system control problems and things could really be handled at a level above how you thought them out. And I think there's even a little bit of that applied in Von Neumann's letter there if you read it in detail.

EDWARDS:

I'm sure the impact was realized. The problem, the problem, and we had a lot of inventors. But we had very few engineers and the basic problem for the whole early period of computers is that none of them are real [?]. And it was by the very creative group and type of people but they got bored with it before they finished it almost always because they thought of something new to do and were never really willing to put the time and energy into the individual product to make it better.

MAPSTONE:

That's interesting to [?] what you've said.

EDWARDS:

Yes.

MAPSTONE:

When you say engineers, you're talking about getting your hands on and pursuing it to its maximum –

KAUFOLD:

No, no. I think of -- and in those days there were very few analytical circuit designers. Worst case technology probably was invented along in that time and probably had the biggest impact on all of us, but in general, in the early late forties and early fifties, oh, I guess we did a little bit better in the fifties, but in the late forties, you didn't design anything. You just went down and built it. And well, I guess CRC about there in '52 was the first time that people really started to do circuitry.

EDWARDS:

Yes, they tried to make rules and things like that.

KAUFOLD:

Yes.

EDWARDS:

But there are two things, and it's hard to put this concept across, but first off, the components weren't any good. You know, vacuum tubes just weren't good enough to do that job. The old diodes we used weren't reliable and so there was an argument that way. The other thing is that for the first time with digital systems we were able to build a whole system and a huge number of components. See, when you're working with analogues and things like that, you're not smart enough to think up anything that big. It gets beyond you. But with digital techniques, you're able to take these modules as building blocks and make huge systems out of it. Once you do that, then you have statistical problems. See, if I've got a hundred circuits, I can build it and if it doesn't work I can measure it and go fix it. Once I get up into -- in those machines we probably -- computers have maybe, let's see, we were about three thousands gates so we probably had six thousand, seven thousand diodes plus the vacuum tubes and things like that. Okay, now I've got to think about it in a different way. Now if you don't really do your homework and do your engineering properly, okay so only one in a thousand don't work right. Well, that's enough to make the whole thing terrible. Well, so the whole class of problems came about that a –

KAUFOLD:

There's no question about the application of the Boolean to the design of the computers. This is the thing that allowed us to treat it that way. And if anything and that impact I think the Boolean application to computer design which occurred on the West Coast was the whole reason for the West Coast jumping ahead. I believe it was the reasons for their, I really think, preeminence in the field. And I think it was really the only way you could design complex machinery. The diagrams still just are not satisfactory as compared with the computers.

EDWARDS:

It's kind of interesting because, I don't know if you ever knew Ed Kline—

KAUFOLD:

Yes.

EDWARDS:

The other one, remember? Two fellows; one here named Ed Kline and one who worked with me at CRC. And he came out of the Los Alamos group that did the Maniac, he came in later, but he came to work for me about, oh, probably '53 or something like that.

But he had worked on the Princeton-type machine. Another thing, there wasn't much difference as people say. There's a lot of difference and a lot of difference in how it was thought about, but if you take perspective and look at the whole thing, --

MAPSTONE:

I'd like you to enlarge on that -- about Kline.

EDWARDS:

Okay, that's kind of big. I guess what I'm trying to say is that everybody invented it themselves. Okay?

MAPSTONE:

Yes.

EDWARDS:

And that was really invented what they were doing themselves. And that was really the environment that we're in and the thing I think you're trying to write about.

MAPSTONE:

Yes.

EDWARDS:

It's a feeling of being able to invent things yourself. And really being a lot smarter than anybody else, there really wasn't much need to figure out what they were doing, but to spend your own time and do the thing properly.

MAPSTONE:

I'm really interested because I think there are two slightly different schools of thought going on. You're very strong on Boolean algebra as being, you know, the crucial addition –

EDWARDS:

At that time.

MAPSTONE:

at that time, right. And you're not so sure about it. You feel that either way would have –

EDWARDS:

No, because I had some funny experiences at CRC. We never talk about this too much. But my background is a little different. I graduated in physics and I really hadn't done any engineering at all until I got out of school. And many of the things in Sprague's article, I'll bring it in -- where he talks about the flow diagram, the realizations, you know, he makes one decision being able to help in this program and then we're down to the next one and so on. And when we designed the 304, we really got rid of a lot. And went to more of a conventional command split and things like that. And see, I look at a lot of the –

KAUFOLD:

I don't get your point.

EDWARDS:

Okay. Logical manipulation -- there are many ways to do logical manipulation. And what I think was looked at and what the people at CRC thought they had done was to come up with a set of techniques that were quite unique in terms of how to design a machine.

KAUFOLD:

Are you talking about the tools or the design philosophy?

EDWARDS:

I'm saying the two get mixed up. I think the two get mixed up quite a bit and there are many ways to design a computer. Okay, and if you look at the way they are designed today and you say, "Is that Eastern philosophy or Western Philosophy," you're hard pressed to tell what it is, I think. Personal opinion, okay.

KAUFOLD:

But still, you say that the Boolean allowed us. I know, you always have guys, mathematicians that go too far and got too cute. I think Floyd Stevens at CRC got [?] so far and so cute. So they went too far with it. But for the birth of the machine, instead of doing it by flow diagrams, I think it was a fantastic shot, didn't you? Don't you? [laughter]

EDWARDS:

What I've tried to do [?] is to try to pick out what the difference is between the two [?].

KAUFOLD:

The flow diagram and the [?]__?

EDWARDS:

Yes, and it's like what we're talking about now [?]_ I can make my point a little bit better. Because right now, we're quite involved in new software design techniques and we look at software business today very much like hardware was ten or fifteen years ago. In fact, that's why some of us have [?]_ the [?]_. A lot of wild inventors writing programs today. It's very much like what we're talking about here.

MAPSTONE:

That's true.

EDWARDS:

You say, how could it be? Well, I could take you through some places where there aren't any software and I'll show you the same kinds of environment.

MAPSTONE:

Yes.

EDWARDS:

With the same kind of problems. Okay. Now, you say okay, what is the difference between them? It's a notation, a way of keeping track of it. Okay. And the Boolean allows you to keep track of it in a very neat orderly and easy way.

EDWARDS:

Now, the point I would like to make is that the real key to design whether it's software or hardware of systems or what, is to separate data paths and data flow from control. And what we talk about software, a lot of key to good software is laying out tables, naming things properly and ordering them independent of how I'm going to control and handle the two separately. Okay. What the Boolean technique allowed people to do was to mix up the data and control into a lot of time sharing and all this wonderful stuff. Because in a one case flip-flop would tell me it was a carry flip-flop when I added and it was a precision flip-flop when I was going through my [?]. So it didn't enable you to build things with a minimal number of flip-flops.

MAPSTONE:

And wasn't that pretty important when you're considering, as we discussed earlier, that the technology was pretty, I mean, [?]

EDWARDS:

Yes. It allowed you to get on it –

MAPSTONE:

Hardware was no good –

KAUFOLD:

That's the reason the revolution occurred.

EDWARDS:

Okay.

KAUFOLD:

No, we couldn't have done it without that.

EDWARDS:

I just want to pursue the point enough to say this part of it. If you say that was a very important historical tool to allow you to build a class of machines with a low number of flip-flops which was possible, I say fine. I agree. And you see what's happened is because of integrated circuits [?] we can get lots of flip-flops, we've really gone to a layout that looks more like, to me, the old Princeton-type machine.

KAUFOLD:

Sure.

EDWARDS:

That's the point I'm trying to make. So at that point in time I think the reasons that you could build airborne computers and things like that out here was because you do [?].

KAUFOLD:

I look at it a little differently, though. The concept of what a computer was so poor in that day and so much freedom in it, you know, [?] differential analyzer and different forms of computers, the hybrid computers and these sort of things. And I just think the

creative time was reduced fantastically by the application of the Boolean where one man could keep the whole machine in his mind in a notation form would allow him to create it. Now, I agree completely they got too cute with it. But I still think it allowed one man to design the machine.

MAPSTONE:

[?] about one man having the machine design in his head. It might have been Eric Weiss, I'm not sure who it was.

EDWARDS:

When I went to work for CRC, my favorite cases, I was very young and naive and I fell all over the computers and so I went to work, empty building in those days, and they gave you a desk and you went to work for Bernie Wilson.

KAUFOLD:

Yes.

EDWARDS:

And all day long there were two guys used to walk around this empty building. Bernie Weiss looking up in the air smoking a pipe designing the 105 and Will Dobbins looking at the ground smoking a pipe designing the 102A. [laughter] I said, "Man, that's what I want to be." [laughter]

MAPSTONE:

So you bought a pipe.

EDWARDS:

[laughter] No, I never bought the pipe. I said, "Man, that's the kind of business to be in."

MAPSTONE:

Didn't anyone tell you it wasn't up here? It's the pipe that made it? [laughter]

EDWARDS:

That's what I missed. But that's really true. That's the kind of thing it was in those days.

KAUFOLD:

Everybody designed their own.

MAPSTONE:

That's really great. You know, even if we cut the tape here, that whole philosophical discussion is fantastic. And I'm really pleased.

[End of Tape]