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MAPSTONE:

Let's go back and put a career trace on you. How did you get to go to Aberdeen and what were you doing there?

KORN:

That is an interesting story by itself. I was drafted into the Army. After completing basic training I was assigned to Aberdeen in another laboratory--I guess it was the Ballistic Research Lab which had a computer lab in it. But I was assigned to, essentially, Atomic Bomb instrumentation. After three months I was transferred because my security had not come through. I had to get out of the web. I went to the Automotive Lab at Aberdeen where I did automotive instrumentation and chalk testing and so on, for about nine months and when my security finally came in, I went back to the Ballistic Research Lab and said I would like to come back there and I would like to get into the Computer Lab. So that is how I got into computers. And the first assignment I had was integrating the first, what I believe to be the first, high speed printer ever built. Which was made by Shepard which was delivered for purposes of integration with the EDVAC. You probably have data on the EDVAC. It is also like maybe the number three computer or something like that.

MAPSTONE:

That's right, I do.

KORN:

That was, I think, the sister machine of the one at the Bureau of Standards, with the mercury memory and the transformer logic.

MAPSTONE:

You are referring to SEAC.

KORN:

Yes. This I think was a sister machine to SEAC. I think it was built by the University of Pennsylvania.

MAPSTONE:

It was built by the--some of the crew--well, that was the machine that von Neumann and Goldstine and Dick Burks wrote up.

KORN:

Incidentally, I don't know if you ever got the story about what happened to some of the heads of the Computer Lab at Aberdeen. Two of them were kicked out for security reasons--one apparently had a communist background himself and one whose wife had a communist background--it was part of the McCarthy purge. Which was really a shame. I think von Neumann might have been one, I'm not sure of that because it happened just before I got there at Aberdeen. About '51 I guess, is when it happened.

MAPSTONE:

Who was this who got kicked out?

KORN:

I think von Neumann did, I'm not sure. Anyway, they were two people who were instrumental in starting the Computer Lab, who were both caught in the McCarthy purge.

MAPSTONE:

More good people lost out in that purge.

KORN:

Right. Anyway, getting back to the printer, it was the rotating, print-wheel philosophy where you hit the characters on the fly with a strike hammer, the first of its type. And it was really not very successful, except at low speeds due to problems in the paper advance mechanism. At that time, this being the first one, they just had a very heavy roll of paper, like butcher paper where you had to pull the whole roll of paper to advance it. And it was it didn't work well. And it sounded like a machine gun every time you had to advance the paper. I think we got it working at about three or four hundred lines a minute. But it would never go up to a thousand lines a minute. Although, I left that program before it was completed so I don't know what the outcome was.

MAPSTONE:

So you don't know if it actually went on to the F.F.

KORN:

It probably didn't, I would guess, but I don't know. And I don't even recall the people's names...Oh, well. That history, I am sure they probably have a lot of stuff on that.

MAPSTONE:

Yes. Right. That has been pursued...

KORN:

Now, I also did some work on the ORDVAC while I was there. But, again you probably have got a lot of information on that.

MAPSTONE:

What were you actually doing on the ORDVAC?

KORN:

I was just doing a little programming on it. There was interesting stuff--if it isn't written up--on the Williams tube memory which it was one of the early users of. This is a cathode ray tube memory and a so called read around ratio which was a figure of merit for that kind of memory--I don't know if you are familiar...do you have a computer background yourself?

MAPSTONE:

No, I don't. But I have some knowledge which I have been picking up.

KORN:

Well, let me give it to you for the record, in case it is not there, because I think it is an interesting thing in the memory background if it isn't there. The Williams tube memory is a cathode ray tube memory and when you address a spot on the memory to record something, you either put an electronic spot there or you erase an electronic spot. One of the problems with it is if you write on an adjacent spot, some of the electrons spill over onto all the spots around it. The net result is the memory is imperfect in that if you have a lot of activity in the vicinity of the spot, you may ultimately affect the spot. So what you have to do is regenerate the spot periodically both because being in electronic storage, it is gradually decaying of its own natural intent, plus as you write in the vicinity of it, you are prematurely making it fade out because of the spillovers. So what we used to do is have what we call a read around ratio which is how many times could you write in the vicinity of the spot without affecting the spot? And one of the figure of merits we

would develop on a daily basis--is how good is the machine--what read around ratio could you run a program at because some of the programs required a read around ratio of fourteen, for example, which was a good number. Which we very rarely achieved with the equipment. You had to wait for a day when had fourteen to run certain programs. This is in the old days. Whereas twelve was kind of normal. And if you wrote for ten, the machine was pretty well always for that. But the programmers had an interesting problem in keeping track of the read around ratio and refresh in addition to all the other things they had which programmers don't have to contend with today.

MAPSTONE:

Now, what you are saying is that the read around ratio difference was affected by how long it was since you had sort of cleaned out the whole.

KORN:

Well, there were two things. One is, how well maintained was the equipment. That determined what the read around capability of the equipment was. Then the program that was written had certain sections of it where they hit adjacent spots without refreshing the spot of their interest and you could run it through routines to figure out what the worse read around ratio case was, and certain routines had fourteen references. Now the thing that made the read around ratio of the machine change on a daily basis was how well it was maintained. Plus its inherent limitation which was fourteen high. O.K. That is really--I wasn't at Aberdeen too long. I was only there about six months. So from there I went to the Computer Division at Underwood, which had just been acquired recently by Underwood. It was formerly the Electronic Computer Corporation of America. It was on Sixth Avenue in downtown New York. And I was working on what was called the ELECOM.

MAPSTONE:

Oh, yes. Yes.

KORN:

There is probably some data on that. In fact, I may have some literature on that in my garage, I'm not sure.

MAPSTONE:

I would like that. We haven't got into the ELECOM. It is interesting because that was one of the computers that, although it was on the East Coast...

KORN:

Now the first ELECOM machine--in fact the people in Electronic Computer Corporation

were interesting people. Let's see if I can get the names. Al Auerbach who was head of Digitronics later. Edmond Shriner. Bob Shaw. Dr. Lubkin was the President of it and the others were all the key people. There were others. Let's see if I can think of their names. The best way to trace them down is through Digitronics although Digitronics just sold out to somebody else and I'm not sure if they are still around. Now, this is not the Ike Auerbach for Auerbach Associates. This is the one from Digitronics. They came from UNIVAC--in fact, it wasn't called UNIVAC in those days. Eckert-Mauchly--they came from Eckert-Mauchly basically. And the technology on the had at that time was first of all drum memory because they were a low cost end, and secondly, circuits similar to the SEAC circuits--dynamic circuits for the power elements except that we had one novelty which I think is interesting because I think they are the only ones that I can recall that used it. We had what we called the DC amplifier which was compatible in a sense with the SEAC type logic. This is an amplifier which was a one megacycle transformer called an amplifier, but it had full wave diode detectors on the output through a transformer that got the high voltages down to logic level and one below logic level with full wave rectifiers. With either pull down or pull up circuits to give you rise and fall time. Anyway, this was a transformer coupled DC Amplifier which was then gated to feed back on itself to perform logic functions such as a flip flop which were really gated DC Amplifiers which was in a sense the way we do it today with micro electronic logic. But in its time, I think it was the only one that ever did it this way but we had typically a hundred million flip flop which was unheard of in those days. The net result is we had extremely tight logic, efficient logic if you will in that we could drive a lot of loads with products. Now the first product that I am not too familiar with which existed at the time I got there--this was to give you a time frame--I got there in February of '53 when I got out of the Army. They already had built the ELECOM 50 which was a machine generally organized like the early IBM 650 only smaller and slower. And I don't know what kind of details I am supposed to give you on it. It was a binary machine--a drum machine, a serial and--I was that familiar with it but it had a moderate instruction set. I don't think it had rapid access loops on the drum. It was just a plain old drum machine with one read and write amplifier that was relay switched to all the tracks. I'm not even sure if there was ever even legitimate sale on the two machines. One of them was eventually donated to Stevens Institute of Technology and I saw it there, oh, five or six years later. I lost track of it after that which would put it about 1958. And there was another one that they may have sold. I'm not sure.

MAPSTONE:

So they just made two.

KORN:

Just made two. Anyway the ELECOM 120 which was in the final logic design phase when I went ever there in '53, the first one of which--what was the ELECOM 120? It was a machine again much more like an IBM 650. It was a decimal machine using binary coded decimal excess three internally. Fairly extensive instruction set, quite similar, I would say to a 650. It was again a single read-write amplifier drum with relay

switching to all the channels. Except that it did have approximately ten rapid access, re-circulating drum memories which had several read-write amplifiers. It had integral through the main frame was a typewriter as the main means of input-output. It had accessories--tape units and what have you. The Development Company in Houston. I happened to be in charge of delivering that first one. They sold, I believe, about twenty of those over the next two or three years. The second one to Shell and that used to run very often unattended all night, because it was a relatively slow machine.

MAPSTONE:

But reliable.

KORN:

Reasonably so. Reasonably so. The memory for example, would typically go two years without failure. And then you would have to replace the reel in the whole thing which was bugging. Anyway, is there anymore on the 120?

MAPSTONE:

No. But you can tell me--if you can tell me--how did Electronic Computer Corporation get started?

KORN:

I don't really know. I guess it was a spin off of Eckert-Mauchly--the guys got together--I don't really know. I would guess that they were in existence for about two years before then so that would take it back to about 1951.

MAPSTONE:

And then they were bought up by...

KORN:

Right. Maybe 1950 or thereabouts.

MAPSTONE:

Now. The ELECOM machine then was in direct competition with the IBM 650?

KORN:

Not really--because the 650, I don't think in those days, was decimal. It was a low priced 650 for people who wanted to buy a machine and IBM wasn't selling them at that time. I don't remember the cost. I think it was about $160,000 or so...

MAPSTONE:

Did people want to buy the machines or rather go the rental route?

KORN:

Oh, yes...

MAPSTONE:

What would have been their reasoning?

KORN:

Cheaper.

MAPSTONE:

In the long run.

KORN:

It was a lot cheaper in those days. Now when I went back to Underwood about three years later, they were building the ELECOM 125, which, if you will, was the big brother of this one. It was basically the same only it had expanded features and better hardware packaging and more reliable and so on. And I believe that we had sold about maybe ten of them on the books and we had delivered I believe, only the first one when the division went out of business. Maybe we can get back to that in a minute. Backing up, there was also an ELECOM 120-A. And I don't recall what the difference was. I think it had floating decimal. Added. Otherwise it was the same as the 120. And there was a few of those. I recall one went to Sylvania in Walford, Massachusetts. The reason I mention these places is that you might be able to get some clue over there if you want to trace these any further.

MAPSTONE:

Oh, yes. And it also gives an idea of the kind of uses the machines were getting.

KORN:

Now the 120, for example, getting back to it--Shell Research was using it to--for oil exploration calculations. Prior to that they had used analog means for plotting the earths magnetic field to look for anomalies in the magnetic field to go for the oil drilling. And I don't even know how they did it accurately enough using analog meands, but they finally went the digital means because they couldn't do it accurately enough with analog. They

used to run this thing all night and eventually they went to other means which were classified by then, so I won't even repeat them now. But I know everybody is using them now. That's one of the uses. Another use for the 125-A was British Drug Companies--and since you are British: Pure Food and Drug had ordered several 125-A's which I don't believe were ever delivered to them because we went out of business. And they were going to use them for Real Time Inventory Dispatch with people calling for what they wanted in the various drug stores and having the Bill of Lading for each of the delivery vehicles prepared by the computer real time--well it would be the vehicles. They probably got some other computer to fill that need.

MAPSTONE:

Yes. So really the ELECOM, although similar to the IBM, was influenced more from the UNIVAC people—

KORN:

Now, I say it was like the 650--it was like the 650 in a general sense in that it was a drum machine, it was about that size,--it was serial, I think the 650 was serial--I'm not even sure. And the instruction set was about that degree of sophistication as the early 650 instruction set. But the way it was built was completely different. IBM at that time was using conventional Eccles-Jordan flip flops, very high resistance gating, low current gates, whereas all the ELECOM machines used dynamic pulse amplifiers--well pulse amplifiers as a basic power element, customized gates which were relatively fast, multi-level gating. IBM typically only used one or two level gating. We used up to seven or eight level gating. Where the end of the gate might have a hundred million on it driving through all these gating chains down to a quarter of a million of what the vacuum tube--of course, this was a vacuum tube machine. Then we used those high powered DC Amplifiers as flip flops. We could also use a SEAC type flip flop which was a pulse amplifier with a delay line feedback, a dynamic flip flop. So hardware wise it was much more like SEAC than it was like a 650, but from a users point of view it was kind of like a 650.

MAPSTONE:

While we are on it why don't we follow through the next three years and then we can come back to IBM and Hughes--and follow through on the Underwood story. **KORN:**

Okay, well I've kind of given you up to the 125-A. Now there was another product that was in the formularized phases which I don't recall that a proto-type was built around--it was very close to being built if it wasn't. This was called the ELECOM DATA FILE PROCESSOR. And this was a very special purpose machine which had special algorithms for handling three tape units which was used for sorting, filing, merging--it was an off-line thing which was fairly well received, but again when the company--I may have literature on that in the garage too. I had at one time on a lot of stuff... I don't believe that that ever was delivered.

MAPSTONE:

What is the time frame?

KORN:

That would be about 1957. And the 125-A would be 1957, which was the later version of the 120. The Computer Division went out of business. We were, ever since it existed, were in the red. However, for the first time we had a projection of being in the black, because the sales on the 125-A and so on a la...and so on, look very good. And it looked profitable and what have you. But, Underwood had very old management. They were all about seventy years old at the time. And finally, the management was being turned over because the banks were putting pressure on Underwood to get a little more modern, and about the third turnover in management--I had an interesting talk with one of them--I don't recall his name--but he used to be with Watson--he told us some interesting stories about what the IBM Board used to do after a Board meeting. Anyway—

MAPSTONE:

What did they do?

KORN:

They used to go out and get drunk and for IBM--they used to walk two blocks away so they wouldn't be seen by Watson and they would go out and get drunk--Watson used to have a desk which was higher than anyone else on the board in the room, so he would be in a position of authority and he would take his Senior Vice President and he would say "This and this is what is wrong with you and you should be ashamed of yourself"--and he would make them stand up and he would chew them down in front of all the others for twenty minutes. And so "Okay--sit down"; and he would get the next guy up. And the fellow that I spoke with--I think his name was Ray--who was Senior Vice President or something at Underwood around 1956 or 1957--would tell me this story. And then after this, and after three or four he would run out of steam and if they all go out as a group--go two blocks away and get caught--and that was IBM that wasn't supposed to drink.

MAPSTONE:

Well, one has always believed that it was only in front of God that we didn't drink.

KORN:

Anyway, as a result of several changes in management which were much belated, the last manager, I don't recall who he was, each time there was a management change, they went over the books, took inventory and so on. They found something in the vicinity of ten

million dollars inventory, in the typewriter line or something or other. And the banks pulled out their financing and they had to stop the...So it had nothing to do with us but because of the rest of the company...

MAPSTONE:

So nobody acquired it. It just folded.

KORN:

It just folded. There may have been little pieces of it sold. One of the things that they did since they used the SEAC type logic and delay line and so on and so forth, we had quite a business making delay lines and pulse amplifiers. They're part of the business may have been sold. If it wasn't sold, it was a good business for someone to take over because that was about a million dollars a year.

MAPSTONE:

How about servicing the machines and things like that?

KORN:

Most of the servicing was done by people themselves. I was head of Field Services in this time frame. And prior to that we had no field service at all, other than an occasional factory support. I'll give you an example. I was called by Stevens Institute to help them fix ELECOM 50. We didn't have anyone left who understood the ELECOM 50. I had never worked on it. I had just seen it across the room. I went to Stevens and I met the fellow who was servicing it there who happened to be one of the guys in the Army with me, which was interesting. Dick Krewkausky. And so--what is wrong with it. And he explained it--and using his knowledge of the machine and my logical approach, I was able to fix the machine in a half hour. And I've done that since, for example on the Bendix G-15 which I know nothing about and we were using here--and we were really stuck using it--it was our acceptances vehicle--we had people trying to fix it for three months. I had never been inside a G-15. In fact, I had never used one. And using my logic and his knowledge of the machine, I was able to fix it. That is interesting.

MAPSTONE:

Yes. It sure is.

KORN:

Anyway, I guess that is--is there anything else on Underwood you want to know?

MAPSTONE:

Well, just did Underwood get out before they got into technology such as transistors and cores?

KORN:

Well, definitely we weren't using cores, although I put in patent disclosures, interestingly enough on magnetic logic which were ultimately patented by Rajchman of RCA and Underwood never filed my claims. About in the same time frame as Rajchman. I'm not claiming I beat him--but independently, I put in such suggestions to Underwood, but they weren't very big on patent stuff.

MAPSTONE:

Were you doing this work on your own at Underwood and how you got into it?

KORN:

We wrote it up as a patent suggestion because I felt that magnetic logic and also--we all knew about core memories--we just weren't using them at Underwood. I just felt that Magnetic Logic was probably going to be used for something or other one of these days and I wanted the right patent disclosure. To the best of my knowledge, Underwood had never done any work with magnetic memories, although we were very knowledgeable with magnetic because of our transformers which were magnetic. Everybody in the place knew how to design a transformer. And we used to design our own and delay lines. Everybody in the place could design those. So it was a natural for Underwood to get involved in it, but they folded too soon. Now transistors, again, they were around in 1957 and we were just starting to use them in some of the peripheral devices and I don't believe any device with transistors was ever delivered.

MAPSTONE:

So no cutting edge of technology work was done?

KORN:

No. The cutting edge of technology may have been in the delay line area. I believe the delay lines were unique to Underwood. These are--were lump-constant delay lines using, of course, capacitants and inductants, but the inductants was cubcore or secore transformer which were bound with mutual inductants between sections which gave you fairly good, I believe, technologically, at that time--very good rise time to delay ratios. In the vicinity, for example, some of our longer delay lines ran sixty micro-seconds with a rise time of about one micro-second which I think at that time was very hard to come by.

MAPSTONE:

What is the time we are talking about now?

KORN:

Oh, when I was there it was '53 and they already had that technology so I would guess '52.

MAPSTONE:

There is one thing I would like you to explain is the term lump-constant delay line.

KORN:

You know what a delay line is?

MAPSTONE:

Yes. I know what a delay line is.

KORN:

O.K.--Well, you can simulate a delay line by putting together lump constant elements--where lump-constant says a delay line has so much capacity per foot. So if I get a capacitor of so much and I put two of them right next to each other--that represents a foot or what have you--of delay line. If it has so much inductance per foot you put an inductor. So you simulate a delay line by having inductants in series the capacitants in parallel. That is common in electronics and physics.

MAPSTONE:

I want to go back a moment. You mentioned a disclosure on using core memory.

KORN:

No, it wasn't core memory. It was core logic--magnetic logic. I wouldn't debate about it though because there were all kinds of people who wrote disclosures and so on which never were pursued by the company.

MAPSTONE:

My question really was do you have a copy of that?

KORN:

No.

MAPSTONE:

Now, I know this kind of work was going on everywhere at the same time.

KORN:

Underwood made their own drums, their own magnetic drums, their own tape units. But the only technological edge was I think in their delay lines and transformers. And the difference is partly in that we adjusted the inductants and mutual inductant parameters by means of adjusting the air gaps on the pores which I don't...anyone else did at that time.

MAPSTONE:

Let's go beck again to when you left Underwood the first time which was in 195-

KORN:

Early '55. Okay, I went to Columbia University Electronic Research Lab which was not directly computer related. And it made the tie in to something else that is computer related, so maybe let me tell you a little be about it just in case. There I worked under Ragazinni and Melman which was an interesting combination because Melman was kind of the granddaddy of digital circuits at that time. And Ragazinni in information theory. And we were doing work on extracting signal from melodies and also on simulation of noise which I don't think had been done prior to that and the way this related together with the computer which may be an interesting preface--for example, we did some signal extraction where the signal was eighty degrees below the noise at that time by means of low filter integration which I think was probably first done their with Ragazinni. And also did some radar simulation with--detecting ban limited galsea noise to generate relay noise which also was a new thing developed through Ragazinni. And that was the predecessor for the long range radars which were ultimately used for the Dew Line. And I also worked on the computer netting study because the particular radar approach that was developed at that time was not conventional and you required multiple sites to determine where the target was and we did it with computer sizing. But the only thing of interest is--there was a lot of ground breaking there which ties into the Due Line Radar which I think RCA eventually got that contract on. Maybe someone else will tie in with that. From there I went to IBM really as a job shopper. I wasn't working for IBM And the first assignment was I was working on a what was then a new IBM high speed printer again rated at about one thousand lines a minute. And my assignment was to develop the electronics to interface between the printer and the IBM 729 tape. It was an off-line printer that would work directly with a tape unit. The electronics there used the cores. I believe it was vacuum tube technology--yes vacuum tube--used cores and switched cores for I think it was a five thousand character buffer which would allow the tape unit to operate directly with the printer. The electronics was nothing special--no problem with it. The printer was an interesting printer. IBM had taken their relay--their rather, wire matrix printer, which they were using in some of their tabulating equipment--lined up sixty of them on a...They wanted one hundred and twenty, but they couldn't get them close enough together to make one hundred and twenty so they put sixty of them on it

and you would print the line of sixty characters. Then you would index the whole over one character and print another sixty. And do a thousand lines a minute which is two thousand shots a minute. And with big five horse power motors, big chains driving the whole thing--very noisy--and it worked until one day the timing gear broke and the whole thing just disintegrated and went every which way. (laughter) And if anyone had been close to it they would have been killed.

MAPSTONE:

Oh, my gosh--it really blew up.

KORN:

Oh. Yes. And so that was the end of the program. I.B.M. realized that if that ever happened in an office--you know. So that killed it.

MAPSTONE:

Where in IBM was this happening?

KORN:

Poughkeepsie.

MAPSTONE:

Oh, yes. Who were some of the people?

KORN:

The only one I can remember is a guy named Herb Abzug--the reason I happened to know him is he married my X-childhood girlfriend who lived next door to me. He is a nice guy--I ran into him up there.

MAPSTONE:

Do you--whose concept what this originally? Do you know?

KORN:

Well, he was either in charge of one of the key guys on the project--the concept of course, I think came from Madison Avenue IBM. And I don't know where it came from. But the printer was built by their tabulating machine people or something or other. And the electronics was built by their, I guess, they had come from the 709 line and we used 709 type circuitry at that time.

MAPSTONE:

This is around what date?

KORN:

Well, I'm trying to think. Let's see. IBM--I left IBM--This must have been early '55. Roughly--January of '55. Anyway, at the conclusion of the program I was transferred up to Kingston to work on the SAGE production redesign. Are you familiar with the SAGE?

MAPSTONE:

Yes.

KORN:

The first SAGE was developed by Lincoln Labs with IBM's help, I guess, making the prototype. And I think there were two prototypes in existence and IBM got the production contract in roughly the beginning of '55. And I guess it was called Project High which was for High Street which is where the program was located--super secret stuff which was ridiculous and we were working in it initially in a bowling alley. A converted bowling alley. And the guys who were more project oriented were up on what used to be the stage overlooking the lanes and the circuit designers were down on the lanes of the bowling alley which was cleared off. And IBM put up a very big plant there--five million dollar plant which they were allowed to write off in five years. And on the fifth year and one day, it became a sewing machine factory. I mean a typewriter factory. The sewing machine factory was...And on SAGE, I was in charge, I guess, of what we called Frame Five put out the control section--I don't know if it's going to be too important--just going to be a very small piece of SAGE. The biggest changes were that the prototype of SAGE had a seven and one half microsecond core memory and the production version had a six second microsecond core memory. And the original designers sort of designed in advance for a six microsecond memory should it be available because it wasn't available at that time. So actually the change over was quite simple. And the people next to me were working on the arithmetic control the arithmetic section. I don't really know what more to tell you because I am sure you have a lot more on SAGE.

MAPSTONE:

Yes. SAGE is pretty well documented. Yes. I personally don't have it, but I am presuming it is in the documentation.

KORN:

Yes. And this was in mid-1955.

MAPSTONE:

Okay. So somewhere along here, you moved west.

KORN:

Right, I went from there to Hughes Aircraft. And I worked on the MSG-4 System which was a military data processor. I just wonder if the MSG-4 has a name. It is the computer system, I guess, that is used in an overseas environment for air defense and tying into the HAWK missile system. It is the--I guess it is still being used today. It is still in use today overseas and it was the immediate successor of the MSG-2 which was basically the same except it was for a different echelon of equipment. I am not too familiar with the MSG-2 and I get confused between them because they are really quite similar. But the MSG-2 which existed a few years earlier was the first to my knowledge--the first all transistor equipment made.

MAPSTONE:

Using both of these can you give me a description of what they were, what they were built to do?

KORN:

Okay. Well, I don't know how to describe them because we now get into a whole series of non-conventional data processors and I don't know if you can even describe them with words. But, for example, the MSG-4 started out with radar measurement equipment which converted radar data to target existence data and centroids and beam splitting and so on. That was a very special purpose processor using digital techniques but you just can't relate it to anything in a more conventional computer. It is a very special purpose thing. And those radar reports went into a sort of a central processor that correlated those reports with previous track histories in the file and did kind of, I guess, it is like SAGE. In a sense. It did a SAGE like job. I did tracking and it did--I don't even remember on the MSG-4 whether it did or no--I guess it did HAWK direction. It said there is a target over there or this missile battery--we will tell you to fire on this one and not to fire on that one to effect more frugal use of missiles and more effective use of missiles. But insofar as the data processor went, I only worked on the radar measuring equipment on the MSG-4 and I was only there seven months, so I can't describe the rest of the equipment very well. I could describe some of the transistor circuits since they were the first transistors ever built to my knowledge. Certainly the first military equipment with transistors and maybe the first equipment with all transistors.

MAPSTONE:

Let's go on to that a little bit because you know there is a lot of claim for first in transistor technology and someday someone is going to need to get it a little bit together. **KORN:**

Now the key person on the MSG-2 and MSG-4 was a fellow named Dick Barlow.

MAPSTONE:

And where is Dick Barlow now--do you know?

KORN:

Probably, if he is still alive--he is unemployed--he was unemployed a few years ago--or he is a consultant. That is a nice way of saying unemployed.

MAPSTONE:

In the area?

KORN:

Yes. He lives in Redondo Beach. Richard D. Barlow.

MAPSTONE:

Is he getting on in years? You say, if he is still alive.

KORN:

Well, I lost track of him. He was at Litton for a while, in fact, he got Litton into the Army business. And it was unappreciated here. I worked directly for him. I think he is a good guy--you know--shortcomings. He lives in Redondo Beach in--what is it called--Pacific Palisades area? Hollywood Riviera--it is on the hill there.

MAPSTONE:

I'm not sure. I don't know the area. Well, tell me of the transistorization of this device.

KORN:

Well. Again, I wasn't there when it started. I could tell you what the transistors looked like in those days. And they were really only as I recall, three or four transistors available at that time and they attempted a design to be able to use all of them. The net result is a flip flop that might have otherwise been accomplished with two transistors or three transistors had six transistors in it. So they could of the parameters so that they could all work. And I think it was a very wise decision because the state of the art of transistors changed tremendously right in the process. And half the suppliers went out of business and the quality was poor and so on and so forth. And yet it evidently worked quite, considering.

MAPSTONE:

What were the three types of transistors?

KORN:

I don't know. I wasn't ...then.

[End of Tape 1, Side 1]

[Start Tape 1, Side 2]

MAPSTONE:

We were talking about the...

KORN:

The Hughes transistors?

MAPSTONE:

Hughes transistor developments.

KORN:

The basic, I guess, circuit approach was to use diode gating and then transistor flip flops and inverters and what have you pretty much the way--Eccles Jordan type flip flops. Pretty much the way all transistor machines were so that they pretty well set the tone and I think some of the later transistor machines went to more circuits and got rid of diode logic but I think it was pretty well represented and set the pace for the transistor machine.

MAPSTONE:

Now were these devices that were actually flying in missiles or were they ground...

KORN:

No, this was ground equipment that worked in association with the next high level control, not at the missile sight. In other words the next higher level control that had several missile sights working for it basically--the missiles could operate either autonomously or under higher control. This was the next higher level control. Now there were various other pieces of equipment that Hughes made that were related to this and located at the missile sight. One of them relates to Litton, so maybe I will tell you about it, because Litton made the next generation of this equipment which I think was a

milestone in itself in micro-electronics. This was--now Hughes made a device called the coder decoder group which was at the missile sight and acted as a coordinate converter from--between the missile and the higher level authority which was called the Adcap--AADCP--on an Army Air Defense Command Post whatever it stands for. But basically all this was a parallax conversion and XYR theta converted back and forth missile sight and also generated some markers from the higher center to the missile site scene. At this point on display is the thing we are talking about were actually interfaced into the display. For example, the coder decoder group was compatible with the MFG-4 and made of the same technology and with it was one typical shelter's worth of equipment. And when we get into Litton, I can show you the next generation of that which was only three cubic feet. For example, doing the same thing.

MAPSTONE:

Who were some of the people at Hughes that...

KORN:

Well, there is a Bill Ferry, Leon Beck, Eric Weis, Ralph Rodriguez, Norm Enstein who was one of the Division Managers later at Litton, Mick Begavitch who is now our Division Manager—

MAPSTONE:

So there was a progression from Hughes to here?

KORN:

Back and forth--yes. Insect there.

MAPSTONE:

Yes. Well, Litton did grow out of Hughes, didn't it?

KORN:

Right. Right. I was only there for about seven months.

MAPSTONE:

Were these DDA's? The MSG-2 and 4--were these DDA's or...

KORN:

No. I had better take that back. I don't know if they were DDA's or not. I really don't know what was in them. They definitely were not general purpose computers in the true

sense of the word, but I don't know how they were implemented a special purpose computer. There was another one that Martin made which was in the same class with the MSG-4 that I don't have any first hand knowledge of which was used in the continental United States before SAGE. And again, that relates to a Litton product--I don't know what they called that thing--again a coordinate converter working with the missile master which was their big monstrous, old fashioned, pre-SAGE continental United States thing. And there was a later version of that which I don't believe was ever sold used a Chordic computer in it.

MAPSTONE:

Used a—

KORN:

C-H-O-R-D-I-C which is a computer that had an instructions set, so-called CHORDIC instructions. I am not even sure I know what that is. But it is like you could do an XYR-theta conversion in one instruction because the machine was programmed to do that. And the net result is it generated and rotated it. And I don't know if you have any literature on that. I don't know about it. I could just help steer you a little bit. Martin Marietta did something--did a lot of work on that. And we have a Sam Sternback here who might be able to tell you about that who came from Martin.

MAPSTONE:

Martin Marietta is the other...

KORN:

Martin-Marietta is Georgia--Martin--Orlando it was. RM; What was that man's name--Sam?

KORN:

Sternback. He is in this Division here. Of one of the things you are trying to do is get odd little computers, that CHORDIC is a strange one.

MAPSTONE:

The is C-H-O-R-D-I-C? I'm not really trying to get strange computers just for the sake of strange computers because there have been an awfully lot of them. You know--trying to get things that related to and had significance in one say or the other.

KORN:

Okay. Then when I left Hughes, I went back to Underwood where I was a Field Service

Manager and we were in the 125-A era at that time and about nine months later when Underwood went out of business the Computer Division at least was abolished. In fact, I remember that day very well. It was either March 14th or 24th because there was an IRE--what we called an--Convention on Monday and on Friday we all got laid off and used that as a place to commiserate and find jobs.

MAPSTONE:

That was rather convenient.

KORN:

Yes. It was actually.

MAPSTONE:

So you joined Litton?

KORN:

Right.

MAPSTONE:

You joined it three and one half years after it had been formed.

KORN:

I guess. Anyway, I joined it in April of '57.

MAPSTONE:

What was Litton doing. Firstly, what division did you get into and some general history.

KORN:

I guess that it was called the Electronics Equipment Division at that time. It was in Beverly Hills and there were, I believe, two divisions in Beverly Hills--Electronics Equipment Division and the Space or something or other division.

MAPSTONE:

Okay. And both of these were in Beverly Hills?

KORN:

Right. In what used to be an old sewing machine factory, next to the Beverly Hills dump. The garbage barn.

MAPSTONE:

Was it Space Research Laboratory?

KORN:

Probably because really the work they were doing was vacuum chamber work. It may have been another division I am aware of. And there were two main departments in the Electronics Equipment Division. There was a department I think, thirty-three and a department twenty-two. The numbers may not be right and I may have them reversed. Anyway one of them ultimately became the Guidance and Controls Division in Woodland Hills. And the other one eventually became the Data Systems Divisions here in Van Nuys.

MAPSTONE:

When did these two divisions split off?

KORN:

Split off. About--I don't recall exactly. About 1959. I think we split first in the facility that is on Eden Avenue and Van Owen--there are two buildings there. Yes, I think we went there first. And then they built the big facility next to the freeway in Woodland Hills which was for Guidance and Controls. So we got the rented building and they got the big buildings, and of course, they were a bigger division because they were in inertial work primarily and that is...Okay, I can't even tell you anything about what Guidance was doing at that time. Let me tell you some of the products that I recall floating around when I started there. And see if I can maybe give you some names that you might look further on some of the older products...was a Litton-20 which was a digital differential analyzer which you already apparently spoke to Floyd Steel about. The Litton-40 which was just twice as much in one box and the Litton-80, I believe, which was four times as much was in existence. I can't tell you very much about them. But we do have a fellow who lives in the vicinity if you want more information about it--Cameron Forrest, Cam Forrest.

MAPSTONE:

I have been trying to find that man. He was at Hughes too.

KORN:

Right.

MAPSTONE:

Oh, fantastic.

KORN:

Also Dick Hess was in the same area and was also at Hughes. I can trace him on some of this stuff. Now Cam Forrest lives in--the next thing past Woodland Hills--anyway I can get you the address. I got hung up on--that is the wrong way--anyway I can get you that part. He should be somewhat familiar with it. Now another product Litton had at that time was called the Morter which was a motor computer.

MAPSTONE:

Motor?

KORN:

Morter--computer. Again I don't have too much familiarity with that thing. But Cam Forrest should have some. Ordvick has. Vick has--who was also at Hughes in the same time frame as Cam Forrest is currently with CSC in New Jersey--in the New Jersey office. Cam Forrest is right here.

MAPSTONE:

That makes it easy to get him.

KORN:

The Morter Computer was a Boarder Direction Computer of some kind and was relatively small being two feet by two feet by three feet or something like that. I believe both the Litton 20 and the Morter Computer were all transistorized. I believe. I am not sure. Okay the first significant program--both of these were relatively small--the first significant program that this branch of Litton worked on and the one that I am most familiar with was called the Airborne Tactical Systems--System rather which was a time contract from the Navy and was an airborne early warning system that went--an experimental warning system that went in the Lockheed WV2-B--We didn't too easy. Which you may have seen pictures of. It was a Constellation with a forty foot dome on top, a forty foot dish. Only one at a time. We can probably get pictures of that if it is of interest because it was a weird looking airplane.

MAPSTONE:

Oh yes.

KORN:

Now basically what was the system. It was basically an airborne SAGE. For all practical purposes, only with fewer consoles and so on. But the functions included--well, let me start from the beginning. It was airborne early warning, as the name implied, in detecting aircraft, tracking them, communicating with various other stations by visual data link or what have you about the position and other information on the aircraft. And controlling interceptors directly, or missiles indirectly to data links or other control elements. And the whole thing flying around in an airplane. And I don't know what to tell you about this. Shall I tell you about piece of it what the general approach was?

MAPSTONE:

Yes. Tell me about the general approach.

KORN:

Okay. Well the general approach for the computer--the central computer--let me take that first--was first of all not a general purpose computer. It was primarily a wired logic computer, however, the organization, I think, was perhaps first--did you personally run across any of the work done on the MADDIDA?

MAPSTONE:

Yes.

KORN:

With the steel Rather--well I think through the influence of Steele probably the main memory, which was drum, was organized like the MADDIDA, with re-circulating registers. And the novelty was that the technology in those days was transistors wasn't super fast, but for example the machine had a nominal clock rate of about three hundred and twenty five kilohertz and transitions could get somewhat faster--maybe up to megahertz. We wanted a tremendously fast data rate while using only a drum memory rather than a core memory because of the tremendous amount of storage that we had--storage well over a couple million bites and core--you know to fly a core around that size was out of the question in those days. Of course, a drum like that today could be done on a quarter of disk—

MAPSTONE:

That's right.

KORN:

So anyway--I have got to go back a little bit. We also had to do radar processing. Now in order to do the radar processing, again without core memory what we did was basically

synchronize the drum to the radar so that we could lay down all the radar returns around the track on the drum and that may have been a first. I don't know...synchronized onto a radar. And did the radar processing as a separate processor on the drum, but the drum speed was determined by the radar with a very tight...Now, that same drum, another section of it was used for computation. And so firstly, we had the programmable parts of the computer stored around the drum and series and as I recall, there were two hundred and sixty eight words in one track. Then we had the working data storage portion of the drum which was a re-circulating register of nominally two hundred and fifty five words length. So that with every revolution of the drum there was a procession of thirteen of the program store with reference to the track store or the working data store. In addition, since one of the functions of the machine was intercept control, and we didn't have as many interceptors as we had tracks, obviously, we had yet another length of register on the drum which circulated, which was, I don't recall the exact number, fifty-seven words long or thereabouts, which present for the interceptors. Now the main timing diagram, if you will, for the thing was such that when, for example, we wanted to update a track, we would get until we got a new radar return. At that point, we would update the track and the track would ask for a computation. Well, since the program relating to track update was permanently stored on the drum as it were, we had to wait until say step one of that program lined up with precision to that track and the procession rates were such that this would happen four times within a radar report cycle. We then would execute step one of the program on the first track. Meanwhile, on the drum the next track would come up which would be say, Track II on which we would be executing, say step fourteen of the program, and on the next one we would be executing step, say twenty seven. The net result was, we were always computing. And we were reading all the tracks on the drum simultaneously. So whereas, we had, if you will, a machine that was a serial machine with a ten thousand cycle instruction rate, we may have been doing a hundred tracks at once which gave us ten or twenty megacycle instruction rate which is how we got the state of the art at that time compressed into something that would go in an airplane rather than a single GP that did one thing at a time. So we were doing a lot of things at the same time. And now, the main sections we had for that equipment were the radar processor which was a special purpose machine oriented to the drum, the tracking computer which was the processing computer that I have discussed. And the intercept computer which was a general purpose serial computer as a sub set of equipment within the equipment that handled intercept vectoring upon demand in pretty much the same manner that a conventional small, serial machine would do it--sharing again the same memory, but being a general purpose machine. Then the various data link control elements were again special purpose to the equipment and we had in the airplane three major displays where again the display processing equipment was very much special purpose rather than general purpose. There was also height finding equipment and so the main radar in the airplane was a two dimensional radar. We had a separate height finder again with a special purpose interface...This may have been the first use of multiplex air to air data link I'm trying to think what the generic name of it is--We called it the MPC-Multipurpose--the communication link was made by Collins. I don't know the generic name, but anyway that was product and the technology of that was all transistor, diode logic and Eccles-Jordan type flip flops and power amplifiers. It was again fairly conservatively built because the transistor technology was not strong. Where our flip

flops also I believe had six transistors in it. Fairly high powered flip flop. And now this might be a first come to think of it. We used a contact head drum. Now I think that drum was used earlier on the MOTE, but I think Litton was the first contact head drum manufacturer. I think that may be the case, which is the way the use in a lot of disks today. But one of the people--if you can find him who was also around even earlier than me was a fellow named Pete Retsinger who was around at Microdata in Chatsworth. Not Micr--Macro.

MAPSTONE:

Micro.

KORN:

Pete Retsinger--but I believe Litton may be the first contact head drum manufacturer, come to think of it. I guess SAGE didn't have it at that time.

MAPSTONE:

Okay what is the contact head? I'm familiar with the term floating head.

KORN:

That is what I am talking about--floating head.

MAPSTONE:

Is it the same term? Contact head and floating head.

KORN:

Yes. Well a contact head when it stops it rests on the surface.

MAPSTONE:

Yes.

KORN:

And when it is running it floats aerodynamically. I think Litton may have been the first on that I'm not sure.

MAPSTONE:

I'm not sure. You know, there had been so much work done in drums and I think everybody has been working on the same technology parts. Coming up with the same

thing so--It will take in depth probing to really establish first here. Can you give me some kind of date on this?

KORN:

It probably goes earlier than '57, but I wasn't here so I don't know. Because I know the MOTE which was around had floating heads also. I know at SAGE for example, which I worked on a bid--I didn't get onto equipment very much--had drums and we used to adjust the drums by turning town a differential spool until you heard a ping and then back off. That wasn't a floating head.

MAPSTONE:

See, now ALWAC, I'm pretty sure used a floating head and are you think of J. B. Rea--a lot of work going on in this area.

KORN:

Well, I get confused because don't forget now, Litton was almost all militarized. And a lot of the firsts we did may have been firsts for the military.

MAPSTONE:

Yes. That's right.

KORN:

In some cases the military leads because no one else can afford it. But in most cases they lag because they can't take the risks that other people take.

MAPSTONE:

And then there is the other with the military stuff, so much of it is done behind closed doors that we are never quite sure of whether they are first or whether they are picking up on somebody else's. But it is interesting and significant whether it is a first or not.

KORN:

I wish I could recall the name of that first airborne tactical data system. That was incidentally, definitely, the first airborne tactical data system. It was AN--AS something--54. Litton may have literature on that. I don't know. Roy Ballard who is our sort of public liaison and approver, I talked to him about it and we do have some literature that was previously approved for release and all that stuff--but that be too old you have it in there.

MAPSTONE:

Well what would be the literature that he has got?

KORN:

I don't know. I say it may contain that--maybe not. I don't know. **MAPSTONE:** It is true though that it might contain other interesting stuff too. **KORN:** No, I am saying that this may be too old for literature. **MAPSTONE:** Oh. I'm sorry. Got you. Okay. **KORN:**

Okay, I can go now kind of historically down the line with Litton. The time frame for that one--we received the contract, I would guess, at the tail end of '56. Since I got here about April of '57. And I guess we delivered it three years later. To give you the time frame. There is another contract we had which was ultimately cancelled for similar equipment in a blimp--I don't know if that would be of any interest particularly. Again, you know, airborne early warning but it would be longer on station. But it was ultimately cancelled. Now time wise I am not sure exactly how these two line up but let me go along the airborne tactical data system line for a moment and we can come back...

MAPSTONE:

Yes.

KORN:

That program followed--there were two of those built--only one of those went in an airplane. The other one went to Point Mugu and stayed on the ground as a sister system to talk to the other one and so on. The next system along that line was a time contract given...Aircraft which was called, I guess it was also called airborne tactical data system initially but it went in a different airplane which was ultimately called E-2-A Aircraft. You may have seen pictures of that. It was probably one of the largest carrier based airplanes and again had a dome on the top, but it is more in the vicinity--I'm not sure of the size--a sixteen foot dome. So it doesn't look quite as gawkish as a big constellation with a forty foot dome on it. And I guess now there are E-2B and E-2C versions of the aircraft, but you know, essential the same type of aircraft. At that time, I guess, the airplane was called--I forget what it was called. Anyway the E-2A's--the equipment that went into this airplane performed essentially the same function as what I described earlier for the airborne and for the larger one, except it was a much smaller aircraft. And as a result the concentration on equipment miniaturization was more important. And this was essentially the next generation of equipment compared to the first one and the first one was, for all practical purposes, the first--the technology of the early transistor equipment. And this was now the later transistor equipment technology. For example, a flip flop which used to take up--four or five square inches of circuit board now would only take up a few square inches--or one square inch of circuit board so that it was smaller. There were fewer transistors in a flip flop--the circuitry was faster, smaller, lighter. We were in a modified core group construction as against the more conventional circuit board

approach of the earlier machine. The basic implementation was similar to the earlier one in that it had the rotating drum and the processing registers, roughly the same basic clock speed and word size. And on those we maybe getting into some classifies numbers because some of those are still in service today. But we built--we went to production on that one and built a reasonably large quantity... and--still in service so they must have been around for--I guess we delivered the first one in maybe '62 or '63 so they have been around for over ten years. Okay, now, in parallel to that there was another offshoot--the contract for the so called...FSG-1 is what the Martin--whatever I call it--Missile Master or whatever, Missile Monitor--no Missile Master which was the predecessor to SAGE. FSG-1, I guess, was its name so the was to add certain capabilities to that system. I guess because was still going to be around for a while because SAGE hadn't made all the deliveries yet. The capability--it may be classified--so I won't go into what the capability was. But we did generate a general purpose computer. It was the first general purpose computer that this division made because all the others were kind of weirdoes although very interesting weirdoes. Which had a name but I only know it as the FSG-1, and I don't know a heck of a lot about it. Now there is a fellow here, George Miller, who aught to be able to tell you something about it. You might have run across his name at Rey or what was the other one you said in the early days here?

MAPSTONE:

ALWAC.

KORN:

Or ALWAC. I think he may have been at both. Mort Goldwater.

MAPSTONE:

Yes. That is a name I have heard.

KORN:

He also was on the FSG-1 computer. But to the best of my knowledge, it was an all transistorized, GP computer with a core memory and I don't know all the parameters on it. That one, unfortunately, never went any place. And that program just went off to the corner.

MAPSTONE:

This is what, circa 19-

KORN:

1961 or 62 something like that.

MAPSTONE:

Goldwater is at Litton, right.

KORN:

I'm not sure where he is anymore. He has been in and out of here so many times, I don't know where he is now. He was here about nine months ago-I don't know where he is now. He even ran for public office here...ran for School Board.

MAPSTONE:

It is a name that has come up in several places. I can't quite pin him down.

KORN:

I'm pretty sure he came from ALWAC. or Rea--one or the other. Okay, you want some of the names of maybe some of the early people at Litton here on the computer.

MAPSTONE:

Yes.

KORN:

There was an Irving Lieberman in logic design. Does that name mean anything? Reny Bosh who is still around. I think he is out at the Culver City facility. Let's see his real name is--it is German--Eugene, what was it--Eugen? I'm not sure how you spell it.

MAPSTONE:

And he was involved with what projects?

KORN:

The airborne tactical data system, at least. Because I was involved on that one...was one of your other logic designers. Some of the key people are Irving Bosh. The program manager was Tec Wilson who the last I heard was the Vice President--just like Litton was an offshoot of Hughes--they were an offshoot of us. I can't think of that name. They are down the street here on...

MAPSTONE:

I can't help you.

KORN:

Let's see who else was key there? Well Vic and Cam Forrest and myself--There was a Fred Gagnon was one of the guys on there. Co-program manager sort of. And anyway that was in the early days. Now, there was another line of equipment that was an

offshoot of this, built in approximately the same time frame as the original ATD-S--maybe a year later. There was the MTD-S--Marine Tactical Data System which started using the same componentry and the same basic approach as the Airborne Tactical Data System, but went in the airplane. This was a machine that went in shelters which give all the airborne early warning functions, but did it on the ground and in addition did much like MSG-4 did missile control system, interface. Did also interceptor control which the MSG-4 didn't. And like the airborne tactical data system we directed interceptors on rectors and so on. And did some planning functions and so on for direct support aircraft. Minor planning functions for direct support aircraft. Again, the basic approach was primarily special purpose computer. The main tracking and computing much like the airborne computer had the rotating memory with the processing tracks as before. The intercept computer again was a small adjunct but a captive general purpose computer within the framework of everything else that was special purpose. And, this consisted of about eleven shelters worth of equipment with all kinds of special equipment complete to developing their own photographs of maps and things like that out in the field and its own maintenance shelters to be sufficient. It had a much larger number of displays. It had about fifteen displays. Whereas the airborne stuff typically had about three, and while we had a lot of trouble giving birth to that system and getting it out the door, ultimately, it was the only thing that worked in Viet Nam. The only air defense system that worked. Don't quote me on that. Quote me on it without a name if you like. But my understanding that originally had the responsibility for air cover and defense--all their equipment never worked there--was beautiful and performed roles that it wasn't designed for. It was te main way of tracking down flights. They used to find them by means of tracking the airplane on the MTD-S radar and leading the search planes in it. That is the way the thing worked. And it was in Viet Nam until six months before the Cease Fire. It worked out beautifully. It really--And on the carriers they had out Airborne Tactical Data System flying around, again doing a function it wasn't supposed to do. So, it was an interesting situation where maybe equipment was over designed or what, but we got some serendipity out of the equipment because the nature of what we designed it for was different than what it was used for.

MAPSTONE:

That is interesting. How much in the, I guess I would say company that goes on, do you feel that or have you understood that what came out in these military instruments, guidance and control instruments was influenced by Steel's ideas.

KORN:

I really don't know. I can tell you this that outside the basic concept of the precepting registers, nothing at all. Now whether Steele made us do it or whether the guy said, "Hey that is a good way of bridging on squeezing a lot of capability into a relatively small area and not too expensive because we can't just fly five tons of core memory around." That's it. I guarantee that nothing else from '57 on was influenced by Steel because I was--at least in this chain--because I was there. But, whether that is his idea, I don't know. I think Litton does have patents on that.

MAPSTONE:

I was thinking more of the philosophical approach to guidance—

KORN:

As I had talked to Steele he has great dreams about control systems which are small but have fantastic capability and using the DDA approach.

KORN:

Well, I don't know how much you have met the DDA people. They are nuts. Everyone of them is a nut. You know they see the DDA as the end of everything. And it just so happens there are certain advantages of the DDA, but unfortunately the disadvantages outweigh the advantages. One advantage is a DDA, for example, is the first single full computer that could be made on an was a DDA. Because it is small. It has a smaller component so that, Okay, now that you have a DDA building block, you aught to be able to, you know, tame the world as an circuit. You know, that was the concept. Now guidance is where we have all the DDA nuts. The Guidance and Controls Division still. But let me give you an example. Are you a little bit of a mathematician in your background?

MAPSTONE:

Not really, but go ahead.

KORN:

Well, you can understand basic math?

MAPSTONE:

Yes.

KORN:

Here is a problem we run into in our E-2-A program. Incidentally, I didn't finish that. There was an E-2-B and C after that. Are you familiar more or less with the principle of the DDA?

MAPSTONE:

Yes.

KORN:

Well, what happens is in a simplistic DDA with primary flows it must be a word he gave you--you have--let's assume the thing is at rest. When it is at rest you get an ultimate train of ones and zeros which average out to--well it is an ultimate train of whatever it is about the value--let's assume the value is you get an ultimate train of ones and zeros. Okay. If I now perturb the input the output will perturb. Now if I go through a complicated loop, to get from here to there so that instead of just going through a simple path I go through a lot of other paths, you find that instead of, if I jiggle this one notch, instead of that jiggling one notch, if I don't know what I am doing, that will juggle twenty notches. So that net result is you have a noise amplifier which if you understand the basic concept of servo which says that when I do this I will generate an era and the output will get magnified and come back and move this back down to where I want it to go, so it is an error magnifier that drives you back to close the loop. But what happens is, if the error magnifier magnifies the noise rather than the error, you can't drive the loop back or you will get a very good... Well, we found out in dealing, for example,--that was my only real in fact I got into the guts of the DDA--in fact, I found out myself. We got noise magnification. We couldn't what you call zero rate if this would zero rate or approximate zero, if you will, by a plus or minus one byte--the way it was programmed this was approximating zero by plus or minus sixteen bytes. Which made it kind of hard to use. And that was only symptomatic of the fact--anyway the point I am trying to make when you get into a complex program, it is beyond the capability of a program to understand it. Now in this particular case, after we saw what it was and so on, we were able to fix up the program to minimize that because we were stuck with that implementation. But I swore then, I would never use a DDA again. Because you can't get smart enough programmers to program them. I think they are good for very specialized little things. For example, I don't know if you are familiar with the Zinetics Company makes a kind of a novel high speed plotter. They are down the street on Avenue. And they use a little mini computer the aerodynamics of a plotter that is moving around so fast it anticipates what the air breaking is going to be at a certain speeds and so on. And they use a little DDA in there to calculate how much in advance of when they want to shut it off should they start stopping it so that it will stop when it gets there. Now for something like that it would be alright. But for a general purpose thing they are awful. Absolutely awful. But they are all nuts. All nuts. It is better in one sense--if you find the right job, there is nothing like a DDA. But that is all. There aren't those right jobs around, hardly.

MAPSTONE:

So, now even at Litton we have two very different groups--there is the Guidance and Control which is DDA.

KORN:

No, it is not necessarily DDA. It is inertial-values oriented. And inertial guidance is full of servos and torque rates and things like that. Some of which lend themselves to DDA's. But even there, which is where all the DDA guys are clustered and keep trying to push management into DDA's--they really departed from DDA's and analog and went to

digital computers. Many, many years ago.

MAPSTONE:

So what has been the main thrust of Litton then?

KORN:

Well, this Division has been military command control systems of primarily the airborne or warning variety in the early days or the ground space airborne detection and intercept or missile control. In later days, now for example, we are doing again related functions more advanced versions of the air defense function and we are also getting involved in artillery planning and gunfire control, if you will, automation--which is a first. It is the first time the Army is really involved in that to give them better first accuracy and more effective spending of the cost of the ammunition. You can fire one round rather than one long, one short and so on you can waste five shots on a salvo. It is more important to use...Plus, more important, you lose the lethality effect of the surprise which is, you know what artillery is all about, I guess, ultimately. If you can get it there the first time you can catch them before they jump into the foxhole. Making a science out of this. Well, you know, if you are going to play that game, you might as well play it for keeps. Otherwise don't play the game.

MAPSTONE:

Yes. Right. Otherwise somebody is going to play it on you. How about crossing lines, for instance, what kind of influence if any has the command control group say have on space developments.

KORN:

Well, Litton, hasn't really, to my knowledge been very big in space. Really, see we weren't one of the big space people. We started early with our high vacuum research which was also beneficial to us in our San Carlos operation, I guess, where they were making magnetrons and things--to be able to actually get in a space chamber.

[End of tape]