



Oral History of Joseph Killian

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START TAPE 1

Bob Fraley: Hi. This is Bob Fraley for the Computer History Museum. We're here today interviewing Joe Killian and this is January—

Joseph Killian: 26th.

Fraley: Thank you, January 26th, 2007. Joe was the chief engineer for the company IMSAI, one of the instrumental companies in creating the home computer, personal computer, type industry. And so we'll be hearing about how the history took place from the point of view of IMSAI and how it contributed to a number of other companies over time. So, welcome, Joe.

Killian: Thank you.

Fraley: First, we've got a few just sort of routine questions. So your name is Joe Killian and where did you grow up?

Killian: That's right. Grew up all over. My dad was in the military, army engineers. So West Coast, Texas, East Coast, Paris for a while.

Fraley: Quite exciting times.

Killian: Well, advantages and disadvantages but I appreciate the advantages.

Fraley: And so we've heard what your father did. Did your mother have an occupation, too?

Killian: Raising eight kids was an occupation for quite awhile. Later, when we were finally out of the house, she took languages for awhile.

Fraley: Oh, great. And what was your first exposure to computers?

Killian: In college, Harvey Mudd. In freshman first semester they had a basic course. And that was the first time I had my hands anywhere near a computer.

Fraley: What computer was that?

Killian: That was the IBM 1620 that they had.

Fraley: Okay. And why did you choose Harvey Mudd?

Killian: Because it was small, a science school and I was going to go somewhere where I could study physics and it was small and I was a little bit scared of places like Berkley and MIT. So it looked good to me.

Fraley: Okay, great. And so you were studying physics, then, at Harvey Mudd?

Killian: That's right.

Fraley: And then what did you do after Harvey Mudd?

Killian: I went to grad school at University of Nevada, Reno where I guess I spent about five years there in atmospheric physics.

Fraley: And why did you choose University of Nevada?

Killian: I chose that place because a previous HMC student who was a grad student there, came down and recruited me, basically. And I hadn't thought of atmospheric physics before but I love flying and the air. And I realized near the end of my stay at HMC, that I wasn't so specially interested in atomic physics which is what most of the other stuff was. So it seemed like a good deal and I think it was.

Fraley: Great. So what was the first computer program you ever wrote?

Killian: Well, I guess that basic program in that class, whatever it was. I don't remember, it was some simple—

Fraley: You don't even remember. Right.

Killian: — some simple program there.

Fraley: So scientific-type program, probably.

Killian: Yeah, it was classroom exercises in programming. I'm sure the first ones were very simple. But I found it enticing there. And then being a student and needing to find part-time work, I noticed that there was an opportunity to be an operator on that, as you well know, too. And that was just very interesting and I worked at that a little bit until I got accepted into that group to operate the computer for students.

Fraley: Great. Now you wound up not doing atmospheric physics so much as doing circuit design. So what was your first exposure to circuit design?

Killian: The first exposure to circuit design, well, I would have to break that down a little bit. I looked at electronics in grade school, got interested. My dad helped me buy a little science kit of the month and it had a big electronic portion. And I just took to that. [Vacuum]Tubes, at the time. A lot of people haven't seen tubes but I started on tubes. And continued my interest through high school. I got my ham radio operator's license in high school. Never did anything with it. I was interested in electronics, not talking. So I'd seen circuits, not logic circuits per se. I'd learned about logic and logic circuits in college, in HMC. Didn't really do anything with them. But [I] understood them and did stuff with circuits again but not logic circuits at grad school in Reno. And actually the first logic circuit I ever designed was for IMS Associates. I did debug logic circuits at University of Nevada. So I got some good experience there.

Fraley: So who would you say were the most important influences either in your college career or early professional life?

Killian: Well, you gave me that question before and I haven't thought about that a lot. But thinking a little bit, the names that come up, there was a physics teacher in high school that was just very encouraging. And that was particularly useful to someone like— army brat like me that gets moved around and, you know, new places all the time. And then the next is just my peers, you know, that computer operating group at HMC. That's really the major factors that come out to me.

Fraley: So after leaving grad school, what was sort of your early professional history then?

Killian: Programming initially. I left grad school and came down to the Bay area. I didn't have a particular idea about what I was going to do except, well, I've been using computers, you know, ever since freshman year, undergrad. And I figured, "Well, okay, I can get a job doing that." And I looked for awhile and through our classmate, Dennis Hallman, got introduced to Bill Millard of— who had IMS Associates, and talked with him every few weeks for about six months saying, "Well, you got any work yet?" And finally he did and I came down and did some— a little bit of programming. And then quite immediately he wanted some hardware help. And I hadn't thought of myself as a hardware engineer but I understood electronics, so why not? And we got into it.

Fraley: Okay. Now before we get deeply into what you were doing with IMS, what I sort of was thinking we could do is just sort of what you remember of where the computer industry was in 1974. What kinds of computers were around? Who had them and—

Killian: Well, in '74, I mean, the mainframes were around. All the campuses had a mainframe. Nevada had [XDS/SDS] Sigma 7 for awhile and they switched it for a CDC 6600. Pomona down there in Claremont had their 360— I don't remember what model. They might have been moving to a 370 or something about that time. So the mainframes were there. And the magazines were talking a lot about minicomputers. And there were a bunch of different brands. Digital, DEC, was one of the main brands. There's a lot of others; I'm not going to remember all their names. Data General comes to mind. A lot of them were 16-inch square boards. Integrated circuits were getting to where they could put a computer on a single board. And they were doing that and that was less expensive and I guess they were used a lot more in industry. I didn't see a lot of those except that I did see the DEC PDP-8 at the University of Nevada, in the lab. They had purchased a PDP-8 to use to process in real-time, I think, I'll have to go back and think about that. But anyway, to process radar data, radar data studying the atmosphere. And they had a PDP-8 and they needed to interface all sorts of things to it. And that's where I got my training debugging, was [by] helping our earlier classmate who was there as a grad student to develop that system.

Fraley: Okay. So shortly— as you started into 1975, you're going to get to the point where computers reach the ability of the normal— the standard person to be able to buy one themselves. What changes were taking place in the industry, would you say, that enabled that change to take place?

Killian: Well, it's what we know now, I guess, as Moore's Law. And things were getting more and more integrated. Putting more in the chips and Intel was playing a major part in the final leap to where things were really affordable. But it was happening elsewhere, too. You'd put more on a chip, you could get more computer on that single 16-inch square board, you know, more memory in a chip, more flip-flops in a chip. So that was really the main thing and before microcomputers, you know, one thing that pops up in my mind is I think it was called "Micro 11," the— DEC had a much smaller version of their PDP-11. It was almost a single board computer and as I recall it was much smaller than 16 [inches]. It was like eight inches square or something like that. And less expensive. So just because of increasing integration, costs were getting closer to where individuals could consider a computer.

Fraley: Okay. So now let's go back to IMS Associates. So you came in and you started doing some work for them. What was the nature of the work that you were doing?

Killian: Well, the first year— I joined them early '74. Them. "Them" being Bill. And that first year there was a mixture of some programming projects, some hardware projects. I remember doing test equipment measurement equipment for an Oakland-based transformer plant. But the most relevant piece of work was a contract he had with Philip Reed to develop an automobile accounting system built out of Wang

desktop calculators, programmable calculators. Multiples of those, interfaced into a single hard disk so it could share a database. And Wang had not thought of those as computers but they were programmable and, you know, once you got a branch, then you can program. And we did that. I did the hardware. That was the first hardware that I designed. And put that into service and it functioned fine and it was a later attempt— a contract to redesign that with more modern hardware that morphed into the IMSAI 8080.

Fraley: Okay. Great. So at this point, IMS Associates was just really two of you?

Killian: For the bulk of '74, yes. It was the two of us. Part of that summer we had hired Jessie Booth, a technician, to do a lot of wire wrapping and other technician things. He was very good. But mostly it was, then, the two or the three of us. There was another engineer involved right at the beginning. Bill had worked with another hardware engineer and he would have used him to design this interface except he wanted to be a podiatrist and was trying to get out of the field. So I worked with him as he sort of specified, "Well, here's how we could go about it," and talked about state machines and all that stuff. And then he was gone and I finished the implementation.

Fraley: Great. So now you're towards the end of 1974 and what happened in 1975 that sort of propelled you towards the IMSAI computer?

Killian: Well, late '74, maybe it was early '75, this Wang system we'd put together was functioning. It needed too much maintenance. It was like a 200-chip wire-wrap interface. And the Wangs were not cheap and the disk drive wasn't cheap. But it was functioning well. So Phil Reed came back and said, you know, "We'd like to make a contract with you to just redesign this using more modern, cheaper hardware." His intention was to sell it. He had an automobile dealership. The first one was being used in his own dealership. But he's a businessman. He wanted to get it so it was producible and make money selling it to other automobile dealerships. So we landed that contract about that time, early '75.

Fraley: Okay. And so then what was your approach to try to bring the price down?

Killian: Well, our approach, actually initially was to use the PDP Micro-11. And Bill hired a programmer for the effort, Bruce Vanetta, who was a key player early on in IMSAI. And the three of us went after putting this system together. And as you get into it, as happens so often in contracts, the work looks like it's more than you thought it was and the costs are mounting. And he had— Bill had price targets for the final hardware. And I don't have a recollection of exactly what they were and what went into them and what changed. But I do have a recollection that we were having trouble meeting the price targets. And even the Micro 11 computer was a pretty big chunk of the cost. So we were looking around for, "What can we do? Is there some way we can reduce the cost of that?" And early '75, of course, MITS had that article in *Popular Electronics* with the Altair. And we saw that and were looking at microprocessors in various different places including intelligent terminals, the Omron one in particular. They had one— 8008

in a terminal. And pretty quickly we figured out, that's plenty powerful enough to do the accounting that we're talking about. So we sort of homed in on using the microprocessors. And in the world as about that time we said, "Well, why don't we just use the MITS?" So Bill called them up and asked about quantity discounts because we wanted to produce this system. And how soon we could get some units. And he was told, "No quantity discounts and cash upfront. It's got to be 90 days before you can get any units," because they had a lot of orders. And that was at the point where we said, "Darn, guess we'll have to do it ourselves."

Fraley: Why don't you tell us just a little bit more about the article and the Altair and—

Killian: Well, sure. Intel had just put out this 8080 chip. And it was sort of— they'd been putting out a succession of chips starting with... they had contracts for doing custom chips for calculators for Japanese manufacturers, I'm not sure who. [Busicom—Ed.] And one of their engineers figured, "Well, we should make this programmable and start out with a 4004," and they're going down that path, making it more powerful, 4040. Then they did an eight-bit microcontroller. So there's a lot of the— all of the CPU functions were now in a single chip. And single chips weren't all that expensive. Ed Roberts, you know, who was a hobbyist engineer, was looking at these and talking with the *Popular Electronics* editors. And between them, they sort of got a bee in their bonnet to put a computer kit together. And it was a cooperative effort between the magazine and Ed Roberts. And he worked on it awhile, put it together. And they did an article on it and I don't think anybody realized what the interest was going to be. And I know there were people at the magazine that were saying, "Oh, no. We shouldn't do that article." But once it showed up, there was just a flood of interest and Ed Roberts got a flood of orders that he was not prepared for.

Fraley: Right. Okay, so then you decided to do it yourself. So what was that going to involve? What was your initial thought _____ how you go about this?

Killian: Well, the initial thought was that we— that I needed to build a machine. It was going to take several boards. I needed to debug these boards as we did them. We wanted to do a machine that was physically going to be commercially viable, you know, a good, solid machine. But debugging a whole computer was not something I'd ever done before. And I thought, "Well, this is going to be a lot easier if I can debug it a piece at a time." And here this platform existed. Not only that but our technician friend Jessie Booth had bought one of the early MITS kits and built it and had it. And he was willing to loan it for us so I could use it as a debug platform. And the only constraint that put on us is that, well, I had to use the same bus so I could plug the boards into that system and debug it one board at a time. And that's what we did.

Fraley: Now when you speak of these boards, did these boards have distinct functions of some sort? If you could sort of describe what you thought you needed to do.

Killian: Well, yes they did. And there weren't very many at the very beginning. There was a board with a processor chip on it and clocks and minimum logic just to keep that alive. And another board with some static RAM on it and then a front panel with some little, you know, switches for I.O. and that's about all there was on that early time.

Fraley: Okay, so then what did you think the effort would be at that point in order to create this computer?

Killian: Well, we looked at it as a four-to-six-month development project, running sort of lean as we always had in the consulting company mode. And, you know, in retrospect, that is probably about the time we spent just on the actual design of the machine itself, that— beginnings of the machine, those first few boards.

Fraley: And you say that's what you spent on that part. What else was there to be done?

Killian: Well, if we were going to sell it in an automobile dealership system, we just had to provide the programming and the peripherals. But as it morphed into realizing that we should sell it on the microcomputer market itself, now we had the need to document it for customers who were going to use it. And, in fact, at the time these were sold as kits and this was sold as a kit. We had to document to the customer how to put the kit together. Plus once we got started at all, there was a lot of demand for additional pieces, peripherals, software. And then other things that come along with— business with customers, customer service and manufacturing on a bigger scale than just building a couple machines.

Fraley: Okay. And did you have a target price in mind for the machines?

Killian: Oh, that's easy. The January article with the Altair had \$439 for the kit. So we had to match that. And it seemed like it was going to be difficult as we started to get in to it and look at the cost of parts. But we had one thing going for us which was '75 was a recession in the electronics industry and the parts vendors were very hungry. We had many parts vendors come along that would make us good deals. And we met that price okay.

Fraley: Great. And— but in order to build this, it takes up-front engineering and lots of it and so on. And so how was that all funded?

Killian: Well, that was funded basically by Phil Reed or Phil Reed and his dad. The people with whom we had the contract to build the accounting system. And what happened is we're— as I'm developing this, working on the accounting system and, you know, we're looking at *Popular Electronics* and we see all this flurry of activity. I went to Bill and said, "Bill, look. Why don't we put an ad in the *Popular*

Electronics and maybe we can sell 50 of these units a month on the side?" And he was very reluctant but I, you know, we persuaded him to do that and we put the ad in. And a couple weeks later, we started getting mail, orders with checks. And that increased and that was very impressive to Bill who had been struggling with a small consulting firm for a year. I mean, the '74 year actually had been very lean. So what he did was he went to Phil Reed, showed him what's happening here? What was going on? And didn't—I don't think he had much trouble talking Phil Reed into abandoning the thought of selling automobile accounting systems and simply going into manufacturing our microcomputer and selling it to this obviously burgeoning market.

Fraley: Great. Okay, so now you've got the idea for the machine. You're starting to get some reactions and some— people have interest. You're also realizing, well, okay, so what month was that ad put in, would you say? What point of time have we reached?

Killian: That should be researchable but my guess is it was, like, May, June of '75, something like that.

Fraley: Okay. So now you're realizing probably that you need a few more people than just three of you. So what was happening with the company itself in terms of—

Killian: Well, as we started to do that and he needed somebody to even answer the phone as we started to get calls. And, yes, he started to hire a couple other people. Hired Bruce's wife and a friend of hers that came in and while she was waiting to be interviewed, the phone rang so she just picked it up and handled it. So she was hired. And there—I don't remember how many people. There weren't a lot. There were, like, maybe four or five others that were brought on to handle the communication with the customer, chasing— getting parts. Actually Bruce went out and did a lot of that initially. And then a little later Dennis Hallman, another classmate of ours, joined us and took over that function. And Bruce's wife, Marva Vanetta, sort of ran the customer relations, the customer service area, plus worked on the documentation, transcribing the documentation. The source of the documentation was— he only— had the machine pretty much going and realized we're behind on that. They shut me in the office. Put a sign on the door that said, "Don't anybody disturb him." Gave me a tape recorder and I talked for three or four days and Marva transcribed it and that was our manual.

Fraley: Okay. Great. So as we get on into the summer and maybe the fall, you're hoping to get this machine out. Tell me just a little about sort of the work environment. I mean, what was the mood going on there and how were people interacting and were you working days and nights and so on?

Killian: We were working long hours for sure. Bruce had a sleeping bag in the office. And it was— yeah, it was an excited atmosphere because, you know, because the orders were coming in. You know, obviously we had something here if we could handle it. And it was a lot of hard work to get those manuals all together, get the design finished up and, you know, tested and actually running. And get

those parts coming in and not only just ordering the parts but, hey, when you get them here, you gotta put them on shelves in an organized fashion so you can find them. And then you gotta pull the kits, you know, get the collection of parts that you need to send out for each machine. And there was an awful lot to do there. And it was like six, eight people. I don't remember exactly. All of them working very, very long hours to do this.

Fraley: And did you have to move to a new office or anything to have space for this? Because I would imagine your original office was too small.

Killian: Well, we did. We did. And the timing— I don't remember whether we moved just before or just after we convinced Phil Reed to join forces and sell this. But it was about that time. And we moved from an office suite— two-room office suite in a bank building to a small garage-door-type industrial building with a couple offices in it.

Fraley: Where were these located?

Killian: San Leandro, California.

Fraley: Okay. So in terms of now you're trying to create your final product and get it shipped. So just go through the sequence, then, of when you thought you could ship versus when it actually shipped and what it took to finally get it going.

Killian: Well, I think when we put the ad in, we thought, "Hey, we'll get this done in a few months and promise delivery in, I don't know, July," something like that. And then as we're getting swamped by this work and wading through it, realized we're going to miss that. We sent out letters to all the people who had sent in checks with orders and explaining that, "Well, it's taking us longer and we'll send you your money back if you want. But otherwise we'll just hold on to your order and we'll get there and keep you advised when we can deliver." And I'm sure we promised a date that was another month out. And that happened two or three times. The last time the date we mentioned was December and that was still very hard to meet. But we really didn't want to miss the Christmas season. So we, you know, did what we had to and I read somewhere that we shipped those kits out lacking a few parts. And I don't remember that but I can easily believe it. You know, I would say, "Okay, we're short these parts but we'll get these to you shortly," or something like that. So we shipped them in December.

Fraley: So you recognized that the parts were missing?

Killian: Oh, yeah.

Fraley: It wasn't the people writing back to you.

Killian: Yeah. No, I don't recall that we had any issues of not knowing that we'd missed a part.

Fraley: So once the people got their kits, did you get any feedback from them as to how they liked them and so on?

Killian: Well, I'm sure we did and I was so busy doing other follow-on things, I wasn't directly involved with that. But certainly it was well received. That was clear. And we were getting more and more orders and we were seeing reviews of the machines in some of the magazines. And there was a new magazine starting up just for microcomputers called *Byte*. So it was clear that a lot was happening in the field. It was clear that our machine was well liked and— yeah.

Fraley: Okay. We've been talking about this machine, the IMSAI 8080 that your company was producing. Why don't we take a moment to just look at what that machine was like?

Killian: All right. Well, we've got one over here. And in deference to the museum, I'm going to put on a pair of gloves here before I touch it. But here's the machine with the front panel that's got the switches that many people believe I copied from the PDP-8. And I didn't consciously do that. But it does look a lot like a PDP-8. So we have 16 bits to put in a binary 16-bit word. And then a few control switches on-off, reset, step, examine. It's been many years since I've looked at those but just a few basic functional switches. And initially when you first bought the kit, I believe it only had this front panel, the processor board inside and power supplies, and if you were going to do anything at all with it, you would key the program in using just these switches. C3 is a jump, I still remember.

Fraley: Now you said "16-bit," but aren't they 8 bits?

Killian: Well, yeah. There's 8 bits and 8 bits. And it was an 8-bit machine. You're going to ask me to remember about the details, the functions of the panel, and I'm not sure I'd remember all of that without digging into it a little bit. But definitely the 8080 was an 8-bit machine and it would take a series of 8-bit words, instructions, data, whatever that you could insert into memory using these switches. And then you can, you know, one of these is single step or run and you can turn it loose and let it run your code.

Fraley: Okay. So it was a rather lengthy process to enter more than just the very basic program into this machine _____?

Killian: Oh, initially, yes indeed. But initially, you remember, we're selling this to hobbyists. And this is where the field was at the time. And it was a computer, you know. Hobbyists had never had anything that could store a program and execute it before. So this was quite a big step even with just the switches. It wasn't long, of course, before demand for more I/O capability was there. And we initially would—we did a serial interface and talked to Teletypes which were an existing technology out there for I/O. And terminals, there were beginning to be some terminals available. We tried a paper-tape reader, just a separate paper-tape reader. And a cassette I/O where we'd encode the bits and write it on a standard audio cassette player and play them back. And the various interfaces had various degrees of success. The standard ones, the Teletype was, you know, very reliable and the CRT terminals were very reliable. And it wasn't too many months before the market sort of just gave up on the cassette I/O schemes and other things that weren't quite so standard.

Fraley: Okay. Before we go into all of those details, why don't we just take one more look at the machine itself? Because it's a kit, people would not just be seeing the outside of this box. They'd see the inside of the box. So why don't you show us a little bit about what's inside?

Killian: They would get very familiar with the inside. So, yeah, the initial thing was a kit and probably something like a week if you actually spent most of your evenings at it, you could build it. Let me just lift this cover off and the kit included the cabinet, of course. And a motherboard that's down in here and cards that plug in the motherboard. And the front panel itself plugs into the front of the motherboard.

Fraley: Now when you say a "motherboard," when I think of a motherboard on PCs today, it's got quite a lot of stuff on it. What is the motherboard on this computer?

Killian: Well, in this day and age, the motherboard had connectors for the cards and that's it. Now as time went on, yes, more and more stuff got put on the motherboard and you still plug other cards in. But you don't need to plug a card in for the processor and and stuff because it's on the main board. But in this case, we have separate cards for that. The front card would be the processor card and in this particular chassis, we've got a RAM card and a video display card and a serial I/O card. Which would be fairly standard for a system, not in the spring of—I mean, not in the— January of '76 but halfway through '76 this would become pretty standard.

Fraley: Okay. So are you able to— okay, so we'll take another time to look in detail at those cards. But at least you can see the general structure of what the cards looked like. And how they were placed into the machine.

Killian: Well, let me just add in there, because I know somewhere on the list of questions, is, "What's the difference between this and an Altair?" And speaking of the physical difference and this is where you see it, where the Altair was not in a custom cabinet. It was put into an Optima cabinet, I believe, a standard

electronics cabinet you can buy. And in order to fit it there, he had the boards oriented to 90 degrees from this. And he had a little power— commercial power supply put in the corner. And connecting to his front panel he had a bundle of a hundred wires and it all worked. And what we did here, we considered an individual cabinet. And, in fact, Bill and others sort of leaned on me hard to use a standard cabinet because they thought, “Well, designing a cabinet. That’s a big piece of work, too.” But having done a little bit of that earlier, I knew you make compromises if you use a standard cabinet. And we didn’t have to make those compromises if we built our own. And I persuaded him, “Let’s build our own.” And by doing that, we were able to orient the cards so that the motherboard went right up to the front panel and the front panel plugged in and there was no harness with a hundred wires you had to solder and debug. So that was one of the major differences. And another major difference was the very large power supply. The MITS had a smaller commercial supply put in there that worked fine for a couple of boards. But as you start adding boards into these systems, they take a lot of current and you quickly run out of power. But in our box, I don’t remember how many amperes, 30 amperes at five volts or something, pretty substantial, was very well liked because people could plug boards in here and they wouldn’t run out of power. So those changes, which we advertised to say, “Well, this is more of a commercially viable machine,” and I think that’s probably accurate. Those things made the machine much more usable. And that was a major part of the value in the IMSAI as opposed to the Altair, going into ‘76.

Fraley: Okay. So we’ve sort of talked a little about what the machine looks like itself and a little about the competition now. So when you— okay, and when you first shipped the machine and so on. Now you were initially advertising it and shipping out all the machines yourself, at some point you made them available through retail outlets.

Killian: Well, yes we did. Initially we’re selling them through ads in *Popular Electronics* and *Byte*, when *Byte* came out and some other magazines, directly to the hobbyists. And some time early in ‘76, there started to be stores. One of the first ones [was] on University Avenue in Berkley and there were some other early ones. And they would talk to the company and say, “You know, where’s my discount? How can I make any money if I can’t get any discount?” And we weren’t making enough money to give them a discount. So the solution was to raise the price. And we raised it a couple times: \$439 to \$499, some time early in ‘76. And then some time a little later to \$599. And this is all for the basic kit. If you were buying more boards or stuff, of course, there was a greater cost. So that, you know, that was specifically to allow us to have the stores in the middle. And it was— the stores were starting to pop up. So that was becoming a bigger and bigger portion of our shipments, was to the stores.

Fraley: Okay. So as the price went up, the customers were still getting basically the same thing. And then they would then add on things like the serial board and so on.

Killian: Right.

Fraley: And do you remember roughly what some of those boards might cost, obviously, it would be a range but—

Killian: Well, we had price sheets. In fact, I remember putting the price sheets together with press-on Letraset and stuff like that. But do I remember the numbers? Only vaguely. We're talking about eighty, hundred, a hundred and twent [dollars]— that ballpark for a kit for a board.

Fraley: Great. Now also I saw in one of the fact sheets you gave me that there was a layoff in '76. So what led to that?

Killian: Very early '76. And I do remember it. I don't remember a whole lot of what was happening there. But in the beginning, we were funding it from the same funds that Phil Reed had originally dedicated to our fixed-price contract. And as we were adding people and doing all the work we had to do get this out, we were going through those funds very rapidly. And I think basically, you know, January '76 we were basically through those. And Bill didn't have other funds at the moment. He was looking for funding. And eventually he got funding with a quarter-million dollar convertible debenture from Phil Reed and his dad. But probably this layoff was just before that. Before they knew they had the money in hand.

Fraley: Okay. Well, just to close one line of the story here, so what happened to the automobile contract?

Killian: Oh, that was converted. Basically, Phil traded participation in selling into this market as, you know, part owner of this venture for not getting the, you know, the originally contracted system.

Fraley: Okay. So you didn't really go back and finish that contract.

Killian: No. No, we never do go back and finish it. I think originally, you know, we thought, "Yeah, we'll sell a few on the side and we'll finish that system." But as we saw, as Phil saw the market heating up as much as it did, he quickly realized that any dollars to be made would be in that market as opposed to his accounting system.

Fraley: Now the kits that you were selling were fine for the hobbyists but I would imagine there's some people who didn't want to take the week to construct the kit or didn't have the skills to do it.

Killian: Yes, well, especially as stores came on line and here's this computer in the store window and people would walk in and say, "Hey, can I buy one?" And then they found out they have to build it. We started getting requests for assembled ones. And I don't remember when it was but at some point, we

hired a couple assemblers with soldering irons and sat them down at the table with our kits and they put them together. Initially, that was just a few machines. But it rapidly grew and at some point it may have even been as early as still in '76, we actually ceased selling kits. So the assembled units grew in percentage fairly rapidly.

Fraley: Okay, so you also, as part of having done this release, got a visit by a couple of people named Steve.

Killian: Well, indeed. And I remember the afternoon well. Bruce and I were working on something in early '76 and these two guys walk up to the front door, you know, no appointment or anything. And asked to talk to someone and Bill, I don't know if he wasn't there or he didn't want to. But he said, "Well, go talk to Joe and Bruce." And we were sort of, you know, chief hardware guy and chief software guy. So they didn't look like pictures you'd see more recently, you know. Longer than shoulder-length hair and looked like hippies and they had this little wire-wrapped machine in a metal Halliburton case. And it was just a all— keyboard, all-in-one computer and they were looking for help to manufacturer it. And we talked about it for, they were very enthusiastic, for a few hours. And we ended up saying, you know, "Sorry, we got our own tiger by the tail," I remember that phrase and, you know, sent them on their way. And I've always thought very fortunately for them, because they were able to find some very good backing and obviously have done well. But that was interesting to have met them at that stage.

Fraley: So just to clarify for anyone who didn't catch the context, that was Steve Jobs and—

Killian: Oh, Steve Jobs and Steve Wozniak, yes, indeed.

Fraley: And at this point they had basically the idea for a company or—

Killian: Well, they had an idea for a product. And they had a wire-wrapped Apple 1 in their hands, neatly packaged up in one of these, you know, round-cornered metal suitcases. And, you know, so they had one built and operating and they thought there was a market and they were looking for someone to help them finance and manufacture it. IMSAI would be an obvious company to come to, you know, early '76 for that. And so they showed up at the door to see what they could find.

Fraley: Okay. But you couldn't help them. Okay, so at this point you had put a lot of effort into getting the IMSAI shipped out and by Christmas, what was your next focus of attention at that point?

Killian: Well, we needed more pieces. And I'm sure some of the very early ones were like the serial interface. We could hook a Teletype up in a parallel interface, too. And a floppy-disk controller. It was plain we needed some disk storage of some sort. Floppies were rather new at the time for a hobbyist

market. And so we built a floppy-disk controller. Actually we contracted out the design of that to a Peter Olson who went on— well, he founded another significant company down here and I'll think of that when it's too late. But we got that floppy-disk controller designed. It had an embedded 8080 in it itself. So that was perhaps an early example of an embedded controller.

Fraley: Okay. And so when you then put this controller out, what were people's reactions?

Killian: Oh, very favorable in terms of marketing reactions. They wanted that storage and a bunch of them were sold. There were some technical issues with that early-on controller. And not even just the point of the controller. Being an embedded processor controller, you've got a second master on the bus which we won't get into details about but that raised complications that were not particularly in Robert's head when he laid this out initially. So there were issues that— it basically worked but, you know, if you miss a bit every now and then it's very significant in computers. So we had a problem to solve there. And one of our early customers, just to get into that a little further, was Glen Ewing on the faculty at Naval Post Graduate School in Monterey. He had bought one of our early machines and built it. He bought one of our early floppies and built it and put it together and was running it and see the— well, he saw this problem and came back and complained. And he's an engineer himself, hardware engineer. So we talked about it and along the way, as we get into it a little bit, I don't remember if we asked him or if he offered, but basically it came down to well, he could fix it. So we contracted with him to fix it. And he did the engineering. He was still in the Navy down there. I remember flying down there in a little plane a few times with a scope in the backseat to, you know, work with him. And he did a good job of analyzing the issues and coming up with fixes to the design which we implemented. And then we had a floppy controller that worked which was a big plus. We hired Glen when he left the Navy some number of months after that.

Fraley: Hired him to do?

Killian: As an engineer in IMSAI.

Fraley: Okay. So then you'd released a new disk controller and that didn't have the problems. Now at some point you had not just a controller but you sold the product that was dual disks. Was that at this point in time or was that later?

Killian: Well, yes, and that was actually the same time. When we did the controller, well, you have to have something for it to control. So we used— the initial things were Calcomp disks. We got two floppy disks and mounted them in a case about the same size as the IMSAI.

Fraley: That's something. Okay, so now we have a floppy here so that we can actually look at it.

Killian: Yeah, it's a floppy-disk unit. So there's two eight-inch floppies, Calcomp floppies, with a power supply and that's all this is here. And then the floppy-disk controller would go in the computer and would have a flat cable coming across to talk to it. So that really turned it into a computer with a terminal of some sort whether it's Teletype or— about the time we had this we were much more using the video terminals, keyboard and screen. And that really began to be a real computer.

Fraley: So when was this floppy disk available, would you say?

Killian: Well, the very first one was very early '76 because we realized from the beginning that we needed storage like this. And I don't believe we had it with the initial kit shipment at all. But it wouldn't have been more than a month or two or three afterwards that this was on the street.

Fraley: Okay.

Killian: And then a few months later for Glen to help us fix it and have a working one on the street.

Fraley: Right. It's nice to have it work, too. Okay. Now you mentioned that you're having disk errors and so on, were there other kinds of testing issues and what was happening with testing in general?

Killian: Well, there was no end of testing issues, actually. And, you know, initially when you have just a kit and you're keying in a couple bytes, there's not a lot that's got to go right for it to work. But now and later and we'll talk about software separately, perhaps, but as you start to get significant programs and you're using a lot more of the memory, the occasional bit error starts to wreak havoc. And pat— once we got past the disk errors and we could reliably read in and out from the floppy disks, we had a programmer working on trying to get us an operating system. And he basically pretty quickly said, "I can't work with this. There's too many errors in the machine." So what he wrote instead, initially, was a RAM test program that he saved on a floppy and we'd put that floppy in all— every new machine for quite awhile. And what that program would do was just start up and test the RAM, a— very straightforward but that was quite something for the machines, the hobbyist machines, in the time. And that enabled us to find out where we had the problems in the memory and go fix them and then we were bootstrapping ourselves to where we had reliable I/O and reliable memory.

Fraley: Okay, great. Well, you mentioned software. So let's start talking about software.

Killian: Okay.

END TAPE 1

START TAPE 2

Fraley: We've sort of hit on the idea that you needed some software, so why don't you tell us about how IMSAI started getting involved with software?

Killian: Well, indeed. And again, we realized very early that we needed software. We had none as we put the initial kit out, absolutely none. But very early in '76, we hired programmer Rob Barnaby, and we hired him for the specific purpose of writing us an operating system to run in here. One of his first efforts, as I described a moment ago, was realizing hey, this machine isn't reliable enough and [so he] wrote us a memory test program. The next thing is he needs an editor, because he doesn't have anything to edit with. He's taking an editor. I think we're going to get a little mixed here, because this gets involved with CP/M at the same time and I'm trying to remember the time sequence.

Fraley: Before we get into CP/M and so on, let's go back to where you said you wanted him to write an operating system. What would an operating system in those days be? What kinds of functions would you want his operating system to do for you?

Killian: It was a short list in those days; be able to read a program off of a floppy and start to execute it, or to allow a program to write data to a floppy and, perhaps, do a directory to see; what files do you have on that floppy and change directory. We may have just about reached the end of the list. <laugh>

Fraley: You then were talking to some other people about software, too. There's something about BASIC.

Killian: Well, indeed. MITS had acquired the use of BASIC from one Bill Gates. We're sitting here without software. We want to get some software, and that looked like it would potentially be available. I think it was still Bill at that time, had to have been, contacted Bill Gates and arranged to license BASIC from him. That was, again, very early in '76. I can distinctly remember after they made that agreement, Bill Gates and Paul Allen are standing there in a room in the back and we've got one of our machines going. We had connected it to a modem and they dialed up their PDP-10 at the other end and were downloading BASIC. I remember his comment. I remember him saying, "It's good to know you got the power of a PDP-10 on the other end." Now here we're moving about 110 baud, a long program, and I remember Bruce and me looking at each other and we're thinking if you compiled it in the 8080, this is a capable machine; it would take less time than downloading it from a PDP-10. That's a scene that sticks in my memory. But we did license the BASIC. That was probably the first software that we actually offered for sale with the machines. I don't remember the price. I do remember that Bill considered us a hardware company and software was not good for anything except as necessary to make the hardware run, so you you've got to have it available.

Fraley: That was the viewpoint of the day.

Killian: Yes. Well Bill Gates, to his credit, knew better than that. To continue the operating system story, Rob is being a little slow getting an operating system going and, perhaps understandably, because he's got these impediments that he's having to solve one at a time. While this is happening, our friend Glenn is sitting down here with a now operating disk interface and a computer, and he wants an operating system and we're being slow. Now there's another fellow at the Naval Postgraduate School faculty down there in Monterey named Gary Kildall who has done a little bit of software consulting. In fact, Intel had hired him a few months earlier to write a control program monitor to run on their little demo system for 8008 and now 8080. Control program monitor, you'll recognize the initials are CP/M. Glenn knew this and he would be talking with Gary, and he started twisting Gary's arm. He said, "Hey Gary, why can't we run this in this IMSAI?" "The I/O's all different, won't run." But Glenn persists and finally makes a deal with Gary. He says, "Okay Gary, if you split out the I/O, I'll write the BIOS, basic I/O's system," and Glenn named it then. "We'll split it out separately. I'll write that part, as long as you can make a division in the program there." And he got Gary to do that and Glenn put those two pieces together and was running Gary's CP/M on an IMSAI. Glenn let us know that, and it wasn't too much later than Bill was down there making arrangements with Gary Kildall to license CP/M.

Fraley: That license, did that ever really happen?

Killian: Oh, yeah. Oh yeah, that actually happened. I'm confident we're the first people that have licensed this from Gary. And because software is nothing but support for the hardware that you're really selling, Bill didn't put any constraints on Gary about selling it elsewhere, so Gary started advertising that. Now that the BIOS is separated out, anybody could write a BIOS for their machine, if it was 8080-based, and run this, so he started selling that separately under the company Digital Research that he formed and did quite well. I mean they're still around as Symantec now. So we had an operating system then, and sort of simultaneous with this, Rob Barnaby, needing better tools to write software with— because he didn't have any other input devices, other than the systems that we're building— needed a better editor. He took a line editor out of CP/M that was meant for a Teletype, where you could tell it which line number you wanted to edit, and space after the character and change your characters. It was rather unwieldy. He changed it into a video editor. Now that we had video terminals and this had curser control, he could put the whole bunch of lines up on the screen at once, and let you move the curser around and insert wherever you wanted. So he modified that CP/M editor into what he called a video editor. That was very successful for him and everybody else in the company started using it, and shortly, we added it to what we're shipping customers with the CP/M, as part of the CP/M offering.

Fraley: Now I think you also mentioned another CBASIC commercial business.

Killian: Well yes. See we're paying royalties to Microsoft for this BASIC, and Bill's thinking it would be better if we had our own. And through Glenn and Gary, we met another Naval Postgraduate School

faculty member, Gordon Eubanks, who for his thesis had written a BASIC. So we contracted with him to augment that with features that would let us call it a commercial BASIC and make it run on the IMSAI. And we contracted with him to do that and he did that. And once again, since software was only support for the real product, which was hardware, we allowed Gordon full rights to sell it wherever else he wanted, which he did to great advantage. So for quite a while, the CBASIC was out there competing with Microsoft BASIC.

Fraley: And so then your customers had a choice.

Killian: Our customers had a choice. As time went on, Microsoft isn't sitting on their hands. They did Fortran next and we licensed that. And then shortly afterwards, they did a Cobol and we licensed that.

Fraley: So you had quite an array of languages then.

Killian: Yeah. Yeah, we did, and assembler and linker, also from Microsoft. Actually, they were both. Digital Research had an assembler and linker, also.

Fraley: So now we've talked about changes that took place to the company in order to be able to get your first shipment out. Now it's '76. You've had your little layoff. What started happening at that point to the company?

DAG SPICER

Killian: Well it's growing. I mean sales are just going up every month. We're adding employees, not infrequently, as we need to get more people to get all of these products through and out the door. We also moved from that little garage top shop type commercial building into actually the old Singer building. It was quite a bit bigger. It was a pair of buildings, 33,000 square feet, I think, something like that, maybe each, that included both a bunch of good manufacturing space and a bunch of good office space. So we had room to expand the people and we filled those buildings up, actually.

Fraley: That's quite a lot of people then.

Killian: Several hundred. I don't remember exactly, 250 maybe, something of that order.

Fraley: Now the Singer building, what had they done in that building?

Killian: Singer had made a computer, actually, and I think in those buildings. I don't remember their business situation, but things weren't going so well for them and they had vacated the buildings, and they were available for lease and Bill got them.

Fraley: You were, in addition to the kinds of expansion that we're hearing about, creating another product, the 8048. Tell us a little bit about that.

Killian: Well we were watching—I think you can see the picture of it over there—we were watching what Intel was doing, what Intel was coming out with, and one of the things they were coming out with was more integration, a complete microcontroller in one chip, a single chip, which was the Intel 8048. We took that chip and put it on a board with a keyboard, a little display, a few I/O lines. So basically, everything you needed for a computer was on a single board with minimal I/O, but there was some I/O, and put that out there as a product.

Fraley: While you were working on the various things we have been talking about, you came out with another product, the 8048. Tell us a little about that.

Killian: Well we were watching Intel, of course, who makes the main ship we're using. They came out with another chip, a microcontroller which included basically the complete processor and peripherals needed for a computer on a single chip, the Intel 8048. We took that chip and we put it on a board and added a keyboard, a little bit of display, so we ended up with a single board system like this that included everything that you needed for a computer, including a little bit of I/O to control relays or something like that. This was a higher level of integration than the 8080. I mean the 8080 was a central processing unit, but had no I/O. It had a bus I/O, but it didn't have any serial I/O. It didn't have any parallel I/O, none of the peripherals. Those functions that are always needed were integrated into this single chip. Intel's purpose was control like a washing machine controller, everything you needed in a single chip to do a function. We tried to offer that in a form that people could use that and develop whatever they wanted to with that chip, using this like a development system. It wasn't a huge seller. I mean it had some market, and we were just trying to predict, okay, where is this market going and looked at what was available from Intel, and making it available to hobbyists and, more and more, the small business market was getting into computers at this point.

Fraley: So this was not a replacement for the 8080.

Killian: Oh, not at all. It was more limited in programmability—well in the instruction set breadth, and it only had a little bit of memory on it. So yes, it was more limited. I mean this would never be a business accounting system; it would be a washing machine controller; whereas, the 8080 was fully capable of what much larger computers were doing.

Fraley: We talked a little bit about peripherals being added to the 8080 and we talked a little about some of what those peripherals were. Could we just take a moment and go through that a little more in-depth? You had mentioned, for example, the video card and so on. What other peripherals were happening and how successful were those?

Killian: Well every computer needs attachments to its peripherals, and you need keyboard input, you need some sort of screen output, which rapidly converged on the video terminals. You need the disks. That was the floppy I/O, those parallel I/O. You need printers. You need to put stuff on paper. The very first was the Teletype. I think the next was a CalComp daisy wheel printer with a parallel interface going to it. You need all these pieces in order to make a computer useful for “real work”. We were developing those pieces. Other people were developing pieces like that. I mean long before we had a video card, Cromemco came out with a little, very nice color video display card that would drive a TV monitor. People programmed the Game of Life on it and lots of other things. And as we went forward, we needed to add those capabilities in our product line, which we did.

Fraley: You mentioned that you had used the same bus structure as the Altair. Could you tell us a little about how this played into the whole peripherals business?

Killian: Well, indeed. I had mentioned that the reason why I did that was solely to make my debug job a little easier. And you recall that was before we had even thought about selling it directly to the hobbyist market. But pretty quickly, after we placed our ad and the market saw that here’s another machine that uses the same bus— because we said that, we said it uses the same bus as Altair, the boards would be interchangeable— and all of a sudden, anybody else that wanted to make a board, a peripheral board like Cromemco, a video interface, the obvious bus to make it connect to is this one that had at least two sources. So as the months went by, it wasn’t two sources. All of a sudden, there were many sources of products for the S-100 bus. It was called the ‘Altair bus’ for a long time. It was years later that somebody named it S-100. So just the fact that I, by chance, picked the same bus sort of was a trigger point in the market, and then everybody flocked to that bus. That was the primary bus for microcomputers until IBM came along.

Fraley: In fact, it became standard?

Killian: Yes, I believe S—100 was an IEEE standard. It was not a designed bus; it was almost a happenstance of the process that Ed Roberts was going through. There were many issues with the bus and there were some attempts to clean it up. In fact, when the IEEE got involved, they made some attempts to clean it up, but you can’t change the pins, so there were forever problems with that bus.

Fraley: You were creating some peripherals, but meanwhile, people could also start to buy those peripherals in a store. Is that correct?

Killian: Well yes, they could buy other S-100 cards to plug in and many people did. A large part of our sales was the chassis power supply front panel and processor board, and people would buy everything else from others. I mean there was a lot of competition for the pieces. There was very little competition for the chassis and the power supply, as it turns out. In fact, one of the few pieces of competition, we actually got one, took a look at it. I was amazed to find out it was an identical copy, down to the holes that I put in there for a purpose, but never got used. So that was a lot of the value, the fact that it was a good platform. There was a standard bus. Here's something that would house it for you and power it for you, and then that was your base building block and you could start building on it with boards increasingly available from many, many different vendors.

Fraley: Did you have some kinds of problems with your initial video controller?

Killian: Well our initial attempt at a video controller. About the same time the 8048 was coming out, Intel was doing some more integrated peripherals. And one of their chips was going to be a video display chip, everything in one chip that sits on a processor bus and runs a video display and sounded terrific. 8275, I'm pretty sure, is the number. We got some early chips from them and we built a board and put it on it. It didn't quite work right and we started talking with Intel about the problems we were having, and basically, we could get it to work mostly right, if you ran it at 6.4 to 6.5 volts, instead of five. Basically, they had problems with the chip. And of course, they fixed them. They could make another turn and fix them. That was quite an eye-opener to us and to me that while chips don't magically work, they've got the same issues anybody developing a circuit has. But we had time pressures. Other people were out there with video display boards already, and we didn't want to wait the number of months that Intel said it was going to take them to make some fixes and get us a new chip. Glenn Ewing again, that was one of his early tasks. He said down and said, "We don't have to have a single chip; we'll just design it with a flip-flop DIP chip, the smaller integrated things that were available. He did that and that was a tight board. There were 50 chips in that board. It was very tight for the time. It worked well and that was one of our better selling boards till the end of the company, actually.

Fraley: One other thing that seemed to be happening then is you had mentioned that there were computer stores being built.

Killian: Yes.

Fraley: That was a new booming business. Tell us about one particular one called ComputerLand.

Killian: Funny you should ask. As it turns out—I mean Bill sees this too—the market's taken off, and more and more, there are stores out there selling these things. A fellow comes along, talked to him, John—I'm afraid I'm going to forget his last name, starts with an "M"—but he's a marketing person. He's done some franchise putting together for other companies. He comes and talks to Bill and convinces Bill

that this is a franchise opportunity. So Bill takes a step to start a franchise, which he calls initially Computer Shack. As soon as that hits the street, Radio Shack complained and Bill changed the name to ComputerLand. But that was very successful, basically, as a franchise, and he set that up as a separate company from IMSAI. The company's purpose was to provide assistance to store owners and business owners to start a computer store and supply them. That was extremely successful, because the market was burgeoning and a lot of pressure and opportunity for people to start stores, and all over the nation, they were starting up.

Fraley: One of the people from IMSAI actually left and started his own store.

Killian: Well no, he actually left to run corporate ComputerLand. Very early on, as we're building staff to sell into this market, Bill had been impressed with a fellow named Ed Faber that worked for Amron. Amron made intelligent terminals, terminals with an 8080 in it that we initially considered. He went back and convinced Ed Faber to come on to IMSAI as head of sales, which he did, sales and marketing. Ed just did a fantastic job, really helped IMSAI get off the ground and get moving. And then when this franchise idea came up, Bill tapped him again and said, "I think I could use you better over here," and got Ed Faber to leave IMSAI and join ComputerLand as its first CEO. And basically, ComputerLand was built by Ed. I mean yeah, Bill owned it and kicked it off the ground, but from a zygote, Ed Faber took it and built the whole organization.

Fraley: Somewhere around now, let's just talk about the end of 1976, because I think we've touched on most of what was happening in '76. How was IMSAI doing in '76?

Killian: Pretty fantastically. Sales are going up very much. But there is a lot of other competition out there— and Apple among them— but a lot of S-100 machines, and a lot of them were more integrated. Processor Technology, if I remember the name right, had a keyboard built in with a single board computer— it was sort of like an Apple, but it was S-100— and other machines, and the stores were finding that some of the customers preferred these things that were not so much like the hi-fi component systems, but were more integrated, had more of the pieces together that they needed. To answer that, Bill found somebody in Europe that had designed a case to hold a tube and a keyboard, and made arrangements to license that case and came to us in engineering and said, "Hey, let's put our computer in here." Fantastic idea. Actually, it wasn't quite the right case, because it wasn't built with the room to hold it. It had a bunch of big mounting bosses that just made it difficult to fit our pieces in there. Nevertheless, we did that. It was the same boards. The very same boards that are in the other computer system got housed in this case, along with a 12-inch monitor, which was big enough. It was a standard monitor size and a big keyboard. You had everything for your computer, including a floppy disk, in one cabinet. There's what it looked like. We built that. We crammed the stuff in the case and got it to work in our lab. And we had some problems with it heating up a lot, because of the way we had to put things in there. I'll just show you a quick one of the colors. IBM blue was the color of the day for machines that we intended to look commercial. We got that together and I think that the sales were flattening off a little bit on our

other system, because of this competition, and Bill was very anxious to get this out there. And even though engineering said, "Hey, we've got more work to do," he said, "Well we've got to start shipping it." We handed it over to production and they started building these and shipping them to, largely, the ComputerLand stores. See at this point, ComputerLand is a very major portion of our business, 30-40 percent, something like that, so they had first line on a lot of things, including prices. These got on the ComputerLand shelves. They weren't cheap. I don't remember the price, \$5,000, \$7,000, something like that. And they just walked off the shelves. It was a fantastic marketing success. That was basically, I think, the end of '76 is when this started selling, and sales started picking up again very quickly.

Fraley: What was this model named?

Killian: This is the VDP80, video data processor 80, I guess.

Fraley: And at that point, your sales were still a little below?

Killian: Well if I had to guess, there were about 100,000. Sometime, I believe it was in '77, with the VDP80 being a part of the mix, the sales went past a million.

Fraley: Another machine that came out somewhere around that time, I think, is the PCS80. How was that different than the VDP80?

Killian: The VDP80 was an expensive machine, very expensive for the time. And our other ones, even assembled; I think the other ones were under a thousand. But they weren't integrated and the market looked like it was looking for integrated machines, so we made an attempt to provide some more integrated machines— there's probably some pictures here— that were really little different from the original, except that we pushed the card cage back a little, put a shorter one in and put a display in the front. This was a little high, so we could put a display and a disk. If we look at the other side of this, here's one with just a display. We built our own keyboard to go with these. So there was a series with slightly different configurations in each one that made an attempt to just provide a more integrated system. Also, I think just after the series, we tried to make a better configuration. These configurations had like a 5-inch screen which you could put any characters on, but you had to have good eyesight. And it was not really well received, so we tried to do another machine that was still less expensive than the VDP80, but a bigger screen and still a fully integrated machine. I think we've got one over here we could pull out.

Fraley: You were saying that you had made the new case.

Killian: Well in order to get the integrated functions and not cost as much as that big cast aluminum base and injection molded lid and stuff, over here we've got a sheet metal case. I wasn't going to touch it. Be careful for the museum. It's just got the screen, and the floppies, a keyboard, power interrupt, so you've got everything, and the boards, of course, and power supply, everything inside a single case. That was an attempt at a lower cost, fully integrated system. We named that VDP— well there was a series— this is VDP42. The series differed mostly by the floppies, whether there were one or two, whether they were single-sided, double-sided, like that.

Fraley: How successful were these?

Killian: I think they were medium successful. They weren't a walk-away success like the VDP80. I think a lot of the difference is this is still aimed at the hobbyist market. The hobbyist market is less concerned with a fully integrated system than the business user at this point. A lot of times, they were still mixing and matching, getting a chassis from us, usually, and then boards from all over in this putting together of their own mix of a system.

Fraley: How about the business market now? You said there is a business market, as well, by this point?

Killian: Oh more and more, there's a business market, absolutely. In fact, it was almost a bit surprising to us, but the IMSAI 8080, even before the VDP80, there would be places. I remember one customer in France where they bought an 8080 and a floppy disk controller, a system like that and they had 17 programmers working on programming on that machine. That seemed impressive to us at the time. And more and more stores, small businesses were wanting to use it for accounting for their business work.

Fraley: What types of applications? You mentioned accounting. Are you familiar with what other people may have been using these for?

Killian: There's a lot happening through this time with different functions coming up. I don't know if I've got the timeline quite right. Sometime in here VisiCalc came out and pretty much made the Apple II. That was a radical new application. It's so obvious to us all now how well that fits for the computer, but it was a new thought at the time. It wasn't too long before some competition came out for that. I don't remember when 1-2-3 came out, but at some point, we had spreadsheet. But even before that, people would program their own whatever they needed the computer to do. And obviously, that took a lot more work than you'd think of doing today, because you can get all these applications to do it. But at the time, there wasn't that much available. The computers were just available, and some people would be enough into it to actually program functions for themselves. Word processing was rapidly coming into it, too. That Video Editor was a great success. Electric Pencil was written and sold to this market, which was very similar editing, and that was a very popular program, also. And since we had interfaced the daisy wheel

printer, which was capable of proportional spacing and had different type fonts— of course, not at the push of a mouse button; you had to take the wheel off and put a different one on— but it would produce some good documents. And people were starting to use this for word processing, basically.

Fraley: At some point, though, Rob Barnaby got frustrated.

Killian: He got frustrated with Bill. Everybody in the company loved his Video Editor. He augmented it. He started putting some format controls in it; boldface, underline. I think even at that time, controlling the proportional spacing on a daisy wheel printer, copying a deck. I can't remember the name of it, but there was a program that ran on UNIX DECs, especially, that was to format thesis, originally. And he just copied a lot of those commands into his editor. And along the way, he went to Bill and said, "You know I think I should stop trying to write our own operating system," this task that he was hired for, "and concentrate on this editor. It seems to be a real winner." And Bill would not hear of it. He said, "No. No, we hired you to do this other thing." Most of us in the building knew that was happening, because we heard some yelling and some, "You asshole," and door slamming, and that was the end of Rob Barnaby at IMSAI. <laugh> Just for the touch of the follow on, it was some months later that Seymour Rubenstein, who was marketing director at IMSAI at the time, left IMSAI for whatever his own different reasons, but he thought there was a market there too, and he looked Rob up and talked Rob into coming in and saying, "Well let's take that and build on it." And he did. He built WordStar. And they went out and marketed it and it was the success that those guys realized it was going to be, and then started MicroPro Company with that product.

Fraley: You also mentioned there got to be a point where there were some quality problems with shipping your computers.

Killian: Well the VDP80, in particular, and I guess it was a couple— well, like everything in the real world, there's a bunch of different aspects of it. But it was a complex machine. We did have thermal problems with it. And it was walking off the shelves in the ComputerLands and operations was sort of hard-pressed to keep these things shipping out the door. It got to the point where in order to meet the assigned monthly goal in operations, if they had trouble getting enough running boards, well sometimes they'd ship them out without that board, saying well okay, we'll have it delivered. We've made our number and yet, the store will call us up and we'll have to replace the board then. That seemed to increase with time, so basically, a lot of the work that normally would happen in operations, it got shifted downstream to customer service. That was not good at all. Now on the engineering side, when we'd been told in late '76, well this is going to production, even if you don't think its ready, we complained a little bit, but then okay, what are we doing next. And what we were doing next is this PCS systems and the VDP40, all these other things that were on the table. And we didn't have the sense to insist that we go back and fix the VDP80 right away. The management didn't have the sense to insist that we fix it right away, so that ran for like a year with those problems. And a lot of machines went out there and worked, but there were a lot of problems, too. And as the problems mounted, it started to affect sales. So about a

year later—I think, I don't remember exactly, but it was like a year later, maybe a year and a few months later— finally, we put into the schedule re-designing the VDP80. The approach we took them was say well what was the problem? Well the problem was we had to fit it into this existing case, and it had these problems about it. So we got the constraint that we couldn't change the case removed. Basically, we just had a new base made without a bunch of stand-offs and stuff that got in our way before, so we had the complete volume free to play with, and then just built inside of that, used the same lid. So we did re-design it and that re-design was quite successful. It solved the thermal problems. It just arrived a little bit too late for the history of the company.

Fraley: You say it arrived too late. What was happening to the company at that point?

Killian: Well, with the problems in shipping, frankly, the sales started to go down. I mean they passed a million somewhere in the middle of '77, I think, and it was well above a million near the end of '77, but going into '78, and especially as these problems started showing up, and we have the costs of having customer service supply lots of boards that should have been there in the first place and fix other ones and stuff, shipping machines back and forth, the profits were going down. Our sales were going down. Our costs were going up. So it was just the normal squeeze there. And the receivables were extended out like normal things that happen in business.

Fraley: Were there also some issues relating to ComputerLand?

Killian: Like I say, ComputerLand was at least a third of our business. Maybe it was half. I don't remember. They had very favorable terms, receivables-wise, so when I say receivables were out, a very large part of that number was ComputerLand's. Not that they were being slow, just since it was the same owner of both companies, he just had it arranged for very favorable payment terms, as well as very favorable supply terms. ComputerLand was always the first on getting product, if there were issues.

Fraley: So there started then being financial issues?

Killian: Well sure, with that situation, it gets harder and harder to meet the cash flow. Somewhere in, I guess, early—I do not remember whether it was '78 or '79.

Fraley: '79, I believe.

Killian: Yeah, that must be it, right. So somewhat early, they filed Chapter 11, and then in the fall, they filed Chapter 10 and closed the doors.

Fraley: Other than the redesign of the machine, were there any other steps taken to try to keep that from happening, or after filing Chapter 11, to try to restore the company?

Killian: Not technically. I mean we had design things we were working on. We didn't shut down engineering beforehand. But I think the attempts were pretty much operations management. But you see, we still had the same people in there that were there as we got into that problem, and I don't think the situation was set up to do a good job of resolving it.

Fraley: As the company ended, how did the company fold? What were some of the things that took place?

Killian: We knew we were having financial difficulties and, of course, we knew we'd filed Chapter 11, but I think still, to at least me and I think a lot of the staff, it was a surprise when they decided to cease operations. It was not like there was a lot of stuff leading up to it. We were operating under Chapter 11 and still moving product, and then all of a sudden, we're told, "Okay, we're going to close shop."

Fraley: But then what happened with the resources of the company?

Killian: Well for the resources, I mean being in Chapter 11, you've got bankruptcy court involved already, and they arranged for auctioning off the assets. I remember that, too. It's the typical auction coming in and selling the furniture, and the scopes and stuff like that. And then it came to the customer service area, which was racks and racks of boards that had problems, the bone pile, if you will, or things waiting to get debugged, hundreds—no actually, I think it was probably thousands of boards, many, many boards there, shows you where some of the cash problems came from. And the auctioneer wasn't sure exactly what to do with all of this. He says, "Well we're going to sell this all as one lot." There was a lot of people at the auction, but there's not very many that thought they were going to buy thousands of boards. So that auction starts, and one of these surplus junk dealers is bidding. And one of the guys that used to be a tech there, in engineering for a while, and then also for a longer while in customer service, Todd Fischer, he was bidding. And the bid went back and forth a couple times, Todd tells me, and they realized they were the only two people bidding. And they looked at each other and nodded and stopped right there, and they got that full inventory for something like five grand and split it. And what Todd did, he and Nancy Freitas, who was another technician in customer service, who were partners then and married now, they took that half of the stock and they lived for a while on providing parts to all the IMSAI owners out there who no longer had a company to go to. That lasted for quite a while, and I'm sure that he got near the end of that and there was still some demand, that he actually made more production runs of some of the boards. Along the way, he did a little bit of research and realized the name IMSAI has never been trademarked, so he trademarked it and now that's IMSAI today. They've done a little bit of re-design on it. They're addressing the hobbyist market, clearly, because it's no longer a business machine. And pretty much, his activities have been with the original 8080, not the VDP80. I'm sure he's got some

VDP80 pieces, but the business that was there to be continued was related to the original IMSAI 8080 machine.

Fraley: What was the name of their company?

Killian: Fischer-Freitas Company.

Fraley: In a way, in addition to IMSAI, being in the company and selling machines and so on, you've also sort of spawned off a number of companies, or inspired groups to go into companies. Could you give us a quick review?

Killian: Indeed. The very direct one was the CP/M operating system where it was Glenn's pressuring Gary that created that in the first place, and that went on to be the major operating system, until Microsoft slipped in there and got the contract away for the IBM PC later, so that was a major thing. And Gordon Eubanks, CBASIC was quite a major product out there for a good while. We were a pretty major conduit for the software at the time, Microsoft's compilers and other people bought them too, of course. I think we were the second major sale of BASIC and a fairly major customer for a lot of those. The Video Editor that Rob wrote and should have been allowed to continue with, turned into WordStar, which was the leading word processor for quite some time out there. There's probably some other things, too.

Fraley: And some of the people went on. You had mentioned something about Symantec.

Killian: Well Gary Kildall and Gordon Eubanks got together, joined. I think maybe Gordon—I don't remember where the name came from. But anyway, they joined forces some number of years down the line, and they are currently Symantec and they sell the Norton tools and all that. The core of that was Gary and Gordon Eubanks that both got their start commercially through IMSAI paying them to do a little work for them.

Fraley: At the time that you closed your doors, do you recall anything that was happening in the industry as a whole? Put that in time as to what else was going on in the industry at that time.

Killian: Well the industry as a whole was going great guns. And Apple was coming up as a pretty significant player at the time with the Apple II, and that was being used in businesses, especially with the VisiCalc on it. It's hard to pull out specific names, but the market as a whole was not slowing up. It was forging ahead in spades.

Fraley: Any other experiences that you learned from this?

Killian: There's plenty to learn. Sure, I learned a number of things in that experience. I mean I got to watch a startup and the process of starting up and failing, and I got to— although I wasn't directly involved— I watched ComputerLand very closely as it started up. I saw— unfortunately, a little bit too late, I think, although I don't know if I could have done anything earlier anyway— but I saw the factors that seemed to come into play in IMSAI not doing well, largely in having concerns and values other than the product working, a customer coming first. You hear that a lot of places, but there's a lot of forces that are more interested in meeting their monthly number and getting their bonus or whatever, that get in the way of that. And if they're allowed to, as they were in IMSAI, then you end up going away. That was a pretty substantial lesson there. There's lots of littler lessons in managing technical staff. I was pretty wet behind the ears when I started, and still a little damp when I finished, but I learned a lot of things in the process that have served me since.

Fraley: Any specific ones that come to mind?

Killian: Well yeah, there's a couple. One quick one sort of reflects on the whole engineering of this new burgeoning field. I distinctly remember walking by a lab bench when we had a couple guys, one our own employee, one contractor, working on a new memory board. And they're looking at a scope and one of them is saying to the other, "But doesn't the data sheet say the timing is over here?" and the other guy said, "But that's just typical. I mean that's just worst case. Typical is over here." And I remember sort of shrinking back at hearing that and realizing I had something to address there, if we're going to have a working product. And the other one was early on, on a different project that we had thought of and announced very early, before we even shipped the 8080, was a distributed processing concept. We ended up calling it the IMSAI 108 and we actually sold one to NASA and built it out of IMSAI 8080s and a hard disk drive that we interfaced to a special interface that would share access from multiple processors into the single disk. And a bunch of the team was down there in Huntsville bringing it up, and every once in a while, it would glitch and they'd lose a record. I don't remember precisely. I was not there, but I got on the phone with the engineers that had designed the interface that had implemented the interface that I designed down there, and I'm talking with them and trying to figure out what's going on. And they get down deep enough; they can tell me where it goes wrong. And I say, "Why did it go to the state over here on the way?" And the engineer tells me, "Oh, I didn't see the reason for that state, so I left it out." That was a very big lesson to me, reviewing projects.

Fraley: One other idea that we didn't mention that came up was another form of distributed computing, which you call the Hypercube.

Killian: Yes. This is the same time. As we're first seeing this market in microcomputers really starting to burgeon, and we're starting to work on the 8080 and we thought of this distributing, the distributed computing system, the IMSAI 108, was really just a manifestation of the automobile dealership accounting system that we had done already. But we also realized hey, you know, this is cheap processing, not very much in each chip, but it's pretty cheap. So you've got to put a lot of chips together.

How do you do that? And we thought about that for a while and realized that if you need a bunch, you need some way of communicating through them. And you can't do anyone to anyone; that gets unwieldy, so you start putting them in an array. And some of these I/O chips come in groups of eight. I remember saying, "Well you know we could put it in a hypercube." I remember them even asking me, "What's that?" Bill said, so I explained it. But the hypercube has got eight connections along the nodes, and so we just put out a press release saying we can do this processor. We had a different size specified, and press release for hypercube and it got some attention out there. We never actually did anything, never landed any contracts, never built anything towards that machine, but the press release got enough attention. We learned that Intel had put a couple of guys on following that to see what happens. Of course, they did a lot more than we did, eventually. We put out that press release.

END TAPE 2

END OF INTERVIEW