

## Bill Terry Interview 6, January 4, 1996

KIRBY: This is Dave Kirby. I'm conducting my sixth interview with Bill Terry. Today's date is January 4, 1996 and we are in HP's offices at 1501 Page Mill Road, Palo Alto. When the tape ended last time, Bill, we were talking about the HP35 calculator and its descendants. My notes say that you were about to tell a story about the HP80, the financial calculator. Do you remember this?

TERRY: Yes, I sure do. The 35 had probably been out for about six months and we were experiencing just a heck of a lot more success than we had anticipated. Sales were just taking off wildly, even at \$395. So it looked like this idea of a pocket calculator did, indeed, have a future and we would keep the R&D team together. I think initially there was a feeling that perhaps it would not have a future and most of the R&D team was from HP labs and they would go back to HP labs but this was not the case, that this thing was really going to have a future and there were descendants of it or variations on it that you could do that would have an equally good market also. So, keep the R&D team together, start building an organization and start looking for other ideas in pocket calculators. Other ideas in pocket calculators of the first and most obvious thing was more scientific calculators. As we gained some experience with the 35, ideas started floating around about other scientific things you could do: more power, more memory, different scientific calculations. But at the same time, there was a kind of a feeling about other applications and other markets. The consumer market, with the simple four-function calculator, really didn't have very much appeal. It was a relatively simple machine and there were huge distribution problems that we knew very little about. But there was this other market called the business market, where there were certain calculations that business people wanted to do, particularly compound interest calculations, that looked like it might have some potential for such a product and was thought to be-without a lot of market research-just a huge market compared to the engineering market. You could count the number of engineers in the United States at the time versus the number of both business people, there was probably a difference of maybe 20, 50-to-one, for all I remember. The people that were thinking about this-including me-were all a bunch of engineers but we happened onto a person by the name of Bill Crowley, who was a very bright, young-I think he was a Harvard MBA-accounting person, finance person, that worked for Ed van Bronkhorst or in Ed van Bronkhorst's department and he was recruited without a lot of trouble-he was interested in this project-by the people in the engineering department. Tom Osborne was involved, as he had been involved in the HP35; Tom Whitney, who was the head of the engineering department; and Alex Sozonoff, various people in the organization recognized that Crowley knew a lot about the kinds of calculations that business people wanted to make. So it's hard to pin HP80 on any one person but Crowley was certainly a very, very influential person in terms of the application design of the product. What people wanted to do in it was similar in terms of mathematical content to the HP35, so we were able to fit all of the functions in on the keys and get it all into memory, and do things like that. In fact, we ended up with one extra function on the keys that we weren't quite sure what to do with and we didn't want to leave it blank, so we made a square root, and frankly it was just because we didn't know anything else to put on it! And people used to ask us, "Why do you have the square root key on a business calculator?" And we used to tell them that, "Well, maybe if you're in real estate and you have a 40,000 square foot lot, you could figure out what the dimensions of it were square on each side with the square root key." Frankly, that was just a story; we just stuck it in there because there wasn't any other function we could think of.

TERRY: The HP80 was another instant success. This idea of being able to do compound interest and bond calculations with just a few flicks of a button, where previously these people who were not mathematicians were forced to look up these answers, compound interest tables, in these huge books, they thought this was really wonderful. Now, the techniques we used to make these calculations were, again, algorithmically based. That means, that you actually don't look up the answer in the table stored in memory; you make a mathematical calculation with a formula in order to get the answer. And these algorithms all have certain characteristics and accuracies, and so we had some classical arguments with people about the way these calculations were made because, when you took them out to the ninth decimal

point, they did not necessarily agree the bond calculation tables they had in manuals.

TERRY: And so there was a little bit of controversy with some of these characters about, you know, what was the right answer. And of course, there wasn't any particularly right answer. It was which formula do you use, and it was kind of funny, or it's kind of interesting, I think, that it took 10 years for the bond tables to go away and today, the successor of the HP80 is called the HP12C, I believe. It is the standard. There are no more bond tables anymore and anybody who is interested in calculations of bonds will always see down at the bottom of a justification a little asterisk that says "Calculated on the HP12C."

TERRY: It has become the standard, that is, that formula and those answers that come out to nine or so decimal places, became the standard in the industry.

TERRY: But we had a lot of fun with the HP80 because it got us into new markets, stretched our distribution channels. I believe we started mail ordering, selling things by credit cards just about that time, also, because we had new markets to reach that we hadn't reached before. About the case: Since you put the case in your pocket we thought it should have a case, a classy case, soft black leather. One day I received a package and a letter from a customer. The calculator and case were badly mangled. His German Shepherd loved the leather and destroyed the HP35. I sent him a new one and we switched to a heavier plastic for the case.

KIRBY: I want to pursue the story of HP's calculator business but first, let's talk about HP's computer activities prior to your arriving on the data products scene in 1971. The first computer, which we've already discussed, was the 2116 introduced in late 1966. It was designed to work with instrumentation. Now, what followed the 2116? Were Magleby and Stoft still involved?

TERRY: Magleby was very much involved. He was the engineering manager and he ran the lab, so he was, you know, heavily involved. I don't remember Paul Stoft perhaps as involved at that time. Paul was in HP labs; he was a, I believe, a department head. He had other projects to work on beside this one. So he was indirectly involved through HP labs, but Kay was certainly the mover and shaker. And what followed was variations on the 2116 in smaller sizes. This was not unusual for HP to do, that is to offer a fairly broad line of products within a specific application area so customers had a choice. They could buy the small one or the medium one or the big one and it was good for HP because it gave us some efficiency in our engineering and if we were careful and we just didn't proliferate the catalog with a bunch of model numbers, it all worked out pretty well. So, the 2116 was followed by the 2115, which was about-pardon the expression-"half the size of the 2116." It had less memory; it had less IO slots on it. It was physically smaller and it cost less, and then the junior member was called the 2114, and it was even smaller and less limited application area. Also about that time, the Yokogawa organization got very interested in computers. This was Yokogawa-Hewlett Packard in Japan, and for better or for worse, they-with our cooperation-copied the 2114. They called it the "YoPac", Y-O-P-A-C-I guess that was "Yokogawa Pacific"- "YoPac 21" something or other (I forget the number). It looked just like the 2114-it was an exact copy-except the lights on the front panel were oval shaped instead of round. And we never did figure out whether the oval shaped had something to do with the shape of their eyes or just their tastes... .. but it was really a kind of a weird looking machine, although it was a copy of the 2114. I think they probably manufactured 10 or 15 of them, and that's as far as it went. They found out that it just wasn't quite as easy as perhaps they thought it was, particularly in terms of application and selling it and all the things it takes to make a computer system successful, but there was that one variation. The 2114 and 15 were only modest sellers, the 15 particularly. It seems like in these product lines, when we put one in the middle, the middle one never does sell pretty well. The less expensive one, the 2114, sold pretty well but the 2116 really was the kind of the flagship of it. Now that 72 annual report said the base of HP's computer family was the Model 2100A. Now, was that the next computer? That was the next turn of the machine in terms of the mini-computer. The 16 bit mini-computer. We had the family of the 14, 15 and 16. We were doing pretty well. They were all core memory-based machines. They had certain limitations in terms of size and memory. In physical size, they were pretty big. Got some ideas; again, I believe HP labs was involved. I don't remember specifically but there were some ideas kicking around about faster integrated circuits, making the machine basically cycle faster and going to a different kind of core memory. And this was called "folded core." In a way, it's hard to describe this without a

picture, but the what it allowed you to do was to get a lot more core memory in a given space. You actually laid the cores out-they were miniature cores-on printed circuit boards with flex circ in between it and then you folded the whole thing up like a sandwich and blew a lot of air through it, and you could get just a lot, lot more memory in a relatively small space. And that begat what was called the 2100, which became the 2100 family. And a computer 2100 with this folded core memory was begun in Cupertino. The memory itself, at the time, we had transferred the manufacture of core memories, standard core memory, to HP Singapore. In fact, it was one of the first things that was done in HP Singapore. This is before Penang. And they were making standard core and they were the contributors to the folded core memory, and they did quite a good job at it. They had some help from Cupertino and perhaps HP labs, I don't remember, but they made this folded core memory. And the 2100 project design was going on in Cupertino. The engineering manager at the time was Tracy Storer, and Tom Perkins was the division manager of what we called the data systems division, as I recall, and that's where the 2100 design started.

KIRBY: Okay. I do remember-I had forgotten this-out in Singapore, there was a procedure called "stringing core memories", wasn't there?

TERRY: Yes. And it was a very tedious sort of a thing.

KIRBY: Oh, it sure was.

TERRY: And I used to hear that American workers didn't want to do that because it was so tedious but out in Singapore, they did a good job. That's probably right. They did a good job on it. Yes, it was tedious. It was difficult work. A lot of it was done under microscopes. The little core, the donuts, are brittle, so they break easily.

TERRY: So it's not only hard to string them, get the wires through them, but you've got to be careful when you do it and the people there were trying to make their mark in the world and they were interested in doing it and they had the patience. People used to comment about, "Well, they do a good job on it because Oriental women have small fingers." I don't know that that's really true or not. I don't think they have smaller fingers than American women but they took that on as an initial assignment and did a good job on it.

KIRBY: Okay. Now, let's go back to '71 and your meeting with Bill Hewlett. That's when he proposed you return to the Bay Area and head up HP's data products activities, is that right?

TERRY: That's right.

KIRBY: Okay. By then, was data products an established group on the organization chart or did that come later?

TERRY: No, as I recall, it was established. The name was in place; they had a group manager and the group consisted of the data systems division in Cupertino, the desktop calculator division in Loveland, Colorado and the Mountain View division in Mountain View, California and I think that's all there was to it at the time, but it was a group with three divisions in it. Now, about how many people did all that include, do you have any idea?

TERRY: Oh, I'd have to guess, Dave. I think data systems probably had 300 people, Mountain View had a hundred, and desktop calculators might have had 200 or 300. So it was probably 700 or 800 people, something like that plus the sales force.

KIRBY: Okay. And who was on the group's management team?

TERRY: Carl Cottrell was the group manager. Tom Perkins was the head of the data systems division. I believe Ray Smelek was the manufacturing manager of the Mountain View division. I'll have to think about who the head of the Mountain View division was, or it's in Karen's records, and Tom Kelly was the head of the desktop computer division.

KIRBY: Okay. Now, what is it that Hewlett wanted you to do? Did he try to sell you on the move or was it an offer you couldn't refuse, so to speak?

TERRY: It was pretty much an offer I couldn't refuse. It was more in that context. I think it was Bill and Ralph Lee; they were the two people that were most heavily involved. Noel Eldred had died at that point. Bob Boniface was either here or on his way up here from Southern California. And it was pretty much ... it was a little bit like going to Colorado Springs. Bill said, "You know, we've got this unsatisfactory situation on our hands here and we need to get it

fixed and you're the guy we want to have you go up and fix it, and here's all the things that are wrong." And there were a lot of things that were wrong.

KIRBY: It's pretty tough to step away from that.

TERRY: Yes. Exactly, and it was kind of between the lines, "We know we've talked to you about other assignments but this is a significantly larger opportunity responsibility and you've been in Colorado Springs six years, and you've been the division manager for three years, and now is the time to move on." And they were right; it probably was the time to move on.

KIRBY: How did your family respond to the move?

TERRY: Oh, kind of not too well. The kids were in late grammar school or maybe even high school; I don't remember.

KIRBY: Boy, that's a tough deal.

TERRY: It was a tough time for moving kids and they loved Colorado Springs a great deal, or liked it a great deal, and we had a mountain cabin and it was a good family life so, picking up and coming back to the Bay Area was not exactly easy for them to do.

KIRBY: Okay. Now, I was going to ask you in what shape the data products group was when you took over? I assume there were a number of problems.

TERRY: Well, it was ... Yes, there sure were. I walked in there. After I told Bill I'd do it, I went home and asked my family and we talked about it and I got a grudging agreement, and I told Bill I'd do it, and then when in a few days, Bill had gotten a hold of Carl Cottrell and told Carl he wasn't going to be in the job anymore, and I don't remember if he assigned Carl to a new job or he simply put him on his staff but he made a simultaneous announcement that Carl was coming out of the job and I was going into it.

TERRY: So it got to be public knowledge instantly.

KIRBY: Now, what about the team you inherited? Did you go with the existing team or did you bring in new people?

TERRY: Well, Perkins had left about two months before that, and I think this was one of the problems that Ralph and Bill were really concerned about, because Carl was not quick to replace Tom. I'm speculating but if he had been quick to replace Tom, they might not have made this move as quickly as they did. So data systems had no leader; it was leaderless. Tom had left and... And that was the biggest and most important part of it. That was the biggest and most important part of it, and that was ... Tom's leaving was a kind of a blow up over the direction of the computer business. We call it the strategic direction these days, where Tom had this famous project called the Omega, a 32 bit ...

KIRBY: We're going to get into that.

TERRY: A forward leap ahead and he got cross-wise with the HP management and the project got canceled and then Tom quit in a huff, so here we had a division with no leader and a really demoralized situation with this Omega cancellation, and the 2100 under development. The Mountain View division, and then we can go back to the history of that later, was in okay shape. They were working on a number of ideas in tapes and disks, and the desktop computer division was really doing quite well. They'd gotten the 9100 ... Out and out, the Tom Kelly.

KIRBY: Yes, the Tom Kelly thing. They were kind of the stars and they were making money and they had all kinds of good ideas. So data systems was a real issue. Now at the time of talking to Hewlett, or maybe shortly thereafter, didn't he recommend George Newman to you?

TERRY: Yes, he did. We talked about a number of things. I got there, walked into the place in Cupertino and this was the building that Varian had built for their vacuum products division, probably five or more years from the time I arrived there, and HP had purchased that building from Varian. Varian never occupied it. It was a nice piece of property. The total land there is 90 acres and HP bought half the land - Varian retained half of it-and HP owned half of it with this building on it, and it was called Vallco Park. And VA is Varian, and Burl Leonard was a co-owner, is the L: V-A-L-L-C-O. Must be Leonard, and there might have been a third person in there but that's where Vallco Park came from.

KIRBY: On Wolf Road?

TERRY: It's a nice property on Wolf Road, near 280. I don't remember what we paid for it. I'll tell you a story about buying the other half of the property. But it was a nice factory building. It was a two-story, or a high bay factory building, probably 60 to 80,000 square feet, fairly typical HP kind of building. But the front part of the building was a single-story, flat-roofed, all-glass carpeted office building, and this was very non-HP! HP never had any carpets, so this was really pretty scandalous for a factory building. And that raised a lot of hackles within the company about "Those guys in computers don't make any money and they have carpets on the floor!" And I waltzed in there and I had a corner office that was twice as big as Hewlett's, and a big fancy desk and I turned that into a conference room, and tried to knock off some of the things that we had inherited from Varian. We didn't rip up the carpet or tear down the building, but that there were some things in there that we just didn't like very well. I'll repeat again the story, one of the scandals that I heard about through the HP rumor mill, just to show you how sensitive it is, was that the people in Cupertino in computers had electric pencil sharpeners! That was really scandalous!!

KIRBY: Oh, my! Oh, my! Really scandalous to have electric pencil sharpeners! Okay, so then Hewlett recommended Newman to you? Right.

TERRY: We started talking about the team. Data systems was the biggest problem. I mean, it was a real issue. It had no leader; the morale was all really bad and I talked to Bill about leaders and started making up a list of people that I knew and Bill very strongly recommended George Newman. George had been in Japan. He had had a background in finance, in operations, in Japan and Bill was looking for a job for him-I could tell that, because he was coming back from a foreign assignment. But Bill was strong on George in terms of just fundamentals of business management. He agreed that George was not a giant of computer technology. Other people I had, for example, considered were Dick Anderson, who was in microwave, I believe, at the time and really, I didn't have a big long list of people to choose from and while there had been some people hired from outside the company and some would be subsequent to this event, we didn't have time nor did we feel like going outside and recruiting somebody from the computer industry. So I agreed with Bill and I said, "Okay, we'll take on George." And I talked to George and I told George what the situation was, and I told him that I didn't know that this was going to be a really good long-term because this thing was a fairly complicated technology business but I really needed his help for a while, a couple years, to get this thing squared away into what became more of an HP-style of organization. So George agreed and took on the assignment.

KIRBY: Okay. Now, you just alluded to this. When you took over data products, had we already hired some computer people from the outside or were we trying to go with the staff of HP people?

TERRY: No, we had hired some people from the outside. I think that was Perkins' idea, and I think it was a contribution of Perkins to hire some people from outside the company, particularly in engineering. There were some people in marketing, a number of people in marketing, but most of them were in engineering and they were, you know, they were the early computer science types. They knew about computers. They had designed them before. A number of them, in fact the core of them, that contributed to the HP 3000 were all from Burroughs, and I don't remember exactly why they came out of Burroughs-whether Burroughs was reorganizing-but they had all worked together; there were four or five of them that had worked together at Burroughs and if a computer scientist at the time looked carefully at the architecture of the 3000, they would see some similarities to the architecture of the Burroughs computers and that is what these people brought with them.

TERRY: And of course, there was this thing called "software" that nobody at HP knew very much about.

TERRY: We had hired a number of people who knew something about software and these were young computer science types plus a few experienced people, semi-experienced people, like Roy Clay. Roy Clay was the head of computer development in the data systems division, a very unique guy.

TERRY: An Afro-American individual who had worked in a number of companies and he was a

software development individual. There was a guy I dealt with, a marketing communications guy, whose name was Al Fisch.

KIRBY: Yes, I remember Al. And I think he came from somewhere. I don't know where.

TERRY: Probably, and we were running unusual advertising because and we were writing different kinds of data sheets and sort of feeling our way along in the computer business because it was pretty obviously not the same solid volt meters and scopes and oscillators. Now, let's talk about some of the problems you inherited, or challenges. One was the aborted Omega project. KIRBY: Can you go back to the beginning and relate that story?

TERRY: Yes. Well, let's see. It started ... The project started, it was started by Tom Perkins in the data systems division and I think Tom saw that expanding the 2100 product line-2116, 15, 14-was a reasonable thing to do. It didn't take a lot of extra engineering and it kind of paid the bills. But his ambition, and his answer to "Where do we go next?" was now necessarily to build an improved 2100, 2116 product line but was to take a great leap forward into a much larger, much more capable 32 bit computer. The 2100 family was a 16 bit computer. The original computers at DEC PDP8 were 8 bit computers and when you have more bits, you can just do more calculations faster. You have wider words, as they're called. So Tom started a 32 bit computer project called Omega, the be all and end all of the Greek alphabet. I remember attending, as part of HP management meetings, presentations by Tom and others-even though I was in the instrument business at the time-about the Omega project and it was pretty mind-boggling to those of us who had engineering projects with four or five people on it and this thing had, you know, 150 people on it and it was immensely complicated in a hardware sense but even more so, it was much, much more complicated in a software sense. Compared to the 2116, it may have been three times as more complicated in the hardware sense but compared to the 2116 software, it had to be fifty times more complicated!

KIRBY: Wow!

TERRY: That's what happens when you step up these word widths. The software gets really complicated and there were very few tools available to write the software, this complicated software, the operating system, the thing that runs the computer. So those of us outside the data products group at the time would kind of shake our heads about this great leap forward and whether we were really going to pull it off or not. The other big challenge was the question would arise, "Well, who are we going to sell this thing to?" We were selling the current computers to pretty much our installed base, that is, our friends: instrument controllers. And we had developed other applications for the 2116 and its family. We built a time-sharing system, which was very popular. A fellow named Mike Green was the software contributor to that. And we had a real-time operating system that ran on this computer, rather rudimentary but we could do calculations in real time that had some appeal for certain applications. So that the Omega project was really an ambition of Tom's and it was too ambitious. There's a Stanford Business School case that exists that was written about this whole subject and I think the point of the case was that Tom, whether it was right or wrong really wasn't important, but he did not really rally enough support for the project, particularly with upper management. That was the case where they changed the names and everything to try to ... I don't think they changed the names on the Omega. It never did have a model number; it was always the Omega. But Tom was so sure he was right that whether the head of marketing, Noel Eldred, or the head of manufacturing, Ralph Lee, or anybody else, Barney Oliver-whether they thought this was the right thing to do or not, he didn't really think that was important what they thought. He was sure he was right and I don't know what Dave and Bill thought about it exactly, but I think they were interested to see whether Tom could make this thing work or not. So they were not negative; they were kind of neutral about it. I don't think they were terribly enthusiastic but at least they were, like a lot of R&D projects, they were saying, "Well, let's take this thing a ways and see if we can make something out of it."

KIRBY: But probably Tom, in retrospect, might have done it differently by bringing Eldred and Lee in early.

TERRY: Particularly Eldred because I think that's where the thing floundered when the subject about "How are we going to manufacture this thing?" probably generated a lot of debate but we kind of came to an answer to that. We were cocky enough engineers that we could figure

out how to make something bigger and more complicated and more dense printed circuit boards and more dense memory and bigger power supplies. We could probably conquer that.

KIRBY: Okay, let's pick it up again.

TERRY: We probably thought we could conquer the software but then the question came up about "Who's going to buy this thing? Who are we going to sell it to?" And Tom's answer was, "Well, you stupid idiots! We're going to sell this thing to banks, insurance companies, railroads, airlines. You know, the who's who of the commercial world." And who's the competition, Tom? "Well, the competition is obviously IBM." So somewhere along the way, Barney made a famous about "Well, I guess the objective is to sneak up on IBM without being noticed." And that was thought to be the objective, and of course, there was a lot of concern, particularly by Noel Eldred's part. We only had a fledgling capability of selling instrument controllers to our friends and how the heck were we going to put together a marketing and distribution organization to compete with the likes of IBM to sell into banks? And then there were other questions about support, the application software, and the whole thing was just too big of an unforgiving leap forward and I don't ... I wasn't privy to the cancellation but the project was canceled. Tom Perkins was told, "This was not going to happen and cease and desist. Take whatever resources you've got and put them on the follow-on of the 2116."

KIRBY: Now, wasn't there also computer people formed sort of a cult, where they tend to think in a much broader, wilder terms if you will, than.... I don't know if it's a cult. I guess you'd call it a cult. There's a book called Soul of the New Machine written by a guy named Tracy....Kidder, I think his name was... That was the Data General guy?

TERRY: He's a Data General guy and it was a Data General project later on that was similar to this project and it's an interesting book to read because it was just the same thing that was going on. There's something about computer architecture and creating a computer that instills all kinds of things in man's soul. Maybe it's like a building architect and working at this building, but the people that were doing this, particularly in the lab, but Tom also, this was like, you know, like fathering a child. I mean, this was really intense stuff and how anybody could question what they were doing, they just couldn't understand that at all. They just had to make their mark on society and the world by creating this computer. It was a bit of a cult and when the project was canceled, that happened about a month or so before I arrived on the scene, and when I arrived on the scene, there were a group of people in the lab who all had black armbands on. They had put these mourning armbands on their arms in mourning the cancellation of the Omega project and they were kind of a renegade bunch. Many of them had come from outside HP, this Burroughs group, and they were pretty hostile. They started in ... Some of them started in on me right away about I was going to be the savior that was going to bring the project back. "Our savior has arrived! He'll surely recognize what a great idea this was." And being new on the scene, the last thing I wanted to do was go up and fight with Eldred, Hewlett and Packard about ... Noel had died, I guess, at that point but anyway, to fight with the management about re-instating this project that they had canceled. One of these guys, whose name ... Gene-I'll think of it later-was one of the chief guys. He came in one day with his black armband on and he said "Come on back in the lab. I want to show you something." I'd been there maybe two weeks and so I went back in the lab and we went back to this storage closet, kind of a broom closet, and he opened the door, we went back in there and he had the Omega. He had it turned on and he was working on it. So management may have thought this project was canceled but old Gene, Gene Stinson. He went to another company that was a good customer of ours. But this project didn't get canceled instantly; it sort of died slowly. But Gene had the Omega running and he wanted to show me what a great machine this was, at the same time, we were busily trying to invent the 2100.

KIRBY: Do you ... Are there some people who think, still think, that canceling that was a mistake or what?

TERRY: Well, you know, I don't know if I commented on this tape but you know, if you look back in the history of computing and you look at the Omega project, what you would see is something that later on became the DEC VAX. Digital Equipment introduced a 32 bit

computer-oh, I'm guessing now-10 years after the Omega, that became a huge success in the marketplace.

KIRBY: Yes, I remember that.

TERRY: DEC made a huge amount of money for a long, long time and so, you know, you could look back and say, "Boy, this was a mistake!" Hewlett Packard had the essence of a Vax-like computer 10 years before DEC had it, and they didn't take advantage of it. So you could say it was a mistake. I don't think it was a mistake. I don't think the company was in the mood to gamble that much. I think we'd had stumbled in the marketplace just trying to get the darn thing out, because we just didn't have the background in software. We hadn't cut our teeth. Probably DEC hadn't either; it took them 10 years to kind of get their experience up to the point when they could get the VAX out. But technically, it was a really good machine. And it would have flown really in the face of the Hewlett Packard philosophy, which was sort of "Let's do things one step at a time and grow from strength."

KIRBY: Yes, yes, exactly.

TERRY: For example, and this didn't quite happen this way, you could have said, "Well, let's start in with a family of 32 bit computers that are a little bit easier to sell and a little bit easier to manufacture and a little bit easier to do the software for, and then we'll sort of build ourselves up." I think a typical Omega-Perkins used to brag about it-was like a million dollar machine, and the 2116 we were selling at the time, with the teletype and maybe a disk on it, was about a \$50,000 machine. So we were, you know, this was just... the sheer magnitude of this was pretty frightening.

KIRBY: That's right. So that was one problem when you got there. Now, let's talk about the 2100 computer and the power supply problem. Can you go back on that?

TERRY: Yes. The 2100, at least at first pass, looked like a, you know, a bit of a slam-dunk. We had this family of 16 bit machines; the 2100 was going to be software compatible with all the other machines that we had but it was going to be smaller and faster, and it would support more memory and had a number of other features. It had, for example, something called "power fail auto restart", where if the power failed and then came back on, the computer would automatically restart itself, reset its software and so forth. That was a feature that customers wanted. But, so that was thought to be going along all right and George Newman got into the division and I got into the division and Tracy Storer was engineering manager, and we started digging into the 2100. It was pretty well-invented. There were physical mock-ups done. The features were pretty well set, and I suppose it was thought to be maybe six months from introduction, so the marketing people were getting antsy about showing it to customers and writing data sheets and so forth, and then some problems started to emerge. It turned out for some reason the power supply, the electrical and mechanical design of the power supply, was being done by a consultant outside of HP. I never met the individual. I think that was probably done because the computer people that were there, both HP and outsiders, had very little experience with power supplies. That was all back in the instrument part of the company. So they had this farmed out to somebody else, and it was a very complicated power supply. It had about 6 or 8 different voltages. It was almost a kilowatt, and the people at HP had assigned a space within the chassis for this power supply to fit in, as well as specifying all the voltages and currents, and all the things that it had to do-heat rise and so forth-and when the consultant started delivering some designs and some first prototypes, it became awfully obvious that it wasn't going to work at all. It wouldn't meet any of the electrical requirements. It wouldn't fit in the hole. It was just a really shabby design of what turned out to be a very difficult problem, and so there was crisis in the lab and the schedules all had to get reset and maximum attention to be put on "What are we going to do about this power supply?" And that's when I and George Newman elicited the help, again, of HP labs-Barney, Bill Hewlett and Ralph Lee all got involved on "Hey! You've got to bail us out here and give us some ideas on redesigning this power supply." They agreed to do that and they shook their heads about whether this could even be done or not, and there was enough concern about that, that we started a simultaneous design project in Cupertino for a 2100. We didn't call it the Jumbo; I'd refer to it as the Jumbo. The 2100, I believe, is 10 inches high and this one was going to be about almost the same size as the 2116. It was twice as big, and it was twice as big because it had a conventional power supply in it.



KIRBY: Oh, I see, so that was the problem.

TERRY: So we started in a parallel design with a conventional power supply while HP labs took a look at "Is there something we can do here about some way, somehow try to shoehorn a power supply into the original design?"

KIRBY: How big was the hole?

TERRY: The hole was about maybe 8" x 8" x 10", 640 cubic inches. It seems large but putting that much power with those different voltages in that space reliably-and incidentally, this came back to haunt us a little bit later. Cost was not a consideration, you know. We were willing to pay almost anything to get the power supply to fit in that space, and as it turned out, the power supply that finally finished was a bit costly. It was reasonably reliable; not as good as you'd like but it could finally fit in the space. Anyway, we started a parallel design project because-and the labs knew about this and they agreed, "You better cover your butt here because we're not sure we can do this or not." So we started a parallel design project and I got heavily involved along with George about which way we were going for this thing, and Ralph was involved, and the people at HP labs were, again, like in the pocket calculator: they were magnificent! They really rallied around this. Barney personally spent a lot of time on this in looking at ways of designing this power supply. Ralph Lee was the expeditor; when HP labs needed some prototypes, sheet metal or a printed circuit board, Ralph was pulling strings to get it done instantly. Paul Stoft was very involved. There were a number of people at HP labs. But we built both of these machines up to kind of a prototype stage and there were a number of things that galvanized the decision on where to go. One of them was a lab checkpoint review, where we reviewed the progress HP labs had made with the power supply that would fit in the original design versus this alternative, and we all sat there and listened to this and after the meeting, I got a hold of Ralph or Ralph got a hold of me, and he really surprised me because Ralph is a pretty conservative kind of individual and I asked Ralph, "What do you think we ought to do?" And I thought he was going to tell me go with the conventional design.

KIRBY: The larger one?

TERRY: The larger machine, and Ralph surprised me and said, "No, I don't think you should do that. I think you should try the HP lab design. It's a lot more riskier but you're just going to have a heck of a lot better product in the long run." That influenced me! The other thing that influenced me was the story that George, I'm sure, will remember. We had a very good customer by the name of Allen Bradley. They made controls in the Midwest and they had been a good customer of the 2116 and some of the other ones, and they had a whole new line of industrial controls they were designing based on the 2100, and we had been working very closely with them. In fact, I think they were probably our very best OEM customer. "Very best" means they bought 50 to 100 computers a year. And we realized that this new, this potential alternative, this larger machine was not going to fit into the hole that they had assigned in this two-rack bay of equipment. So we had a guy come out from-we called him out-from Allen Bradley. His name was Zip Zepfenning. Good old Zip came out and George Newman organized a review and made a presentation to Zip about our problem and that we had this problem getting this power supply to fit in this computer, and we were working on this alternative that was essentially twice as big. And good old Zip says at the end of one of these meetings, he says, "But you guys realize" ... or he said early on, "You know, that's nice but that won't fit in my rack of equipment. It's too big. I'm going to have to have a third rack and that costs a lot of money. It'll make me uncompetitive and this is terribly unsatisfactory." And at the end of one of these meetings, I think it was a private meeting with George and I and Zip. George looked at ... Zip looked at us and he started crying, tears.

KIRBY: Started crying?

TERRY: He started crying. Tears were running down his face and he said, "You know, what you guys are doing here is going to cost me my job and it's probably going to cost Allen Bradley this division."

KIRBY: Wow! Wow!

TERRY: So that was another galvanizing action where George and I kind of looked at each other and said, "Gee! This is a real problem! We'd better try for the smaller design." So we ... and it

wasn't without controversy, we sort of abandoned the large machine and we went with the HP labs design and HP labs came through. It was not easy; there was a lot of blood and sweat, but we finally got a power supply that did work and it did fit in the assigned space, and got on with the problem.

KIRBY: And I guess Zip's job was saved?

TERRY: Zip's job was saved. He continued to buy computers from us and somewhere in the archives, there's a picture of me-not with Zip, but I think Zip's boss-presenting the I think it was the 1000th or 5000th—it was one of these cardinal points-2100s or computers that we had ever made and we sold it to Allen Bradley, so we had a little publicity over selling this particular machine.

KIRBY: Okay. Now, once the 2100 hit the market, how successful was it?

TERRY: It was very successful. It was a good machine, very successful.

KIRBY: In what types of applications?

TERRY: More OEM type applications. These were people like this Alan Bradley thing, that were using it as instrument controllers. Dave Bossen runs a company down here in Cupertino- my memory's fuzzy this morning.

KIRBY: Is it Measurex?

TERRY: Measurex! I knew it began with an "M". Machines that were used in the paper industry- they measured the thickness and the moisture content and other characteristics of paper while it was coming off a roll-and they were customers of ours for the early computers but they were really interested in the 2100 and they liked working with us and this was a really tough environment. These computers had to get hosed down with steam at the end of a shift because you had all this hydrogen sulfide in the air of the paper mills. It was tough stuff. But they liked our kind of design philosophy of readiness and reliability, and Measurex is a very good customer. And we sold a lot of computers to Measurex.

TERRY: Our time-sharing system that started with the 2100 family, 2116 family, was ... the 2100 was adapted to it and it became a much better system. Software was improved, but it had a better computer with more memory in it and it became the heart of a real-time operating system. The time-sharing system with 2100, and it was also very successful product. These were pretty complicated systems. They supported 16 or more terminals. We sold them into a number of applications but the biggest one was selling them into education. We had an individual in Cupertino who was I guess we'd call him a product manager these days-his name was Ed McCracken-who was in charge of the education marketing of this thing and Ed was really good at it! He was a real visionary and what Ed did in education was something we wanted to do in other industry applications. We never did do it quite as well but Ed got out, he made a number of contacts with applications software people. He made a number of contacts among educators and we just sold a lot of these time-sharing machines to schools, mostly to high schools.

KIRBY: Yes, McCracken is now the head Silicon Graphics.

TERRY: He's head of Silicon Graphics but Ed personally was really the charger behind selling these time-sharing systems in education.

KIRBY: That brings up a question about field selling at that point. Were you adding computer people?

TERRY: We were adding computer people. We were hiring people from DEC, from IBM, people who had different kinds of experiences. We'd already tapped the well with instrument people to get started with but we were hiring computer industry people-some successful, some not so successful. We were building a support force of service people to go out and support these things on-site, particularly the systems, the time-sharing systems. You couldn't bring them back to the bench and fix these things; you had to fix them on-site I'll never forget talking to a high school principal one day about what happens when the computer fails and the high school, all the terminals in the high school go down and the classes that have the terminals? It's a big problem. And I was trying to make an excuse about how reasonably reliable our systems were; they would fail maybe-this would be a combination of hardware and software-but they would fail maybe once every six months or something like that and by

computer industry standards, that was really pretty good performance. But this guy didn't know anything about the computer industry and he looked me in the eye and he said, "Well look, son, this thing isn't any bigger than my refrigerator and it has failed in 20 years!"

KIRBY: That's pretty good.

TERRY: It was a lesson I never forget about the reliability expectations of the customer versus our expectations.

KIRBY: That's pretty good.

TERRY: But it was a real fire drill every once in a while when Ed had to get on an airplane with some service people and go fix somebody's computer in a high school.

KIRBY: At that point, how were sales outside the US?

TERRY: Pretty modest as I recall. Yokogawa had had this previous experience and we hadn't gone much farther in Japan. Pretty modest in Europe, in general, and in applications suppliers.

KIRBY: Well, we really didn't have an identification as a computer company.

TERRY: Not at all. We were selling these things as instrument controllers for specific applications in specific countries. The French got onto an application of applying the 2116 believe, and then later the 2100 in racetracks. They were running some software, they were working in conjunction with an application developer who had a bunch of software that ran on a mini-computer that was the paramutual system for racetracks.

TERRY: So there were specific application areas the European countries got into, kind of in a system OEM sense, because they had a contact or they had some marketing but it was kind of fledgling. We had one in Holland, where they used a mini-computer as a point-of-sale controller. This was an outfit called SHV; it was related to a big Dutch steel company and they were off building mom and pop stores. It'd be like Costco today. They had racks in it. They were building these kind of discount stores that would appeal to owners of small shops. They'd come into this place and they had all their cash registers and scanners hooked up to this mini-computer in the backroom; it was an HP mini-computer. We sold quite a few of those to those guys. Fred Schroeder was very much behind that. That was, incidentally, also was a big support challenge. I mean, this was something we'd never done before and we had to have service people going to these grocery stores in the middle of the night and of course, these people, in this kind of application, just like the high school, they thought it was not too swift when all the cash registers stopped! The store would stop. And I remember being in Holland one time talking to the head of this outfit-it's kind of like my high school principal story-and we were having problems servicing these things in South America. He was really beating me up about the fact that we couldn't get our service people to come out on holidays, Catholic holidays. And his stores were open but our service people were not thinking about working on Catholic holidays. So we had a big conversation about that.

KIRBY: Now, in addition to the power supply problem, you had a problem, as I recall of it, with solid state memory from Texas Instruments.

TERRY: That came along a little bit later. The 2100, actually there was really only one member of the 2100 family. That was the original one with the reduced power supply and the folded core in it and it was a very successful product. I'm guessing we sold at least a thousand of them. But then we didn't make any variations on it. For better or for worse, we were busy getting the 3000 done, so we let the 2100 kind of take us for a while and then technology started to change and the advent of solid state memory came along. So we started a new family-it was called the 21MX-and I can't remember why, except somebody in marketing thought it sounded kind of sexy, like a Jaguar, an MX or SX. And so there was this 21MX family that was going to take full advantage of solid state memory and it was going to be smaller, faster. So it was a whole new family that was going to come along and supersede the 2100. And it was that family, where the first member of that family that was going to have solid state memory in it. These were 1K solid state integrated circuits. There were a number of improvements but the biggest improvement of all was size, speed brought about by solid state memory. The leading manufacturer in the solid state memory was Texas Instruments and we were working with Texas Instruments with designing this thing. Texas Instruments

was also in the mini-computer business. They had been in there for a while; it wasn't real obvious they were very successful and it was kind of not too obvious what they were doing but that didn't bother us. So we started ahead with the design of this thing and we got it well along, up into a pilot run stage, and we decided to introduce it probably at a trade show or somewhere and to go public with it. And we introduced it at this trade show and TI also introduced a line of mini-computers using their own solid state memory. And that didn't surprise us too much. We expected that to happen. But then we started getting messages from TI that they were going to be late in delivering the solid state memory to us and therefore, we were going to be late. And that was a real problem being late because we had a lot of customers of the 2100, including Allen Bradley again, who were going to switch from the 2100 to the new solid state models. So we had a big installed base that was going to stop buying 2100s! It was really going to be obsolete with time.

KIRBY: Who's going to obsolete the 2100?

TERRY: So here we had this new machine. The vendor of the solid state memory says we're going to be late, late, late, late, and late. And at the same time, the vendor of this solid state memory is telling the market we've got our own semiconductor solid state memory mini-computer. So their sales people are going around raising hell with our sales people. Paul Ely was in charge of the division at the time and I got in the middle of the act, or Paul came to me, and I wrote a letter to Mark Sheppard, who was the president of Texas Instruments and a guy named Morris Chang, who is still in the business, was the head of the solid state memory division and I wrote a very careful letter to him that said, "I am very concerned about your ability to meet your promises on delivering memory to us while you are simultaneously competing with us, and I want to come down to Dallas and talk about it." And about three days after I wrote that letter, I think it was Packard came bristling out of his office and called me up and wanted to know what the hell was going on because Haggerty, who was the chairman of Texas Instruments and Mark Sheppard's boss, was a good friend of Bill and Dave's.

TERRY: And this letter had evidently ended up with Haggerty and Haggerty called his good friend, Dave Packard, and wanted to know what this pipsqueak Terry was all about. And Packard started raising hell with me and somewhere along the line, I told him that I had the letter reviewed by John Chognard. So that calmed him down a little bit.

KIRBY: Before it went out?

TERRY: Before it went out. And I told him exactly what the situation was and he kind of grumped and said, "Well, all right. I think you're doing the right thing. Let me know if I can help." So Paul and I go down to Dallas one day and walk into Mark Sheppard's office. Mark Sheppard, at that time, was about a six-foot six-inch 240 pound Texan.

KIRBY: Oh wow! Wow!

TERRY: And I walk in the door, and he was really hostile!

KIRBY: Was he?

TERRY: Oh, yes! He didn't use any four-letter words but he was really hostile and, you know, I told him ... Paul was ... This is one of those meetings I'll never forget because Paul didn't hardly say anything!

KIRBY: Really?! Really?

TERRY: He didn't hardly say anything! And I said, you know, as calmly as I could, I said, "Look, I'm not here to accuse you of any antitrust violations or anything else. All I'm here to tell you is you're late on your delivery of solid state memory to us. We are terribly dependent upon this, and we want to know when you can deliver it? And I'm not going to address all these rumors about diverting the memory into your own machine. I don't care. All I want to know is when are we going to get these chips that you promised us?"

TERRY: And he turned to his buddy, Morris Chang, and said, "All right, Morris, what's the situation? How's it going? Blah, blah, blah." Anyway, we were covered. They finally delivered the chips.

KIRBY: They did?

TERRY: I don't think, frankly, they were deliberately diverting them into their own machines. They were just plain late in getting this thing out the door. It was one of the first-in fact, it was the first semiconductor memory chip on the market. Morris Chang today is the head of Taiwan Semiconductor, a big semiconductor operation in Taiwan.

KIRBY: Is that right? Okay. Now let's talk about Alpha, because that developed out of the Omega project, didn't it?

TERRY: Yes, it sure did and I don't remember exactly.

KIRBY: Oh, wait a minute. I meant to ask you. Paul Ely then was running what you called the data systems division still? He took George's place?

TERRY: Yes. Things were getting a lot more complicated. This is after the Alpha story. Let me tell you the Alpha story and then we'll get to Paul arriving on the scene but after the Omega was canceled, I think there was a lot of people-me included-who weren't willing to just take the answer that "Look, we're never going to invent a larger computer" or in fact, they weren't willing to take the answer that "We're never going to invent a 32 bit computer." I mean, it was pretty obvious that was the direction of technology in the industry. It was just that our 32 bit computer was way too big and way too complicated. So it was, "All right, let's see if we can get this thing scaled to something in an engineering, particularly in a software, sense and an application sense that is something we can do that isn't quite as much as a great leap forward." And that was when we said, "Okay, we're going to do a 32 bit computer," excuse me, "We're going to do a 16 bit computer." It was still 16 bits but it was a much, it was a different architecture. It was based on a lot of these Burroughs ideas and the software was thought to be a lot easier to do. So actually the 32 bit computer didn't come along until we got to the spectrum kind of a project but it was "Let's do a 16 bit computer, different architecture, much more powerful, more expensive. Yes, a real stretch in marketing and distribution but something that feels like we could get it done." And so somehow or another, it was christened the Alpha, which is the other end of the Greek alphabet, the beginning. It was the beginning instead of the end. And the design was recast in that direction and that became the HP 3000.

KIRBY: This is Dave Kirby and this is a continuation of my interview with Bill Terry on January 4, 1996. Bill, you were talking about Alpha. Do you want to pick it up and take it from here?

TERRY: Yes. Alpha became a 3000. It was not an easy project. The software was immensely difficult, even though it was a 16 bit machine instead of a 32 bit machine. The operating system for the 3000 was exceedingly more complicated than anything that had ever been done. When you develop an operating system, the operating system is sometimes called the "Executive". It resides in the computer, usually in memory; you may load it in but it resides in the computer when it's turned on. It controls all the functions of the computer and this operating system was complicated. It has to be efficient because it has to be fast and occupy a minimum amount of space, memory space. The operating system of the HP 3000 was written in a special programming language called Aspl-A-S-P-L, "Alpha System Programming Language"-that was ALGOL-like but not quite and you had to develop this language first before you could use it to write the operating system.

KIRBY: I see, okay.

TERRY: This was a complicated project. The hardware was not too bad although it had, again, new solid state memory, lots of cooling requirements, big printed circuit boards-that was a challenge -much bigger printed circuit boards, much more complicated assemblies. But it went along reasonably well. Probably the biggest mistake was that it carried with it many of the ambitions of the Omega, in that it was going to be able, within its operating system, to support multiple environments as they're called. That is, it was going to be able to do computations, distributed computations, time-sharing computations, dedicated batch computations, and real-time applications simultaneously. And in retrospect, that was a mistake. The marketing people got loose; I didn't know any better. Neither did George Newman or anybody else around there. But we just didn't have the background in computer science to realize that we were going out on a limb in terms of promising this kind of performance without being able to prove it. We were also real neophytes in terms of answering the question about "When is a computer ready for introduction?" HP had been

burned a number of times and still is by so-called premature introductions of products and instruments and other things. We go out and tell the world we've got this thing, and we haven't really got it totally invented and in production, and we made that mistake with the 3000. We went out and told people it was ready to go, let's start selling it. We also told them it'll do all these neat application things and when we got out on the market, the operating system was "buggy". That is, it had faults in it, it had problems in it. It would stop and start, and it never did really meet the expectations that were originally set at least, falsely set, about doing all these things simultaneously. It would do them but it wouldn't do them very efficiently or very rapidly. And that was an indication of the naiveté of all of us that were involved in it and what a computer system would do, and it's still even today, a very, very difficult situation to answer the question about "When is this computer system ready?" And I had to look and maybe chort and chuckle to myself in a semi-evil way when 20 years later we introduced the HP Spectrum computer system and in its first year, it had exactly the same problem!

KIRBY: Really?

TERRY: Yes, the operating system didn't work very well. There's something called "tuning the operating system" which is very, very different from an instrument. You don't tune the thing at all! It either works or it doesn't. And in a computer system, it's always being improved. You're making changes in the operating system to take out mistakes and bugs, and make the thing work faster and in those days, the early 3000 ... none of us understood anything about tuning an operating system. We all thought it was right or it wasn't right. And we learned an awful lot about setting customer expectations particularly. But there's no cookbook or anything that says, "Okay, now you introduce it." No, there's no cookbook and at that time, there were very few things called benchmarks. That's become a lot more sophisticated where, to answer the question about "Does it work or not?", you ran this standard set of applications or "test suites," as they were called... .. through it and based on what you got, that would give you an answer, and it would set an expectation with the customers. Well, we were neophytes at it and there wasn't very much done in the industry either with things like that. The first one of these things we sold to a guy at McMasters University in Canada. I forget in Canada where it is. This guy ... it's in eastern Canada ... this guy was a real computer nut! And he had some money and we sold him one of these things, and I saw him within the last couple of three or four years somewhere-he's still around and we had a reunion about the early days.... on the HP 3000. He put up with the problems because he wanted to experiment with this really fast 16 bit mini-computer, and even in later years, people used to kind of shake their heads about how much performance we milked out of a 16 bit mini-computer with this operating system and some of the other things that we did. Well, it went on for years and years! Oh, yes! It was a very successful product and there was a whole bunch of variants on the thing and it became a whole product line of 3000 family. But it had a very difficult teething, a very difficult teething.

KIRBY: I think I recall didn't Packard get involved in that?

TERRY: Packard got involved in it, yes, I should tell that story. We had it out on the market and we were getting a lot of reactions from the customers about "You've over-promised" and "The thing's got a lot of bugs in it" and, again, these were customers that we were beginning to address that were a lot more sophisticated with computers perhaps than we were. They were IBM customers and we got a lot of flak in the marketplace about this thing. And I had a meeting down there and Bill and Dave were there about the status of the operating system, and I don't ... I think I decided, like Bill and Dave usually did-they let you decide-that we were going to "take the thing off the market" for the time being, go back to the lab and tune up the operating system. And both Bill and Dave agreed to that very much and we had just gotten this thing out a little too early. And of course that was disappointing to everybody because we'd been making this mistake for years. We had a lot of instruments that we got on the market way too early and the thing didn't work very well. So we "pulled it off the market." What that meant was we took the sales force that was selling these things and we told them, "Look, go back and sell the 2100 family and of systems built around the 2100. Hold the hands of the people that have got the 3000"- we only had probably shipped 10 of them at that point; it wasn't a big financial deal. There weren't very many of them out there. "And we're just going to lie low here while we go back and keep working on the tuning of this operating

system." It got into Electronic News, and they made a kind of a bigger stink out of it than it actually was, as they were wont to do. I also got pinned by an attorney on a federal court stand in Oklahoma City about the problems of the early 3000. I'll make this story short but Bill Hewlett got a phone call from the president of IBM. IBM was being sued by a company called Telex about-I can't remember-they were both suing each other. There was a big lawsuit going on about copying each other's products and the president of IBM asked Hewlett if somebody at HP would come back and testify on behalf of the industry about computers in general, and the size of the market and market dominance, that was a big issue. And Hewlett asked me if I'd do that and I said, "Yes, but I can only tell what I know. I can't make anything up." So I went back to Oklahoma City and I got on the stand, and they asked me a bunch of questions about HP's computer business, which I was able to answer, and memory and this and that and so forth. So it was a fairly painless experience. And then the attorney for Telex got up and he started grilling me and he held up a copy of this Electronic News article in court and said, "Terry, are you the guy responsible for this giant screw-up?" And before I could answer, this really smart IBM attorney jumped up on his feet and said something about "Irrelevant; it has nothing to do with his point!" But my name was in the papers in a not too complimentary way, but we repealed. We retreated and it was about that time that two things were going on. This fixing of the 3000 was a complicated kind of a deal. Data Systems was getting a lot larger. I mean, we were selling 2100s and we were systems and the thing was growing. It was maybe \$300 million at that point. And I was, frankly, a little bit concerned about George, his lack of computer background and technology. He'd been doing a good job about getting the thing shaped up, getting the morale straightened out, you know, kind of the fundamentals and at the same time, I had a bit of a leadership problem in the pocket calculator organization, called APD. Alex Sozonoff, who had been the start-up guy and was a commensurate marketing guy, didn't know very much about manufacturing and he wanted to go back to Europe. His family, he's European, and his family was from Europe. He wasn't in a real hurry but that's where he wanted to head, and so I needed a better full-time leader of the pocket calculator business, so I asked George if he would go over to run the pocket calculator business and left an opening in data systems. And I had a number of alternatives to consider there, and once again, Hewlett gave me some advice. Paul Ely was the engineering manager of microwave division. He had been to see Bill about his ambitions and things that he wanted to do in the company.

TERRY: And he was working for John Young and the last thing I wanted to do was go recruit one of John's stars because that would get me in real trouble with John. But Hewlett told me that he thought Ely really wanted to make a change and Ely talked to John and then I talked to Paul about this opportunity, and essentially recruited Paul to come down and replace George at Data Systems. And Paul arrived on the scene where we were in the middle of this 3000 re-do job.

TERRY: And Paul, with his hard-driving tactics, was really very good about getting the problem fixed and getting the 3000 back out onto the market, and then starting other programs to broaden the 2100, the 2100MX family, and to broaden the 3000 family.

KIRBY: Okay, now in the meantime, I guess you've now remembered who was running the Mountain View division.

TERRY: Yes, the other part of data products was the Mountain View division, and this got started, again, before I got there. Some way or somehow, there was an interest in computer peripherals-tape drives was the interest-and we acquired a company called Datamec. This must have been done by Carl Cottrell because it happened before I got there. Datamec made a tape drive. I can't remember where Datamec was located; I'd have to look it up in Karen's files. At the same time, we had an individual who worked in the microwave division named Walt Selsted. He was a really smart guy that I think was hired into microwave as a mechanical designer, because they had a lot of mechanical design challenges, but he knew a heck of a lot about tape drives because he'd come from Ampex. So he was recruited to go down to this Mountain View division. And these tape drives, the ones that he invented, and the Datamec tape drives were so-called vacuum column tape drives: they supported the tape on either side of the head in a big, long column which was under a vacuum. So that held the tape in place and the tape-head was bilateral: it went back and forth across the heads to read

the data off. And it was an alright machine and we were selling it and installing them. They were a bit unreliable. They were hard to manufacture. It was as big as a refrigerator, or bigger. There were a lot of pumps and you had to keep them clean, and it was a tough product. And later on, some very smart people-Dick Monier and others-came from HP labs but in the Mountain View division, started inventing what was called a "tension arm" tape drive where you supported the tape on two mechanical arms that were on a spring and it made the whole thing smaller and lighter and so forth. That became the 7970 Tape Drive. It was a super successful product!

KIRBY: Was it?

TERRY: It had really good performance, almost as good as the vacuum column drives in terms of speed, but it was a fraction of the size and it was about a quarter of the cost and we really cut a wide swath selling those both OEM and applying them in our own systems. The other element in Mountain View division, I'll get to the leadership, was disk drives. This was, again, an HP labs project. Storing memory on disks had been going on for some time. We were using disk drives that we purchased for our systems from people called Vermont Research; that was a drum drive. It was a huge drum; it cost \$25,000. A magnetic drum; very complicated, very unreliable. We purchased some disk drives from Univac. We learned a lot of things about our competitors who also manufactured peripherals. We thought Univac walked on water and Control Data and Sperry and people like that. And then when we got into them and started buying their peripherals to run on our systems, we found out they were mere mortals! In fact, they were less than that. The stuff was pretty unreliable and not very well-engineered. So we had ambitions in disk drives. The first product, the 7900, was invented or started in HP labs and then went into the Mountain View division. So the Mountain View division was tape and disk peripherals, those two peripherals particularly. And again, we'd better look in Karen's records but Jim Treybig was the division manager at one point in time of the Mountain View division. I don't ... Selsted may have been in charge in the beginning.

KIRBY: Yes, I don't recall Selsted being a division manager.

TERRY: No, it was a pretty small operation when he was there but I believe Jimmy Treibig, who was in marketing at the time in the data systems division, went over and became the division manager of the Mountain View division and Ray Smelek was his manufacturing manager; Bill Abbott was the manufacturing manager in Cupertino. I don't remember who the marketing manager was but the Mountain View division was kind of a ... why I got involved was the beginning of HP on work and peripherals. And I remember sitting in this room that we're sitting in today. We had an executive committee meeting and I had been on the job maybe two months and I was giving a little report about what was going on and I got to the Mountain View division, and they were inventing ... they had this Datamec tape drive. They were inventing a tension drive. They were inventing a disk drive. So we had a lot more expenses than we had revenue, and we weren't making any money and I was kind of shocked. I remember sitting in this room, in the middle of my report, John Young took me on about what a dumb idea it was to be in peripherals and how we should forget all about that and stop losing all this money and concentrate on something else, like computers or instruments. That comment just sort of flew by. Not that any of us are always correct but it's kind of interesting now, what \$25 plus billion, more than half of the company, is peripherals. I always thought there was a lot of money in the peripherals, there was a lot of the value there and I liked HP being in that business because it really stressed our engineering skills. There wasn't a lot of marketing skill involved; the marketing skill was over on the systems and if you got a really good engineered, you could sell an OEM without a lot of huge distribution problem. Printers came along later.

KIRBY: Now, you, along about that time, you became a vice president, didn't you? I guess that's happened in there. 71 or 72.

TERRY: It must have been. It must have been in the data products era and Dave or Bill called me-I can't remember which-and of course, I was really flattered and honored as anybody would be at being named the vice president. Oh, and it was the first time, it was also an accolade for the computer business. This was a recognition item. I had not made a point of this to my bosses but you could tell, just the troops thought this was a great idea. It sort of



gave a signal that the business was here to stay for a while. Yes. Now, how were you personally coping with all of this stuff? It must have been a difficult period. It was a bit of a difficult period. I traveled a lot. The kids were in school here, getting involved in school. It was a difficult family time. There was a lot of stress on the job. And did the lack of a computer background prove to be a handicap to you? It probably was. I didn't realize it at the time. The one I remember, I already mentioned is, you know, when is a complicated computer operating system ready to ship? And a lack of a computer background there was a big problem. I might have been a lot wiser in terms of when it was introduced and how it was introduced and how the expectations were set than I was. But we had a number of these computer people, and of course, they were the ones who were right in the middle of it. There was a guy named Tom Blease, B-L-E-A-S-E. He used to come to see me all the time. His eyes glowed! I don't think he was taking dope but boy, he was really, he was really something else! I mean, this guy was so intensely turned on...

KIRBY: Turned by this stuff?

TERRY: ...involved with this stuff and Mike Green, I mentioned who was the father of the time-share operating system, I got to know Mike and I used to go back in the lab and see Mike and one day, somebody came to me and said something about, Mike riding his bicycle in the factory and Mike would come in at all hours on his bike, and he would not only come in on his bike but he would ride his bicycle down these floor tiles where he'd break his neck into the lab and parked his bicycle in the cubicle, which was really unknown at that time, and they didn't like that and I didn't like it too well either. And I went to see Mike and I convinced Mike without too much trouble to "get off the bike at the lobby and walk the bike through the plant and put it next to your desk." But I used to go back to the lab at night when we were working on some of these rescue projects. I remember one time, I went back there and I don't think it was Mike, it was another guy. I heard this conversation going on, and I thought, "Well, I'll drop by and say 'hello'." And I went over to the cubicle where this conversation was going on, and there was only one guy there!

KIRBY: Really? Talking to himself?

TERRY: Oh, yes, he was talking to himself! Pretty loudly! There were strange kinds of different people there.

KIRBY: Now, the Advanced Products Division had been formed. So George Newman moved over there. And that was still down in the Cupertino area.

TERRY: Yes. That was right across the street from the property we owned. It was in the leased building.

TERRY: And we had kicked them out of there. We were also running out of space in the Cupertino division or the data products division as it was called, data systems division as it was called. We had more room to build on the property and we had a second building under way but there were problems. I think we could have built three buildings there barely. Varian still owned the other piece of property that was right next door to us and the phone rang one day and Frank Cavier was on the phone and he says, "I've gotten a call from the VP of Finance at Varian, and they're having a really bad year, and they're trying to wind up their fourth quarter, and they'd like to know whether we would like to buy this property?" And I said, "Yes, I think we ought to buy this property. It's right next door to us. It was vacant, totally vacant, and what do they want for it?" And I think he said \$2 million. It was 45 acres of land in Cupertino; it was a number like \$2 million and I said, "Well, Frank, it sounds like a pretty good deal to me. I don't know, really, what the value is but why don't you see if you can sort of get them down a little bit and why don't we buy it?" Well, about 25 minutes later, he called back and said, "Yes, I've got a deal of \$1.7 million." It was the easiest land acquisition!

KIRBY: That's incredible!

TERRY: It was the easiest land acquisition deal we ever pulled off.

KIRBY: It's amazing!

TERRY: I think Frank wrote a check for \$1.7 million and 45 minutes later it was over and in Varian's hands and we were on our way to what, I believe, is a 90-acre site in Cupertino. Gosh knows what that thing is worth today. It's worth a lot of money! APD was across the

street in temporary quarters.

KIRBY: And they were going strong!

TERRY: They were going strong. The euphoria had died off a little bit on the 35 and 80 but it was going well. We were making a ton of money. We were terrible strapped for production capacity. We had just this two-story building there and we had ... there was a lot of labor that went into these things. And so we were looking around and what do we do next? And we were looking at alternatives in the Bay Area. We were looking at going out of the Bay Area and we were looking at overseas locations. And we recruited the people at HP Singapore because they did have production capacity: they had people, they had ambition, they had space and we recruited them to start manufacturing pocket calculators. And 10 or 15 years later, I got hauled in one day by an examiner or an attorney from the Internal Revenue Service, who sued Hewlett Packard because we had moved all this production to Singapore at very favorable tax rates and we made a huge amount of money on the lower tax rate in Singapore. And the IRS was trying to make some point that's legally complicated that we'd done this deliberately to avoid US income taxes and that was not true at all because I didn't know anything about US income taxes, corporate taxes. It was because we needed production capacity and Singapore was the place to get it.

KIRBY: Right. I can remember Bill Hewlett used to talk about the quality of earnings because the calculator business made up such a huge portion of HP's profits.

TERRY: Yes, we had a couple of years there where it was very unbalanced and you're right, it was the pocket calculator particularly but also...

KIRBY: And I think it was well over half.

TERRY: Oh yes, it was well over half. Yes, it was well over half. I don't remember which recession that was affecting the instrument business or military aerospace, but we had a, we just had a huge windfall you might call it of profits from these calculators, both desktop and others, and of course, the computer business was losing money and the instrument business was profitable but perhaps not as profitable as it was historically.

KIRBY: Now tell me, though, then Texas Instruments got into the calculator business.

TERRY: Oh, yes, they sure did!

KIRBY: And they were priced under us, and what was the effect of that?

TERRY: Rockwell got in, TI got in. The Japanese Sharp and others were already in with four-functions machines. It took the Japanese a while-I think they were concerned about distribution more than technology-to get into the mathematical, you know, scientific pocket calculators but TI got a project going without anybody from our company that I know about, to invent a scientific calculator. So the ground wasn't virgin anymore and we had competition, particularly in the distribution channel. Our distributors or bookstores or whatever would carry both TI and HP products, and that cost us some sales. They had a good product. KIRBY: How long do you think we had the market to ourselves, roughly?

TERRY: Roughly two years.

KIRBY: Wow.

TERRY: Two years on the scientific one and then maybe a year, year and a half on the HP80. People came along with the HP80. We did ... people who worked on it started filing a lot of patent applications early on. We had an opportunity. John Chognard came to me at least once, maybe twice, to buy chunks of patents related to pocket calculators or the kinds of notation-Polish notation, reverse Polish-and HP amassed quite a portfolio of patents on calculators and Chognard with great glee enforced that patent and made a very, very large amount of money in licensing people, Japanese, to use certain of these patents in calculators and we had a bigger patent portfolio than TI, although I think we had a cross-license agreement with TI. But I remember Chognard going to Japan and signing up licenses on these things and we recouped one heck of a lot of money on these patents.

KIRBY: So as the months and years rolled by, we had competition in the calculator field but HP, by that time, had a reputation for quality that served us well, didn't it?

TERRY: Yes, yes, it served us well although TI had a good reputation among the scientific

community for quality. It probably served us better than DEC. We had this engineering background and mentality so when it came to reliability, real time to failure and so forth, we were better. We probably were worse than DEC when it came to software reliability. We were learning as we went along, what all that meant. We were, early on, again, in following HP principles but a lot of energy and money into service and support and we were probably ahead of DEC maybe only, maybe even equal to IBM at the time in terms of service and support and after the sale, fixing things when they're broken. But it was a very competitive horse race and then we got Data General in the act, and they were extremely competitive, price competitive mostly, in the OEM applications.

KIRBY: That winds up my questions for today. Do you want to add anything?

TERRY: Okay. I don't think so. I've talked about most... Let me add one on the beginning of printers. We were buying printers. A printer was a required peripheral for these computer systems that we were peddling in different applications. We bought printers from Control Data, and we might have bought them, I think, we bought one from Sperry also. And again, it was like my other story: we found out pretty quickly. We thought that Control Data must have made a really reliable printer. Well, we found out it wasn't very reliable at all. These were large \$40,000 mechanical high-speed, multi-copy printing machines and so we sort of stood back and said, "Boy! There is a real opportunity to make some kind of a contribution in these printers." And in fact, most of these printers were designed for much heavier duty applications than we needed so we bought the rights to a printer from a company up in the northeast, northwest Seattle area, whose name escapes me (I still know the guy who runs it, used to run it). And we bought a design for about \$50,000 to make what was called a mogating printer. Ray Smelek in the Mountain View division was the manufacturing manager and he was very involved in helping to buy this design and prototypes and we eventually developed our own mechanical printer out of this design. It was really a pretty successful product but it was a first time we got our foot in the water in terms of printers, kind of driven by necessity to have them on our systems. A lot of money being involved and again, it was an engineering challenge, a mechanical-electrical engineering challenge, to invent a complicated printer and that was the beginning of that interest, which eventually spawned inkjets and laserjets, making marks on paper.