



**Fairchild Oral History Panel:
The Founding Years and R&D
Fairchild@50 (Panel Session # 1)**

Participants:
Charlie Askanas
Sam Fok
Jay Last
Murray Siegel
Bob Skurko

Moderated by:
Harry Sello

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Sello: .As I look out there, I can see at least 150 guys who could lead this off as well or better than I can. It's a pleasure to see all these mature faces, especially when the ones on my panel made it up the stairs all by themselves. <laughter> Charlie Askanas, on the end there, was a very good example. He just had to sign a release form. That was the paper we were signing. I don't know what we're releasing but he signed it and his immediate reply was, "Is this for a percentage of the gate?" <laughter> Well, welcome and it's good to see so many friends. R&D and the early founding years: I was supposed to go on last but, somehow, it came up first. I'd like to introduce quickly by name the great people we have here for the lead-off panel. Number one in order of time and in order of anything, is Jay Last. <applause> And the man who was employee number nine at Fairchild, in case you didn't realize it, is Murray Siegel. <applause> And somewhere along the line, I don't know how he got into the same group that I was in at the time, but I had to interview Bob Skurko. <applause> And Dr. Sam Fok, Sam's work I never did quite understand or master. It's called mask making. <laughter> Does anybody remember mask making? <applause> And one of the real early starts in a business that's a little bit different than the semiconductor business was Charlie Askanas, who was heading up the new division known as Fairchild Instrumentation. <applause> So, let's go ahead and let these guys take their four minutes allotted time. Jay, would you like to start the ball rolling?

Last: Hi. As has been discussed quite a bit, seven of my friends and I started Fairchild in 1957. I'd like to say a few words about those very early days. It was certainly the most interesting year of my life. We went into an empty building in the first of October in '57 and, by next summer, we had developed a product that scooped the industry. The eight of us and a number of talented people we persuaded to join us worked on a variety of things. We knew, in general, what we wanted to do. We knew we were going to work with diffused silicon but there were huge numbers of things that we had to reduce to practice and learn how to make a reliable product. I'll say just a few words about my part of this. I was not involved with diffusion but I was involved with a lot of the things before and after that. The main thing I worked on with Bob Noyce was developing a photolithography process. This is something that had been tried by Bell Labs, who had said that this is a completely impractical process. Bob and I said, "If we don't develop this, we ain't got a company." So that persuaded us that that had to be done. We worked on that and developing extensions of the photolithography went on steadily from that time on. I worked on a few other things as well. I had some optics background, knew how to process crystals, so I got involved with slicing and lapping the first crystals, which were all of 3/4" in diameter and that was pushing it. <laughs> Then another thing I worked on was the mesa process. We had to put a wax around the base of a transistor and etch it away to make a little mesa and I developed a technique for stamping this wax. I was covered with wax. At home, I had a medicine chest full of all sorts of industrial solvents so I could make myself presentable for a date that night. <laughter> After we made the devices, we had to put leads on them and I was involved with thermal compression bonding. Of course, turning all these things into a reliable process down the road took great effort. After the first product, I spent a year helping clean up the process and started working on some R&D products. I did some work with the parametric amplifier and then, in the summer of 1959, we realized that, with the planar process, the timing was right to try to make an integrated circuit so I built up and directed the group that did that until the first of '61, when we had made operating devices. At that time, I left Fairchild and went with Henry Singleton to Teledyne where Jean Hoerni and I started the Amelco division of Teledyne, along with Sheldon Roberts and Gene Kleiner, who joined us for a while. So that was the way things got started.

<applause>

Sello: Man, that's keeping right on time. Murray Siegel, employee number nine. You've got four minutes.

Siegel: Hi. I just wanted to give you a quick synopsis. It's kind of hard to do that as I was there over a span of the 11 years until we were invited to leave by popular demand. I arrived late in September of 1957 to join Shockley Semiconductor. I had been interviewed during the summer. I had just graduated from college and Eugene Kleiner was one of my instructors at college and he became a mentor to me. And, lo and behold, when he left to go out to Palo Alto to work with the Shockley Group, he had taken my home telephone number and address and said he would contact me when he knew I would be graduating, which would be in the summer of '57. Sure enough, he did call and made arrangements for me to talk to Bob Noyce. In fact, I was supposed to meet with Jay Last, also, at the IEEE that March/April of '57. Anyway, when I arrived in the Palo Alto area, I moved into a motel, since I had left my wife at home, she thought I was crazy, and I called Eugene and told him I was in town. He immediately said, "Don't go in." I said "Don't go in, you must be joking? I've got a job there, don't I?" "Don't go in, come to my home. We're having a little gathering and I need you to come to the house." So, Saturday evening, early, I showed up at the house and, lo and behold, there's a whole bunch of happy folks there drinking whatever they could drink and Gene immediately ushers me into the room and there's a group of eight fellows, miscellaneous wives, girlfriends. He proceeds to give me a packet of papers and said, "Go in the bedroom here and read the packet and then let me know." I read the packet and I suddenly realized, it's a proposal, a business proposal, a prospectus that Gene had written for setting up a company. I came out and I said, "Where do I sign?" On October 1st, we opened our doors, in effect, I opened my motel room, Vic Grinich opened his garage and various and sundry folks were scattered about while Gene was trying to finalize arrangements for acquiring a building without money, which is a different story. The Fairchild group had not come through at that time. That was still in the workings, if you will. Anyway, I agreed, as I said, to join the company. I met that Monday morning with Vic Grinich, who came down to my motel room, and we started kicking around what we would have to do to set up an applications lab. Obviously, I was going to be in applications engineering which, in those days, was part of R&D. I outlined to Vic some of my thinking, you know, when he said, "We need work benches" and I said, "Well, you know, I work standing up all the time and so did Vic" so he said, "Well, how do we design the bench?" So we designed it so that it'd come right at our belly button and, if we hired small people, they'd just have to climb on chairs and that's the way we designed the work bench, which became a standard in the Valley. The workload that I took on was basically product characterization, running the applications in lab and trying to make arrangements to get ourselves some materials at minimal cost, which was kind of tricky, from various electronic component suppliers. We did a variety of work, mostly on characterization and new product development.

Sello: Thank you very much. The next panelist is one of my favorites because he fell into Fairchild at a time when I had to decide whether to hire him or not, Bob Skurko.

Skurko: Thank you, Harry. Thank you. It's too bad Murray's talk was just getting interesting. In the short time I have, I want to share with you a few of my recollections of Fairchild. In 1959 I was hired by Charlie Sporck to work directly for Dr. Sello in something that was called preproduction engineering at that time. Preproduction engineering was the organization set up to transfer a product from research and development into production. The device that we were working on at that time was the first planar transistor that the world had ever seen. First of all, I should say that, Fairchild then was a brand new company with a new product in a new industry. By any stretch of the imagination, it was a startup company, not like the Google's and the Yahoo's and things we see today. The fringe package wasn't quite the same as it is now. It was a very austere company. The facility at 545 Whisman. was my guess, about a 20,000 square foot building that had a small assembly area. We had a wafer fab that consisted of a masking room and a diffusion room and, between the two, there were two Bell jar evaporators. And our job, I was hired as a foreman at that time, was to hire and train and get the production line up to a

level that we could turn it over to production. Ed Pausa was the production manager that was going to inherit this line and me as we moved from preproduction into production. My first assignment with Harry was to go to work for a lady named Wanda Chamberlain, who ran the masking room. Masking was where we did the photolithographic work that Jay Last was talking about earlier where we made the patterns that went onto the wafers. The wafers then were about as big as, a little bit bigger than, a nickel and each wafer was handled with tweezers and vacuum wand pick-ups. There was no mechanical transport of anything. We were all learning the business. The people that we hired, for the most part women, had no experience at all, of course, in semiconductor work, there wasn't any such thing, and they came from the canning industry, a lot of them in the area. It was not Silicon Valley then, it was Santa Clara Valley. The men came from maybe Lockheed, some of them, or Watkins Johnson, a few from Hewlett Packard, but that really was the industrial base of Santa Clara Valley at that time. But the company was very austere and tight. It moved very quickly. We had a very short chain of command. For my level, at the bottom of production, all the way to Dr. Noyce, there was only Ed Pausa and Charlie Sporck and Dr. Noyce. So things moved very, very quickly. A lot of changes were introduced by the assemblers on the line or the maintenance men on the line and we could make changes extremely fast. We would process special tests. And these special tests were constantly going through the line and, as soon as it was verified that these modifications were significant, the process specs were changed almost on the spot. So it was a very fast moving, fun company. I spent 24 years at Fairchild. I can say that, truly, that those first couple of years on the assembly line were certainly the most interesting and fun but also they meant an awful lot to me as I moved through Fairchild to have a good understanding of how products were assembled. Was there something else, Harry? <laughter> No?

Sello: No. Not in your work. You always finished the job.

Skurko: Thank you.

<laughter> <applause>

Sello: You'll notice yesterday, those of you who attended the talk, Gordon Moore made a point of saying that there's no R&D at Intel because they don't transfer anything from anybody in R&D into production. They start in production. This was learned at Fairchild. We had a preproduction function but that disappeared very quickly. Something that is not needed in the industry any longer. Sam Fok had one of the toughest jobs around, mostly because he was the only one that understood it. So, Sam, maybe you could say a word or two if you wish about what a super mask-making machine should look like.

Fok: I came to work at Fairchild after Harry left Shockley. And then I got a phone call from him in 1960 and they said, "Sam, how about you come on over in charge of all the diffusion furnaces." I said, "No, thank you, it's too hot a job for me." <laughter> Anyway, I went to the R&D lab on Charleston and it was a job almost perfect for me because my hobby was photography and they put me in charge of microphotography and also in the resist processing. I loved to do that. At that time, we moved from the original R&D lab to near the Veterans Hospital. We were the first ones moved because I had the biggest camera in Palo Alto, I guess, in Mountain View. We got one of the four cameras. We did our artwork usually around 400X and we'd reduce it down to 1X. You can see [the model of the camera] and some of the pictures in the hallway there. The Computer Museum, said they want to keep the model so I said fine. Other than that, let's see, well, one thing is I when went to work for Fairchild, I got badge number

1776 and I had to report on Washington's Birthday. I said, "Isn't that a holiday?" <laughter> So I got out of work on the first day. But they kept me busy, though, for ten years with them and I enjoyed every minute of it. So I finally retired and after that Gordon told me that there's somebody starting up with cameras and so on in East Bay. I went there at that time, worked for a while and then retired.

<applause>

Sello: Thank you. His modesty is immense compared to some of the others of us who approaching the mike and are standing at the mike but I want to say one sentence or two about him. Sam was very much involved in the design and the construction of the first and practically only shoot-on-the-fly step and repeat camera. The words step and repeat means you stop in between when you make exposures. Sam designed and built a camera on granite blocks that shot on the fly. It never stopped, just kept making masks continuously. That was quite an effort. The next gentleman is a master joke teller but he's promised that he won't tell any jokes. This is Charlie Askanas, who it was our pleasure to say was at the start of the long, continuous trend of Fairchild in Instrumentation and Test equipment. Charlie.

<applause>

Charlie Askanas: Thank you. I transferred out to Fairchild in 1962 from the east coast and, at my age, I forget everything after that. And I thought I died and went to heaven, just going from New York to the Bay area. When I took over as the Instrumentation plant manager we were testing diodes, starting to build equipment to test transistors, and we even built a transistor curve tracer that was transferred to Dumont. When I left, in 1970, we were pretty much the standard, the 4000 [machine] was pretty much the standard for IC testing, though there was an awful lot of change of technology in that period of time and it was very exciting. I just would like to add a couple of words about the environment there, though. Bob Noyce was the first real leader I ever encountered and I think everybody felt that way. Charlie Sporck was the toughest and fairest guy I ever met and, even all these years after that, whenever I get my behind in a crack, I say, "What would Charlie do?" And Tom Bay was the coolest guy I ever met so it was a hell of a bunch. Thank you very much.

<applause>

Sello: The slide you have been staring at up there describes something typical about Fairchild. I had five major bosses in the seven years that I spent at R&D and they're all listed up here. The most interesting part of it was the assignment Bob Noyce gave me one day after appearing in my kitchen. He said, "Next month, you are due at SGS in Italy. You are now the Operations Manager." And I said, "How much time do I have to get there?" He said, "Well, you can take the next few days to go over and get acquainted but, at the end of the year..." and there was two more weeks left, "...we want you moved over there." I think this was typical of Fairchild of the period. Now are there any questions?

Audience member: Where were the Fairchild headquarters located?

Sello: Let's see, the opening was at 844 Charleston Road in Palo Alto. That's where it started. The headquarters then moved to Whisman Road, where Fairchild stayed for a long time. Charleston remained as an R&D adjunct for a while and it also housed a few other groups. Then the big building on 313 Fairchild Drive was built, the one that faces the freeway, and, from there, it went to 464 Ellis Street, what we have learned to call the Rusty Bucket before everything disappeared.

Audience member: Wasn't there an impedance mismatch with the East Coast parent company?

Sello: Not only was there an impedance mis-match, it was total resistance. Total resistance.

Askanas: In about 1968 or '69, semiconductor became responsible for the Dumont operations. They were all incorporated into one division. But any instrument that we developed in instrumentation sort of evolved to Dumont Laboratories, like the curve tracer. They were almost our arch enemies in that way. There was also a lot of resentment about all the profits being made by the Semiconductor Division being wasted on the east coast.

Sello: The net profit of all the total divisions of Fairchild Camera and Instrument was zero. The only profit was being made out in Semiconductor.

Sello: I wanted to point out another factoid illustrated on the slide. If there was one symptom you recognized at Fairchild was to answer the question, "Who is your boss now?" <laughter> Chances are, he was gone or he was in another division. You can see [my history] -- this is only some six years. Moore, Sporck, Italy (Bonifacio) and Noyce, then Moore again, thank goodness Gordon was still there. Then he leaves and Jack Kabell takes over. But I think, if you look through most of the history [of those] in the audience, you might find that there are as many bosses, so called, as there are employees.

Audience member: Can you say anything about Les Hogan's arrival together with Hogan's Heroes.

Sello: Let's see. I ended this session at '68 purposely. <laughter> That isn't really the question. The question is, can you talk about that? There are some things I could say but some I won't talk about. <laughter> The departure of Moore and Noyce was sudden. It was a big blow and, for a period of at least two weeks to a month, no one could really understand what was happening. Let me give you an isolated incident. At the time that Les arrived there was a sales conference in Hawaii going on among the marketing guys. They had sales conferences in Puerto Rico, Hawaii and down in Mexico, every place they could find, Jerry Sanders, the ace marketing, after Tom Bay, was leading this conference and he was dressed in his usual Hawaiian garb for that kind of a conference. Everybody was wearing shorts, flowery aloha shirts, you know, the works, some were barefooted. I don't remember that Jerry was barefooted but he was there. And then the word came to the conference that we had a new CEO, his name was Les Hogan and he had arrived with his "Heroes." That's the way it was couched. Hogan and his heroes. Jerry looked around and there was a pause. He said, "Well, maybe we should adjourn for a little while and come back in the next hour or so and we'll continue our conference." When the conference continued, Jerry showed up in a beautiful white suit <laughter> just like an evangelistic minister, <laughter> his hair was neatly in place and white shoes. I remember because I ran like hell the next morning and got myself a pair of white shoes out there in Aloha country. And the whole atmosphere

of the place changed. Jerry said, "Well, we're going to have to find out about all of this," from his white suit. "And the conference will continue to a finish."

Audience member: What are the main problems with the business today?

Skurko: I can't discuss today's problems. I'm not in the business any more. But, when we started, the critical issues that we faced were, first of all, to get the production to ramp up to a level that we could turn it over to production. The sales and marketing people were doing a great job in introducing the planar process and the devices that came from it to the marketplace. We had a challenge to get production up. The issue was then, as they are now, yield was very, very important. And quality was always a problem my whole life at Fairchild. I'm sure that yield and quality are still the critical issues going on today in the semiconductor business.

Audience member: What can you tell us about Jean Hoerni?

Last: He was a very complicated guy. He could be the sweetest guy in the world and could be the nastiest guy in the world. He switched from one to the other. Jean was very French. <laughter> He would get very irritated about things and, fortunately for Fairchild, he did his best work when he was very irritated and he was irritated a lot <laughter> so a lot of work came out. He was a dear friend of mine. He and I climbed mountains a dozen times a year together so I got to know him very well. I'd swear at him and love him in the same half-hour period.

Siegel: I had the pleasure of working with Jean and so did Hank Bloom. We worked with him on several devices that he was bringing down. He did the first gold doping. There were a variety of devices, certainly the planar. I worked with him on that. I had the pleasure of also working with him when he brought me over to Intersil, and I worked with him again at another company. Jean was a very complex person. He ate up marketing sales people all the time. He devoured me at least once or twice. Jean was a very loyal individual to the people that worked with him so, from a standpoint of Jean, complex, absolutely, but an absolutely a brilliant mind. It's just unfortunate that he passed away much too early in his career. He deserves the recognition of a Nobel award, frankly. I know because I did characterization for him.

<applause>

Sello: This isn't a Fairchild story but it's indicative of the personality, I met Jean Hoerni at Shockley Semiconductor. That was a pre-start to Fairchild. And I met all the guys that you recognize as the fateful eight there, I don't like to say treacherous eight but the fateful eight. When I arrived at the Shockley Laboratories I got acquainted with each one of those guys very quickly. No problem making friends with people. I couldn't find Jean Hoerni. Well, it turns out that Jean Hoerni was living in a motel at the time where he was locked up with all of the diffusion manuals and all of the differential equations it takes to operate and calculate diffusion curves. He was the guy who devised the entire data handbook that later was also used at Fairchild and he did this all himself, very clearly and very artfully. It was a tremendous asset to have him explain those kinds of curves to a lowly chemist coming in for the first time. It was really gratifying.

Hulme: I'm John Hulme. I was head of the applications group in the days when Bob Widlar came to interview. I think Don Valentine told me he was coming. Bob showed up and he had a convertible Pontiac. He had on a t-shirt and Levi's and a very scabbed hand because the gearshift knob had come off his shifter and it had just skinned his hand up real badly. He had this panda look from his dark glasses and he didn't make a very good impression most places that went but he and I hit it off pretty well. With a great deal of gambling involved, I hired Bob to come into the applications group while he was still essentially in the Air Force. He had been working at Ball Brothers in Colorado. Before long he became really very, very creative. Just without question, I say Bob Widlar was probably the most intelligent guy that I ever worked with. Our rules were that we could use anything that could be produced in production to design circuits and his assignment was to make an analog or a linear amplifier that could use those processes or those features and that would be interesting to people. Dave Hillbiber worked in R&D at the time. He was in charge of the R&D group for linear design and I attended a meeting one day. Dave Hillbiber had an idea for an op amp and I asked Dave if we couldn't get together and talk about it in more detail and he shut us right off. He didn't want to get something into production that would not be ripe enough to really go. So after I left one Friday afternoon Bob called me on the Sunday afternoon and he said, "I think I've got the idea." He had used what we called the kit-part mask, which had a number of transistors and very loose tolerances, and he said, "I've been able to make a PNP." He said, "It has a beta of point one but I think it'll work." <laughter> He had been there continually during that period of time. I don't think he had ever left the place. And that was the start of the 702. Anyway, he came along with many other things. Bob was a real genius, as I said before, whenever he had a glass of whiskey in his hand, he could just talk without difficulty in great depth, just a tremendous mind. Bob came into my office one afternoon and he said, "Do you have a piece of paper?" and I said, "Yes, I do" and I handed him a piece of paper. And with his red pencil, he wrote down, "I resign effective tomorrow." <laughter> Then I said "Why do you want to leave?" and he said, "Well, my goal is, I want to earn a million dollars by the time I'm 30 and I'm getting pretty close," he said. "That's a couple years off." And after a conversation, I said, "Bob, I think you probably might make it." I said, "I'd like you to keep me in touch, let me know when it occurs." A couple of years later, I got this call about 3:00 in the morning from some bar. <laughter> I don't know how he still had my number but he said, "I told you I'd call you. I made it. I'm now worth over a million dollars."

Blume: Bob went to see Charlie Sporck, he asked for a royalty on every op amp that Fairchild sold. Sporck said, "You'd be making more than I would" and Wilder said, "I'm worth it." <laughter> And then he got some money from Peter Sprague to start up [what later became] National Semiconductor on the West Coast.

Audience member: I was up at R&D and I heard this tale and I don't know if it was true or not. That, at one point, manufacturing completely lost the recipe and yields went to zero and it turned out that a farmer in the neighboring field had been spreading phosphorous fertilizer and that killed the yields.

Siegel: We also had a bonding problem and it showed up with Micrologic when I was working with Bob Norman and a variety of other people. I had been sent from R&D to manufacturing to help bring from R&D Micrologic into production because production was gagging on it. I remember one incident when I was trying to figure out what the hell was going on inside these devices so I kept asking for devices that I could run through a life test program where I could see what was devouring the pad underneath the bond. Well, Charlie Plough, if he's out there, forgive me, but I'm going to say it, Charlie Plough was being judged by how many seals he could make and here am I trying to run an R&D program in manufacturing. I said I needed the devices for examination and life tests that I wanted to run. Well, Charlie insisted on

sealing the devices because he was getting credit from Charlie Sporck for the seals and I was cutting the goddamn cans off at the end of the line. <laughter> So here were these Micrologic devices with the cans being sealed, me buying them from him, I had to buy them, by the way, charged against my budget, and I was cutting the tops off to examine them for purple plague until we tracked that one down.

Sello: That problem was later solved by very ingenious work in my R&D group, then led by Gordon Moore, by Dr. Ilan Blech who published on that issue. He found that the placement of a gold ball in the wrong area of an aluminum run on a device would create the proper proportions of the undesirable compound, aluminum gold silicide called purple plague and the bond would break. If you knew where to place the ball on the proper area of the aluminum and not on the silicon it would work beautifully. That took some years to come around but the marketing guys, bless their hearts, settled on solving most of the issues in the field by saying, "It's those R&D guys that make purple plague." <laughter>. Thank you all. Wonderful talk.

<applause>

END OF INTERVIEW