Optical Society of America
Oral History Project
Interview with David F. Welch
Conducted on March 7, 2011, by Adrian Kinnane

AK: Good morning. It's March the 7th, 2011. We're speaking with David F. Welch at the OFC/NFOEC Conference in Los Angeles. Dr. Welch is currently executive vice president and chief strategy officer at Infinera, a company that he co-founded in 2001, almost ten years ago. He's also a recent director at large of the Optical Society of America and a fellow of the I.E.E.E. At this conference he will be honored with the John Tyndall Award. Congratulations, Dr. Welch, and thanks for spending some time with us this morning.

DW: Thanks. It's a pleasure to be here and a pleasure to be at the conference. It's a great place.

AK: We will get around to the Tyndall Award and to the work that led up to it. But first, to go back to the very beginning, where were you born and what was the date, if you don't mind saying it?

DW: I was born in Washington, D.C. I grew up in Annapolis. I was born on October 26, 1960 to a large Navy Catholic family. I was the last of seven kids. We ended up living in the Washington area. I spent most of my time in Severna Park, Maryland, which is just up the river, just up the bay from Annapolis.

AK: Was your dad at the Naval Academy then?

DW: He wasn't at the Naval Academy at that point. He was retired in the Navy. But he was a Navy grad, Annapolis grad, went through World War II. I actually wear his Naval Academy ring in his memory. Two of my brothers went through the academy. I was accepted to the academy and, much to his chagrin, I decided that that wasn't the right career path for me.

AK: Were either of your parents inclined towards science or engineering?

DW: We have a very technical family. My father, although he was in the Navy, was really an engineer at heart. While I was growing up, he was an engineer at Westinghouse. He worked at Westinghouse. Their facilities were out by the Baltimore airport. They worked on a lot of torpedo, military munitions for submarines and surface ships during that time. Growing up, my engineering experience was with my father, sitting down and developing different engineering projects. I remember the first one we built was an electronic tic-tac-toe game that never lost. That was my entrance into the science fair with some help from my father.

AK: What grade would that have been?

DW: That was probably in the seventh grade or so. Then every year after that there was some electronics project. Calculators, I forget what it was, the TI-11 or something like that.

The first calculators were just coming out. This is in 1970, '72, somewhere in that type of time frame.

AK: You were the seventh of seven children?

DW: Yes.

AK: Were any of your siblings also involved in science, science fairs, and engineering?

DW: Yes, they all had their variety of science. My oldest brother was a fighter pilot in the Navy and he was an aeronautical engineer. My next brother, he really split life between a mathematical economist and artificial intelligence studies. He jumped careers. Another brother was a nuclear engineer and worked in the submarine programs in the Navy. My sister works for the E.P.A. as a biologist. My other sister was a zoologist, and the next brother was a geophysicist. We all had our various types of passions and passions around science. It was integral to our thought process.

AK: When you guys get together, that's a pretty good brain trust there.

DW: Yes, but we like to argue politics as a family. You know, the beauty of the seven kids, especially growing up in the seventies, the dinner table had some interesting arguments to it.

AK: You continued your science interest in high school, along with the other subjects that you were taking?

DW: Yes.

AK: Tell me a little bit about your teachers. Did any of them stand out in your memory?

DW: Sure. In high school especially, mentors are important and sometimes hard to come by, but I have strong memories of my chemistry teacher. She was very supportive of my need to understanding things. For me, I needed to understand the deep physics to really get a sense of how things are going to work, much more of a materials – my understanding derives from how different materials pull together. I think that she resonated with that. Her name was Mrs. Foster, I think.

I had a great gentleman that taught physics in high school, very challenging and did a lot to develop the intuition about how to go about solving physics problems. The combination of that and the outside science fair type of curriculum is where I really developed the thoughts.

AK: What high school was that?

DW: Severna Park High School.

AK: Along comes the decision, then, where to go to college, including the Naval Academy.

DW: Yes. So what drove my college direction? At that point our system was junior high – grades seven, eight and nine. High school was ten, eleven and twelve. In entering ninth grade, I had run out of the math program at the junior high facility, so I moved to the high school. So technically, as it turns out – my wife likes to kid me about this – I never graduated from high school. I left high school a year early. I had all of my credits with the exclusion of a year of English from that.

So I entered college at the age of sixteen. The University of Delaware was right up the road. It was close enough where my parents felt comfortable about it. They had a program oriented around kids who wanted to enter college a year early. So that worked out there, what they called the freshman honors program at the University of Delaware. That's what drove me to the University of Delaware for undergrad.

It wasn't until the following year that I was old enough to apply to the Naval Academy. You can't really apply at the age of sixteen. So I went through the process of applying. A funny story was at this point in time, a year into college, I'm playing for University of Delaware's baseball team. The day that my decision was due at the Naval Academy, the University of Delaware played Navy in baseball. So we came down to the Naval Academy and played them in baseball. After the game I told my father that I wasn't going to go to the Naval Academy. He was very much Navy, so he was disappointed in that. So that's how that came out.

AK: I assume he got over it.

DW: He got over it. It took him about two weeks to get over it but he got over it.

AK: What position did you play?

DW: I was a pitcher. Not a very good one, but I was a pitcher.

AK: Maybe you can tell everybody what a blue hen is, the University of Delaware mascot.

DW: A blue hen? Well, I'm not sure I'm going to get the story right. But, back when cockfights were the entertainment of the day, I guess, the blue hen was a particular breed of chicken or whatever that was a dominant fighter. It doesn't resonate with people today. But I'm sure back then it did.

AK: Recently you were inducted into the University of Delaware's Alumni Wall of Fame, they call it.

DW: Yes. There was a very nice program that Delaware set up to acknowledge contributors to the community. They had a wonderful ceremony where there were about ten of us that year, where they pick a representative from, not every college, but most colleges. I represented the engineering college to be inducted into the Wall of Fame.

AK: Congratulations on that.

DW: Thank you.

AK: They chose ten people out of over 146,000.

DW: Well, the truly noteworthy guy that sat next to me on stage turned out to be Governor Christie from New Jersey. He was elected into the Wall of Fame that same year. So it was a pleasure to meet him and very fascinating to watch him battle his political battles in New Jersey right now.

AK: He was three years behind you graduating?

DW: That's correct.

AK: Did you start playing baseball at Delaware when you were sixteen or did you wait?

DW: The subtlety of the story is I was a University of Delaware student, freshman honors program, to make it complicated; I apologize, but was housed in Dover, Delaware at the Wesley College campus. So they allowed us to play on the Wesley College baseball team. So technically it wasn't the University of Delaware baseball team. It was the Wesley College team. I did play freshman year for them.

AK: I understand. Then you went to Newark?

DW: Then they moved us up on campus for sophomore year. By that time, my arm had fallen off and then I wasn't able to pitch anymore.

AK: As the youngest of seven, I'm going to assume that maybe that made the adjustment to the college life at the age of sixteen a little easier. I don't know.

DW: My next-oldest brother, my brother Chris and I are very close friends. He's about a year-and-a-half older than I. He was at the University of Delaware also, so getting connected with him and all of his friends made the transition in the college very easy. We got to share a car, which, if you remember back in the early days of college, having access to a car is a big deal. That worked out well.

AK: Tell us a little bit about your work at the University of Delaware. You majored in electrical engineering.

DW: Electrical engineering, yes.

AK: Relationships with professors, particular interests that came out during those years or got honed or fine-tuned for you?

DW: Sure. The University of Delaware is a great school. I really compliment it on a number of things. One is that the professors were not only great teachers, but great individuals. Professor Pete Water was the head of the Electrical Engineering Department at that time. I think he was working out of Webster Xerox from Rochester, then came down to run the department. So he had a great academic perspective matched with industry, how to go about and get things done. I had a couple of sophomore and junior projects that I worked with Professor Water on in laying out kind of memory buses for printing applications. That was a great experience to see the engineering work.

There are a number of great professors there. Professor Fagan was the guy that taught semiconductor physics at the senior level. He was just a great guy to be able to intuitively think about the physics processes, what you can do, what effects you can create, the magic of photon and phonon transitions within semiconductors. I think that's really where my passion for semiconductors originated. I would eventually take that through graduate school and through my current career.

Professor Hunsberger, he had come in from Hughes Research Lab. He was the optics guy at Delaware and very passionate around his research. There was another gentleman, I forget his name, but he was in the physics department, and he taught thermodynamics at that point in time. All of those professors had the mixture of exceptional knowledge, but compassion for a student and the willingness to sit there and take time to think beyond what the problem said. A great group of teachers there.

That compassion, every time I go back to the University of Delaware and I run into their current professors – there's a gentleman there I think is fantastic, Dennis Prather, a great optics researcher. He really exemplifies for me the school's intellect, drive and compassion for a student. It's a great institute.

AK: You found lots of resonance for what you mentioned earlier, what you had discovered with Mrs. Foster, your desire to get at the underlying physics of what you were doing.

DW: Understanding the underlying physics for me helps a lot and understanding the dynamic that's going on. I like getting down to the solid state physics or to the atomic physics aspects and how that changes the characteristics of the materials and then ultimately obviously the characteristics of the systems.

AK: The laser specifically, but optics in general, is a great field for blurring distinctions between physics and engineering.

DW: It's fantastic. The opportunity for creativity, and the set of tools available to you to go solve a problem is great. Frankly, I love coming to this conference. You've got thousands of engineers and the key is to make sure they understand the problem they're trying to solve. They just keep on coming up with new concepts. It ranges from whether it's part of a new material system to whether it's just a whole new structure of how the communication network should work.

AK: One other aspect of Delaware and the university there is that Delaware's Chancery Court is emblematic of the state's expertise in corporate financing and everything from bankruptcy to acquisitions. Maybe it's the presence of DuPont and Hercules and other companies historically, but did that sort of business entrepreneurial element in Delaware also infuse the university and specifically some of the experiences you had?

DW: There's absolutely a good tie with the industrial community, DuPont especially at that point in time, this is in 1980 or so. DuPont is very strong. The university's chemical engineering department is one of the best in the country as a result of that, as well as the rest of the engineering college. So DuPont was engaged. There's lots of effort with starting to get into the solar cell technology developments even back in the early eighties process. My engagement with the industry wasn't that strong. I worked through the professors a lot. I didn't quite see as an undergrad the influence of the industries. But there's absolutely a strong tie up there.

AK: I think you mentioned, was it Professor Water, part of his repertoire was this knowledge of the business world?

DW: Yes, Professor Water, coming down from Rochester and the exposure he had there through Xerox , was the combination of a bright, but practical engineer and trying to solve real-world problems.

AK: What did you do in your summers?

DW: Well, I had a number of interesting jobs. I always worked at engineering firms. The first couple of summers I worked at a place called Aeronautical Radio, Inc. or ARINC. They were responsible for radio technologies on planes. A lot of the commercial airlines benefited from that. I did a lot of work with communication systems on anything from fighter jets to AWAC communication systems for the military. My first summer was pretty much a cut-and-paste job of going through a lot of specification manuals for a variety of jets and collecting the information there. But it was fascinating to look at and to learn and a great experience to be in an engineering environment, as early as freshman summer.

We did that for two years. The benefit of ARINC, which as a college kid was fabulous, was that after six months of employment you got all the benefits of, essentially free flight on the airlines. As a college kid to be able to go skiing in Europe for $18 or something like that, that was a great deal. (Laughter.) Another side benefit.

Senior year, in-between graduation and graduate school, I worked for Westinghouse, which was up in Baltimore. They had an advanced technology lab, which is all their silicon processing. Back then it was a submicron push by the military to advance the technologies of silicon.

AK: As you were approaching the end of your college career, a number of things might have been going on in your mind as to what to do, to go to graduate school or not, to do it then, later, what kind of school. Tell me a little bit about how approached this decision point.

DW: I approached it with a lot of naivety and arrogance, I guess. I knew I wanted to go to graduate school, or I felt I wanted to go to graduate school. So I applied to my four graduate schools, which were Stanford, U.C. Berkeley, Cornell, and M.I.T. I got all my letters of recommendations in and sent the packages off. I assumed that it'll all work out. That was probably early January. I remember in March, going to the mailbox every day, waiting for someone to say they had accepted me and then starting to get more and more nervous about, "Gee, maybe I should start looking for a job." Eventually acceptances started coming in, which made me feel better. But there was a good month there where I was sitting on edge on whether I made the right choice of applying to grad school.

AK: But it worked out.

DW: It worked out great. It worked out great.

AK: Tell me about your decision for Cornell.

DW: Professor Eastman was my advisor at Cornell. He had elected to bring me in as a research associate, which is a great position. When you come into grad school, there are lots of ways, but two of the ways would be a teacher's assistant, which is basically grading papers and running problem sessions with undergrads, et cetera, or being a research associate. You get to dive right into the research right away. Professor Eastman offered me a position as a research associate, which was a chance to just get right into the research side of things. I thought that was best. At that point I was still an East Coast boy, so wanting to stay on the East Coast, and closer to the family worked out great.

AK: You earned your Ph.D. from Cornell. Was it ’85?

DW: I finished my thesis December of ’84. The degree date was awarded in ’85.

AK: But you finished your work in late ’84?

DW: Correct.

AK: Tell me about your work and how your interests were shaped at Cornell.

DW: Cornell is a great place. Professor Eastman is a classic, extremely bright, extremely intuitive, intellectual thinker, but he does it in such a way that it really inspires his students. He had a pretty large group of graduate students there. I think when I was there it was maybe twenty-five. At some point it had actually gotten up to almost thirty or forty graduate students. He had all of these concepts going on. Most of his work was high-speed transistor-oriented, and a lot of it was around the materials development to get these technologies to come together. It was a little bit back to my earlier stated passions of semiconductor physics and how to get to the device side of things.

Time-wise I probably spent 60 percent of my time dealing with the material science of my thesis and the remaining part on the more classical electrical engineering device side of the equation. He set up this organization. You could go in there and get your hands dirty, day one. I'll never forget, the first couple of weeks at Cornell they had this machine called a molecular beam epitaxy crystal growth system. You got right in there and you roll your sleeves up and you start fixing a system. You start getting this crystal semiconductor growth system tuned to be able to give you the right quality of material.

At that point in time they didn't have a good understanding of what made the materials good or not. This is a real transition in the science. The historical crystal growth methodology would have been what was called liquid phase epitaxy, which created very non-uniform semiconductor materials, very good purity materials, but they became inhibitive to what the devices of today would be. They really required the development of these new machines, the reactors, the molecular beam epitaxy or the MOCVD reactor systems that enabled the optics industry to take off.

AK: So you were then researching at a critical time for the development of optical communications technology?

DW: Yes. I started grad school in September of ’81. I would say until about the late eighties the optics world, especially the fiber optics world, was immersed in materials development. They had to really get the materials science right in order to get the devices to operate repeatedly at the characteristics that they needed. That phase probably started in maybe the mid-seventies and went through the mid-eighties. It wasn’t until they were able to develop true monolayer crystal control that they could reproducibly put together the technologies necessary for the optics industry.

From that, you can see in the late eighties, the applications started really taking off. That aligned itself with other great inventions like the erbium-doped fiber amplifier that really enabled the optics industry to become what it is. But in the early eighties it was still very much developing the right chemistries for device physics.

AK: I’m struck by the sort of synchronicity between your early interests in the fundamentals of how materials work and where you end up in graduate school and at the same time where the industry is.

DW: That wasn’t by forethought. (Laughter.) It worked out that way. The beauty of coming into the optics industry in that time frame is there’s just a huge amount of discovery that could be made. The types of things that went on in semiconductor lasers and semiconductor optics technologies over that course of time were incredible. The map between the different materials technologies and the desire to get the variety of different applications just created a great opportunity for discovery.

AK: Coming up on the end of ’84, you’re finishing your doctoral work in electrical engineering. Another decision point, what to do, where to go. What were your thoughts at the time?

DW: A couple of dynamics went on in my decision of where to go. I started interviewing in the fall of ’84. I interviewed at a number of places. My first job interview actually was at Bell Northern Research, which eventually became Nortel, transitioned to Nortel. I interviewed there, interviewed at a variety of places out here, Hughes Research Labs. At that point in time there was a company that was being formed called Spectra Diode Labs. It was coming out of a group of researchers out of the Xerox Palo Alto Research Center. Don Scifres and Bill Streiffer and Bob Burnham were this group of researchers at Xerox in Palo Alto. Don Scifres had formed this company, Spectra Diode Labs, the year before I graduated.

It just so happens that my brother, who I had mentioned earlier, who I was still very close with had moved to California the year before. I thought, “Well, what the heck? Let’s go on out to California. We’ll take this career opportunity and get a chance to spend some more time with him out there.” The running joke was I was going to move to California for three years and then figure out what the next thing to do was. Of course that was almost thirty years ago, twenty-five years ago.

AK: Did you consider teaching?

DW: You know, I didn't. My assessment on my talents was that I am not academically – I consider myself intelligent, but I'm not the guy that's going to get into the most deep physics analytical explanations. My talent was what I characterize as running fast. So if there is an opportunity to pursue, then I felt that I could take the tools that I could make available from an engineering or a research point of view and just work quickly. I wanted to make sure I got into an environment that fostered that. This start-up company, Spectra Diode Labs, was just a perfect match because they obviously had to run fast. I enjoyed doing that. So it worked out great.

AK: Running fast?

DW: Yes

AK: I came across a description of people who are very good sight readers of music. And the idea was it's not that their eyes are somehow magically faster but they kind of know the most likely patterns that are going to pop up in the next bar.

DW: Right.

AK: How would you say that applies to you?

DW: You know, over the years you develop an intuition. Basically intuition is having seen the pattern before and being able to draw. I'll digress here for a second. There's a great book I once read. It was actually by a Cornell alumni also. It was a book called *On Intelligence*. I think it was the guy that was integral to the development of the Palm device at that point in time. He laid out what I thought was a very clear argument of what intelligence was. It was seeing a pattern and then projecting forward from your experience where that pattern's going to go. The people that could sit there and coordinate a pattern across a greater breadth, either from their experiences or from the way their brain was configured, could project further forward on where things were going to go.

When you're in an industry or you're in a technology for a long enough period of time, you've seen the patterns of the technologies. You've seen the patterns of the people. That helps out a lot to be efficient in being able to run fast and be able to get things done and to be anticipating things. I've enjoyed two start-up companies. Their successes, a lot of it comes out of the ability to anticipate both the opportunities and anticipate what are the roadblocks early enough where you can make sure to get around them, and understanding that is critical.

AK: So you started as a research scientist at Spectra Diode Labs, which I think is now known as SDL in Palo Alto. You moved out west. Your brother broke the ice. What kind of work did you start doing there specifically? What were your projects?

DW: Well, Spectra Diode Labs was founded on the belief that semiconductor lasers could offer a lot more power than they had been producing. You know, at this point in time, semiconductor laser output powers were in the range of a few milliwatts. They had developed and demonstrated a first couple of lasers that could put out 100 milliwatts of power. It was all about the implementation of these new growth technologies, which at that time was MOCVD or metalorganic chemical vapor deposition techniques, to semiconductor lasers. By bringing that technology in, they were able to create very high-power semiconductor lasers for that point in time.

What they didn't know is what they were useful for. So the company was founded as a joint venture between Xerox, which had developed this technology, and Spectra-Physics, which was a long-stake company from – I think it dates back actually – Herb Dwight was involved in the early gas laser developments in the sixties. They had a whole bunch of laser technologies. They saw semiconductors as a technology that they were going to have to have as a part of their portfolio of technologies. So they formed this start-up with Xerox. The employees owned a share of the company as well, and I pushed off in that direction. My job in coming in was to work with the people doing the crystal growth and making semiconductor laser devices, to advance that, and really doing research for the next generation of semiconductor lasers.

AK: At some point you became vice president for research?

DW: Yes, so my career there spanned seventeen years. It went through a research scientist phase. A wonderful gentleman, Bill Streiffer, who was part of Xerox, he actually went to the University of New Mexico to start their optic center but then moved from the University of New Mexico back into industry and became our vice president of research. He mentored me along with Don Scifres in that process. Then in the late eighties or so I took on the role of vice president of research within Spectra Diode Labs or SDL. That company continued to grow and evolve. It went through a number of very fascinating phases of different markets that they pursued and then obviously the success of the communications business.

AK: You also became chief technology officer and vice president for corporate development.

DW: Yes. As the company grew and the markets grew, somewhere in the ’94 time frame we realized that we had come up with a technology, these 980-nanometer pump lasers, and they were going to be critical to the communications marketplace. The erbium fiber amplifier had come out in the few years prior. It had come onto the stage being pumped with a 1480-nanometer semiconductor laser. But they found that the noise performance was much better out of a fiber amplifier with 980-nanometer diodes. We had one of the unique technologies to be able to get high power, high reliability out of the 980-nanometer lasers.

In that process we converted our company from a company that sold to a wide variety of applications from printing, materials processing, pointer lasers, satellite communications, a whole variety of applications, now centered the company in and around communications. We didn't eliminate all the other applications, but we really focused that 80 percent of our business or more was going to come from the communications sector. So we reorganized. We knew for us to grow in the communications sector, we were going to have to do two things.

We were going to have to dominate the world of the pump laser business. We had to bring in optical packaging expertise in that process. And in order to be a major supplier in the communications industry, we were going to need more than just 980-nanometer pump lasers. We were going to have to add lithium niobate technologies, silica waveguide technologies, a variety of other technologies necessary to be a broad-based product supplier in the communications industry. So I took on the role of both chief technology officer but complemented that with corporate development and went out and looked for what were the right companies or technologies to acquire within SDL and broaden our portfolio for them.

AK: You had mentioned that this was a company that had some really fabulous ideas and discoveries but didn't quite know what to do with them. It sounds like you're finding something to do with them.

DW: In the beginning I characterized SDL Spectra Diodes as a technology push company. It had a great technology. They had some concepts of where the market might be. That company transformed itself around the communications market and said, "You know what? This is a market pull. We really have a technology that's useful in the communications industry. Let's go after it." We did find the applications. Even the technology as it was developed then and the unique semiconductor processes that made it special are still being used today. I would say the original work for that technology was done in probably 1988, '89. It is still the very similar processes that are being used today. As the major supplier, that's part of JDSU [JDS Uniphase].

AK: You were twenty-five years old, I think, when you started at Spectra Diode Labs.

DW: That's correct.

AK: How long did it take you to start moving into a leadership role?

DW: I joined Spectra Diode Labs when I was twenty-four, actually. When there's a company of fifteen people, it doesn't take too long to be a leader. The environment was such that if you could turn – we decided that we were going to focus on getting the engineering cycle very fast. You know, from the point where we grew a crystal to the point where we knew whether it was a good idea by making test measurements on our laser was about three days. That was exceedingly fast. So our learning cycle could be very fast. Instituting that allowed us to develop a lot of things. That kind of creates an atmosphere within the company of excitement, of real teamwork in driving that, and understanding that speed and running fast, again, was critical to success.

AK: Was fast part of their culture or did you make it faster?

DW: I think the whole team believed in fast. I contributed certainly to that. I'm a big believer that speed of learning, especially in an early process of technology development is critical. Predictability, you have to make sure your processes give you the same thing if you do the experiment over and over. But being able to turn out results was critical. You know, we had a team that was excited. If it meant you had to come in at 3:00 in the morning to run the reactor 'cause that's the only time that you could gain access to the equipment, well, then no big deal, we'd come in at 3:00 in the morning and run our experiments. Because getting the learning cycle fast was critical to us.

AK: You were there seventeen years, in the course of which you won several awards, including the OSA's Adolph Lomb Award, for contributions to optics made by researchers who are younger than thirty-five. You could be no older than thirty-five on the day of the award. You received an engineering achievement award in 1998 from the Laser and Electro-Optics Society. Then in 1999 you received the OSA's Joseph Fraunhofer and Robert M. Burley Award. So you're getting recognition. You're definitely running fast. Things are happening. Seventeen years is a fairly long time. An awful lot of growth happened in those years. Then another big transition: 2001.

There were some months there, February to April in 2001 where as the CTO and vice president of corporate development at SDL, you completed six acquisitions as well as a merger with JDS Uniphase, which I read was the largest technology acquisition of its time. Before we talk a little bit about how all that happened, I don't want to let the seventeen years go by too quickly without noting that somewhere along the way, you also picked up how business works. I mean, people go to school to get graduate degrees to figure out how you do mergers and acquisitions. But you're an engineer. You're a research engineer. Where'd you pick up this knowledge?

DW: That's a good question. In transitioning to this role of vice president of corporate development, I had a team that I work with. There were a number of lawyers that we worked with at Morrison and Foerster in Palo Alto and then a wonderful woman down here in L.A., Alison Ressler. They acted as our legal counsel around acquisition. Engaging in acquisitions, there's all sorts of investigations that you have to go into, from the legal side, the due diligence aspects and obviously from the strategy side. The match for CTO and vice president of corporate development is really, this is a strategy process of where we want to go. I learned a lot in that process.

Quite honestly I don't think we made any acquisition mistakes but we made mistakes in the process of that that we learned from. The critical aspect, you ask where did you gain the knowledge. You know, you create a team. You go through the process. Then you say, "Well, okay. What works and what doesn't work?" One of the key things I really learned there was what I like to talk about in the context with my current job, and that is that I owned a process. I didn't own the result. There's a very clear difference between feeling that you have to be the source of all intelligence as opposed to the source of the method of which the total intelligence can be honed to an answer.

For me frankly, that was a stage of maturity that was important to go through, is to understand that you don't have to have the answer. You have to recognize all the people around you and how brilliant they are. You have to have a process that brings that intelligence in, allows the proper questioning of it, allows the process to absorb it, and then come to a conclusion. You have to drive to a consensus. You can't have things playing ping pong for too long. That's a little bit different in a process, especially in the case of an acquisition, because you're talking anything from legal, financial, environment liabilities out to actual market strategies. There's a huge amount of input into that.

I had lots of mentors in that process. John Melton was one of our senior leaders in the company. He helped out a lot in mentoring that process. The gentleman Mark McKenzie, who is an industry consultant in the area of M & A processes, was very helpful and helped in mentoring me in that.

AK: So now, we're at another juncture, 2001. You've completed the – is merger the correct word to use?

DW: Well, that depends on the side of the fence and whether you acquired or you merged. Clearly JDSU was the financially bigger company. But much to JDSU's management's credit – and at that time it was Joseph Strauss that was the leader – he knew that companies were all about the people. There were some tremendous leaders within SDL with Don Scifres, Greg Dougherty, et cetera, that he brought in. They integrated the management teams in that process. Greg took on the role, effectively of COO, of a good portion of the business. Don became the primary chief strategy officer within JDSU for that next integration phase. It was actually an acquisition, but it was a merger of talent in that.

AK: That's a nuance that I think is important to know. So then your role was CTO of optical transmission products at JDSU. But pretty soon you're founding Infinera.

DW: Yes.

AK: Tell me a little bit about that decision.

DW: That was a difficult decision quite honestly. We agreed upon a transaction with JDSU in July. I actually want to say it was July 11, 2000. At that point in time the value at time of announcement of the deal was and still is the largest technology acquisition ever at $41 billion. But because JDSU had already acquired IBM's 980-nanometer pump laser business, when they acquired our business there was a challenge within the Department of Justice of monopolistic concerns over the supply of 980-nanometer pump lasers. That Department of Justice process went on for probably about five months, through the remainder of the year.

So that stopped the acquisition from actually being closed and consummated. It had to get through the Department of Justice investigation; and then ultimately the outcome of that was that JDSU ultimately sold the old IBM 980-nanometer pump business to get over the Department of Justice concerns. Also in that time, I want to say it was November of 2000, Nortel came out and guided down on the communication business. So the whole stock market had been a little flittery in and around O.F.C. of 2000 time frame. Then it kind of came back and recovered. We announced our transaction pretty close to the peak of the stock market.

Then when Nortel announced that communication was going to be a shortfall, a significant slide started happening in the communications industry. We eventually then closed the transaction through the shareholders, et cetera, in February of 2001. In the intervening months leading up to that, I decided that after seventeen years that it was time for me to stretch my wings a little bit and see if there were other options out there for me to pursue.

AK: So you're looking out there and you're thinking, "What could be the basis of a new venture or new line of activity?" How did it work?

DW: I met with my co-founders, Jagdeep Singh and Drew Perkins, at a Christmas party in 2000. Kleiner Perkins has their yearly Christmas party. I was introduced to them by Vinod Khosla. I'd talked to Vinod probably a month prior for other things he was doing in the optics industry. I just started talking with Jagdeep. Jagdeep's a very passionate man that invigorates your energies. What was interesting is Jagdeep and Drew, they had come from the business from a systems perspective. I had been the material scientist, solid state physics guy, device guy and I didn't know a whole lot about systems quite honestly.

I thought this was a great opportunity to talk to them further about it and get into a portion of the business that gave me a chance to expand my knowledge. I'm a big believer of, go places where you can learn the most and you'll have the most fun. They were very contrarian in their belief of what the network should be. It wasn't about optics. It was about bandwidth, you know. It wasn't about all-optical networks, from your computer on out. There was a gentleman, George Gilder, at the time that was postulating that you're going to have a laser in your computer and it would stay in the optical realm forever until it got to whatever its destination was, which was an intriguing thought process.

But in reality it could never get to that extreme. As opposed to looking at the network as based on optics but as based on bandwidth, high volume of bandwidth, the concepts of digital optical networks were formed in that process. Then it came down to the question, "If we were to build a digital optical network, what's the right technology? What's the right core semiconductor technology that would enable that?" That's where my role came in and how I got engaged in the conversation from that. That was a difficult process because you saw the allure of something new, something exciting.

Both the excitement and fear of starting a new company; you're starting a new company in the optics space in the start of the worst crash, you know, of this bubble unaware of whether you're going to come out of it okay or not. But we decided it was a good challenge. It was a very exciting time to try and do that. The competition at that time, all they were doing was trying to protect against a downside of their current business as opposed to invest in the future of where the business needed to go because their revenues were dropping. They were cost-cutting. They were trying to save programs. And they weren't able to invest in new technology.

So we felt actually, and in hindsight it's correct, was that if there ever was a time to change something dramatically within the communications industry, that was the time. But you had to kind of jump off the cliff. You had to make sure you had enough people with money around you to jump off with you to fund the venture.

AK: A little hair-raising.

DW: Very hair-raising.

AK: When you and your co-founders started Infinera, did you start with a product or did you start with an idea of how you were going to get a product?

DW: When Infinera was formed, it was what I would call the inverse of Spectra Diode Labs. Spectra Diode Labs, as I said, was a technology that didn't know what the market was. It was a technology push company. Obviously these are gross exaggerations. With Infinera, we saw a market opportunity but we didn't know the technology would satisfy.

That market opportunity was this digital optical networks and the unknown technology was whether we could solve the issues of photonic integration in order to do that. Basically what you had to do is come up with a technology, as we like to say, that could go from photons to electrons without paying a tax.

I had to get at it from the optical state, which was great for high-bandwidth point-to-point transmission but was horrible for the management of bits. You could only infer bits in the optical realm. You could only see bits when you convert them to electrons. You could only do something with bits when they convert them to electrons. At that point in time photonic integration was a dabbled technology, very much in the research lab. No one had made any practical implementation of photonic integration at all at that point in time. So we started off with a process in putting the company together. We knew that that was the first hurdle to cross. Can we figure out how to make photonic integration a reality, to develop that technology?

AK: This would make transmission more efficient by removing a lot of the fiber couplings?

DW: It did a number of things. So there’s two key pieces in our application of photonic integration, which was I could put all the optics into one solid state, monolithic piece of material. That eliminated all fiber couplings and all the packaging costs. It took all the costs of the optics and greatly reduced it. At this point in time, remember, two things were happening in the industry. One is most of the systems houses had sold off their components business. As a consequence of the big bubble that went on in the communications industry, the components company valuations were actually higher multiples than the systems companies.

So guys like Lucent, guys like Nortel, even Fujitsu, that had component arms of their business, the market cap valuation was such that they could sell these businesses for far more than they were getting credit for in the stock market. That forced the industry from going from vertically integrated companies to now a horizontal structure. All the component businesses were sold. Then the market crashed. All these companies now said, "I have to cut costs in the structure." Their method of cutting cost wasn't by investing in new technologies. Their method of cutting cost was to reduce the labor content. That's when the big migration of optical technologies to lower-cost manufacturing centers was occurring.

We looked at that problem and said, "Well, I've got my choice. I've got to be lower cost also." We liked the concept of, "If I can integrate all of these optical components together, I can drive costs down a lot faster." But it wasn't just about taking the optic components and reducing the cost of the optics. It was about reducing the cost of the optics so that I could integrate in the electronic bandwidth management function. This is a trend that frankly, in the telecom industry sometimes things happen fast, sometimes, a kind of continuous evolution.

What you're seeing out there in the world now is the integration of layers in a network, where I need more and more bandwidth management with my optical transport capabilities. That was the original founding vision, which was that it's not about point-to-point optical transport; it's about network-wide bandwidth management and how to facilitate that.

AK: Are we back to materials?

DW: We went back to materials. I had a hard time convincing the investment community of this. At SDL, Spectra Diode Labs, when we developed our pump lasers, we had developed some very unique chemistries, which frankly are still unique in the industry, that gave better performance. Let me back up. In the silicon world if I want to put together a silicon fab, I call up Applied Materials and Applied Materials supplies me a process. They don't sell me a piece of equipment. They sell me a process to make a polysilicon or whatever chemistry I'm trying to do. That doesn't exist in the indium phosphide world. You make your own process.

Therefore, if you know something about the chemistry that the other guy doesn't, you can protect that in a proprietary fashion for a long period of time. That's part of what we did at SDL. That's certainly a part of what we've done at Infinera. We figured things out in both the chemistry of our photonic integration and in the vertical nature of our design process to be able to put together the photonic integration technologies to solve the right problem for us.

AK: Why was indium phosphide special?

DW: In the fiber optics world you need indium phosphide to make lasers that operate at 1.5 microns. Indium phosphide therefore became the preferred integration platform. I'm a big believer that monolithic integration is important and that the most important piece of optics that you work with is the laser. Don't compromise the laser to get on some other material. Make sure you can make the other optical functions work on the indium phosphide.

AK: I'm going to say for what you are being presented the Tyndall Award. Then I want you to explain what really is special about this, because I think it really is. The award is for your seminal contributions. You'll probably want to spread the wealth to Infinera, but it's to you, your seminal contributions to photonic integrated circuits and the development and commercialization of high power semiconductor lasers, high efficiency Nd:YAG lasers, fiber lasers and amplifiers, and devices associated with non-linear optical materials. Now, that's a lot of words and we can unpack it, but something special happened here with photonic integrated circuits. It was a real breakthrough. Could you tell us what that was, and how you did it?

DW: I do really want to emphasize, obviously I contributed on an engineering level. The greatest thing I did as part of Infinera was pull the team together. So the technological credit goes just across a swath of 50, 100 engineers that made this happen. I can't say enough about them. We're still some of the best friends, et cetera, today. They deserve as much credit as anybody. How do you go about and solve this is a combination of great technology. But it's really about, if I can, it's about people and processes. We talked a little bit about this in running this vice president of corporate development role. When we formed Infinera, we established what we call our tech summits. We'd bring in everybody from the company and I mean everybody.

We would just kind of eliminate any of the organizational hierarchy within the system. We would review all of the technical data. You would have ASIC circuit designers questioning the epitaxial crystal growers on why they did certain things. This connectivity of the brains, if you will, across the organization really created a lot of rapid intelligence cycles. Fred Kish, the first guy that we hired, and I sat down with Jagdeep and Drew. I said if we want to be successful, we have to go figure out how to hire Fred Kish in the process. We did that. Fred's still with Infinera today and doing just a fabulous job.

He and I sat down and we said, "Okay, the lessons we've learned from our past is process things quickly." So as a startup we were running twenty-four by seven. As soon as we established our fab, we knew that learning time was critical to our success and the development process. You know, this isn't a manufacturing team. This is a development team. We ran our way first twenty-four by seven. We learned faster just on that alone. It also created a culture of, ideas never went stale. You could figure out whether you were making progress or not quickly. So you're able to adapt. It kept the energy of the team going. We just learned a ton.

Then we started bringing in – we had a chart that was our gene pool. What was beautiful about this time in the cycle was that all the big companies were laying people off. You could hire anybody you wanted. So we went down the list and said, "Okay. Who's good at semiconductor lasers? Who's good at indium phosphide crystal growth? Who's good at ASIC design? Who's good at optical packaging?" We made the list of who the best companies were. We identified who the critical people within each of those companies. We literally had a matrix that we developed our gene pool from. We went out and we tried to hire these people.

We got exceptional people. One of our classic stories is a guy, Chuck Joyner, he was at AT&T, Bell Labs or, I guess at that time Lucent. They were putting on an early retirement incentive. So we interviewed Chuck. It was something. From the time we first talked to him to the time he had bought a house and moved to California was, like, twenty days. We were able to go off and get, Radha Nagarajan, Chuck Joyner, Andrew Dentai – I unfortunately won't have a chance to mention everyone's name. We were just able to hire the best of the best from many different disciplines.

AK: How long did it take before you felt you'd turned the corner and this thing looked like it was going to work?

DW: I would say the first four months were very hairy. We raised a good pile of money from high-quality venture capitalists day one. We had closed our second round of financing probably about five months later. I'd say we went from zero to about fifty people in about five, six months. At some time within eighteen months the photonic integration technology was substantially enough on its way that we knew we were going to be successful with it. We didn't know that we were going to continue to get all the financing we need and we didn't know whether someone would buy it. There's a variety of risks that go on in starting up a company. There's a technology risk.

Within those eighteen months, maybe two years we were able to, if not retire that risk, we were able to get a good piece of it where you're confident you can solve what other problems what might inhibit you. The problem with building a systems company is your ramp and dollar-spend accelerates the closer you get to market, and it accelerates in a big way. You start spending a lot of money doing that before you know that someone's actually going to buy it. I'd say from the technology point of view, we got through that comfortably and reasonably quickly. But the question of "Were we going to survive as a company," that took a while longer. There were many hair-raising moments, primarily in the financing of the company and getting our first solid set of customers.

AK: Just a few months after you organized, 9/11 happened. Did that have an effect?

DW: 9/11 had a personal effect. I remember actually I was riding my bike to work when those events transpired. But not too much from a business perspective on what directions we went in. Obviously it affected everyone individually.

AK: Your successful development of this photonic integrated circuit technology has had most of its applications, I think, in communications. Can you see other applications in the future?

DW: Sure. Our particular flavor of photonic integration is really centered around the application of telecommunications, initially in the long-haul space, but really in the metro through long-haul and now, subsea applications. There's a lot of application for photonic integration for other applications, too. I'd like to remind my guys as well as the industry, probably the most successful photonic integrated circuit is the integrated either CCD or CMOS detector ray, used in cameras. That's a highly-sophisticated photonic integrated circuit, converting photons to electrons for different applications.

What I find fascinating around that technology, which I think applies a lot to the telecommunications industry, is that when they first came out, the pictures weren't very good. But they solved a different problem in the market place. They were instant, and they were digital. I could do things with them even though the quality of the picture wasn't good. Then over time, much like any good disruptive technology, they start off with the low-quality application and find a unique market sector place for it. Then all of a sudden all of your professional photography is now done by photonic integrated circuit in that form, in that disruptive technology. It completely changed the industry, obviously. There were winners and losers in that transition.

I think photonic integration in telecommunications has the same capability. It is an inevitable technology. If the internet demand and the internet bandwidth continues to expand, it's inevitable that photonic integration becomes more and more pervasive in the data center in telecommunication applications.

AK: I wanted to ask you when you talked about the 24/7 culture at Infinera –you got married at some point, and you mentioned that your children were here with you. When did you get married?

DW: Oh, boy, you're going to put me on the spot. (Laughter.) I got married in 1993.

AK: All right. Good for you. How many children do you have?

DW: I have three kids. I have my wife, Heidi. I have a daughter who's a junior, Alexandra, then two sons.

AK: A junior in –

DW: High school. I have son who's a sophomore in high school, John, and a sixth-grader, Tom. They are out here with me this week.

AK: The kids remind me of what you said earlier, that you own the process but you don't own the result.

DW: Yes. There are times we'd like to take credit and times we avoid credit.

AK: Before we finish I'd like to ask, is there anything that we didn't mention or didn't say that you might want to say, anything about your experiences or contributions?

DW: Sure. If I had to go back and think about what are the most meaningful things to me in my career, there's absolutely the physical things that we were able to accomplish. But realistically, probably the most meaningful thing to me is seeing the passion of people and figuring out a system that harnesses that passion to be able to share their ideas, their intelligence and their passion. And you know what? Ultimately, that's what drives the success of the organization. Engineers are phenomenal people. They can make almost any approach work. They make it work because they've got a passion to go figure out how to do it.

If I were to look back and say, "What are my contributions?" I certainly made contributions on a technical level. I'm proud to have participated in both the experience and cultures that existed at Spectra Diode Labs and the culture that exists in Infinera, which is how to play the balance between driving forward, making decisions, but being able to integrate as much input as you can from people throughout the organization. It is always fascinating to me, the intellect and the insight that comes from places that you don't expect it. It's really special to be a part of setting up an organization that does that and creates that culture.

AK: Well, thank you for subverting any idea that engineers are not people-people, and congratulations on your award.

DW: Thank you. I appreciate it.

[End of Interview]