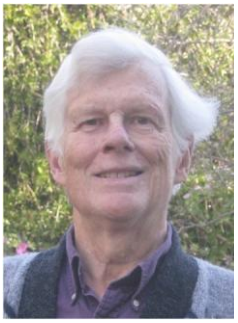
My Interesting Life In High Tech
John Julian Uebbing



Foreword

Mr. HP Optoelectronics---John Uebbing

We all know that mankind harnessed fire for light as well as heat. That technology developed through candles and lanterns and even gas light. But by the late 19th century, electricity came along. There were arc lights and Edison rolled out his filament light bulb, which went national in the early 20th century. This moved up through gas discharge and phosphors for fluorescent bulbs. It developed into entertainment with the cathode ray tube and its electron beam, lighting up colored phosphors for television pictures.

But by mid-20th century, consider this. What if the light-emitting-diode (LED) and the liquid crystal display (LCD) had never been invented? It is literally true that today's world as we know it would not exist. No iPads, no cell phone displays, no games, no flat screen televisions, AT ALL. Back then, who could have predicted that you could make crystal material out of the metal gallium and metalloids arsenic and phosphorous, inject doping atoms, creating an electric diode, and get dark red light out of it? Who could envision sandwiching an organic compound 10 thousandths thick, between two glass plates, adding electrodes, and getting light to turn black and white with liquid crystals? And then do it with color filter LCDs, which is the basis of vast industries across today's world, to the delight of virtually every human being and their smart phone?

Well, that was the situation facing brand new engineer PhDs like John Uebbing, as he emerged from Stanford University in 1966. In 1970, I was working on building some of the first LED digital numbers. We were happy to be able to make tiny LED numbers, 1/10th inch high, to be the display for HP's blockbuster HP-35 electronic slide rule. LCDs weren't reliable enough yet. Nor was the technology yet envisioned which could support those monster flat-screen color displays of today. John's work life involved some of the intermediate steps of technology breakthroughs needed to get to where we are today.

John Uebbing is my neighbor. I see him out walking most every day, going to get the paper. He is a clever researcher with a wide knowledge of modern display technologies, and long years at Varian, HP and Agilent, working in opto-electronics. John and I are both mid-westerners, and share the pride of graduating from the University of Notre Dame. He is religious, I am agnostic, so our street conversations range from display technology to evolution. He was born late in the Great Depression, a child during WWII, and his HP memory gives us a charming read of his growing up and education in the south side of Chicago.

Think of the complexity inside every cell phone picture. You can't see them, but the picture is constructed of pixels, some tens of thousands of them in every square inch of display. Each one is energized with a horizontal and vertical electrode, maybe 1/1000th of an inch wide. 1000 stripes every inch. Where a vertical and horizontal stripe cross, THAT pixel gets energized with the proper synchronized electrical pulse to light up its own color, in sequence with all the other millions. But now consider how you wire up those1000 electrical stripes along two edges of the LCD. You then have to put electrical driver transistors at each entry point of all those stripes. Now imagine making that complex technology continue to work after you drop it on the floor. These are the technology nightmares of the engineers and researchers like John, as they worked for decades, solving all those semiconductor and materials problems one by one.

John is a bit of a generalist. You will see from his moving from company to company, and project to project, that he is able to bring his wide-ranging expertise to problems from III-V compounds (those are valence numbers of atoms like gallium and arsenide) to fiber optics to photo-diodes to the latest LEDs that light our

streets and stop lights, are all over modern cars, and underlie the remarkable mobile displays of a gazillion iPads and Galaxies and 10 foot televisions. This is a fascinating life, and a fun read. A kid from the South side of Chicago to the technologies of today.

I only spent 3 years with my LED product team in 1971. It was frustrating work, with rudimentary wafer-processing technology, getting the tiny numeric and alphanumeric displays going with dark red light. Our milestone big success was to get our 15 digits (1/10th inch high) designed into the HP-35 engineering calculator. But before I moved back to regular microwave instruments, the HPA Division had caught some stunning vision of the HUGE industry that light emitting products would ultimately bring to market. It was mind-boggling big. It was engineers like John who moved in to push out those technologies for the world.

HP's semiconductor management envisioned, in the mid-1970s, their new production site on Trimble Road in San Jose, just at the end of the northbound runway at SJC airport. In a outrageously ambitious plan, they forecast that light-emitting product demand would ultimately grow so large that two HUGE buildings were constructed, one for optoelectronics and one for microwave components. Each one was three stories high and more than an acre in floor size. They knew that all of the semiconductor processing and automation would need facilities flexibility. So they designed the entire middle floor to supply upwards and downwards, all of the electricity, water, de-ionized water, drains, toxic drains, fluids, frozen liquid CO_2, a variety of pure gases, and a dozen other vital ingredients of the day. And in a few short years, those buildings were indeed full of profitable production and wonderful technologies. You see them today all over motor cars, in your street stop lights, and in the home taking over for tungsten filament lamps, and as the back light for virtually every flat-screen TV and handheld smart personal iPad.

There were many personalities in this plan, and generally speaking, the people who populated the semiconductor industry like Fairchild and Intel and HP had assertive personalities. I'm thinking of people like the bombastic Milt Liebhaber. But they were supported in their labs by excellent technologists like John Uebbing. They were dreamers too, and many stories are written of the most successful. You will see this story in John's observations of navigating through those technical and management waters, always busy working on his beloved technology.

What I found especially charming about John's multi-faceted life in science, and decades of complex projects, was his AMAZING connections with other scientists and researchers--by name. Old Notre Dame and MIT and Stanford classmates keep showing up here and there in his walk though life. Old comrades at earlier jobs turn up later when he needs to find a new job. New, fascinating problems and projects show up to challenge John for another year or two. And all these projects require technology knowledge from fiber optic to materials science of light emitting crystals, and all of their processing witchcraft, to computer software vitals. I swear he name-drops like a society matron, except that the names he drops are this very day out running major hospital medical divisions, or highly successful technology companies, or brand-new venture startups.

--John Minck

My Interesting Life In High Tech
John Julian Uebbing

1. My Early Years--Getting Ready

Early Childhood
Grammar School Years at St. Leo and St. Rita
Chicago in the 1940's
High School Years at Mount Carmel
College Years at Notre Dame
Summer Jobs
Graduate School at MIT.
Summer in Santa Barbara
Life in California in the 1960's
Stanford University

2. My World of Opto-Electronics

Varian
Marriage
Mary Frances
Jack
Our House
Church Life
ESL
HP
Promotion at HP
A Little Politics
Children and Home
HP Labs
RMG--Realtime Measurement Graphics
Back at OED
Switch to OCD
Foreign Travels
Domestic Travels
Prostate Cancer
Fiber Optics
Champagne--the Bubble Opto-switch
Back to Fibers
Sensor Solutions
Lumileds
Logitech
Sputnik - Prysm
Apple
Lightwire
QuarkStar

3. My Life in Review

Diversions and Entertainments
Reflection on Life

1. My Early Years--Getting Ready

Early Childhood

I was born on July 7, 1937 at 7:07 AM in Lewis Memorial Maternity Hospital, at 32nd and Cottage Grove Avenue, on the south side of Chicago. That is the same day that the Japanese attacked the Marco Polo Bridge in Beijing. This started the Second World War, in the Pacific.

We moved to 7649 Eggleston Avenue when I was five. I went to Harvard kindergarten on Harvard Street. The teacher, Mrs. Van Horne, would call me John Webbing. I thought this was strange, but then I figured out that people had different names when they went to school. My mother had to correct the teacher. I remember my sister, Christine, aka Kingking. She had tight curly hair and was born in 1942, 4 months before I turned 5. That fall, I went off to kindergarten, I remember rhythm band, with all the kids in a circle banging with sticks and things.

Grammar School Years at St. Leo and St. Rita

Next year, I went to St. Leo's Grammar School. My mother had to take care of Christine, so a neighbor girl took me to school. I waited in the hall until everyone else had gone to their classes, and they placed me in Sister Marie Stephanie's first grade class. There were 50 students in the class. I remember her teaching us about God and the creation using big black and white circles. "Let there be light," turned the black circle into a white one.

During the war, we bought savings stamps, which you put into books. With filled-up books, you could get Savings Bonds. Our school bought so many bonds, the army bought an airplane called the Spirit of St. Leo and named it after our school. There were a lot of things that people said, like "Don't you know there's a war on?" There were slogans like "Bombs on Berlin," and "Bombs on Tokyo." We kids would run around shouting the slogans. Sometimes we would shout "Bombs on Washington!" just to be kids

After a while, we became big kids and wrote with pen and ink. The ink was in inkwells and the pens were steel nibbed. You had to dip the pen in the inkwell to write. Besides writing, I learned arithmetic and spelling and catechism. I made my First Communion in second grade. That was very important to me, and I wore a special white suit with white socks and everything.

The neighborhood where we lived did not have zoning. There were mansions, factories and slums nearby. Once a closeby factory burned down in a huge fire, since it was full of solvents. My father would take the Rock Island railroad line into work. It ran coal-fired, steam locomotives that belched a lot of smoke and cinders. He would stop off in this little basement grocery store, after getting off the train, and pick up 4 one quart cartons of milk for us kids every evening. World War II was on and there was rationing. You had to have ration coupons to buy practically everything. People saved bacon grease and turned it in to the butcher, to be used for munitions.

There were a number of horse drawn wagons that delivered things like ice, milk, coal and vegetables. There were electric trucks that delivered milk. Later in the war, my father took us to see a B-29 at Midway airport. The plane was huge. The tail stuck up very high and there were guards with sub-machine guns standing around the plane. I remember having visited Midway earlier and seeing Ford tri-motor airplanes lined up. You could just walk out around the planes those days, there was no security.

My father worked as an analytical chemist at 9 South Clinton Street, just outside the Loop. The building was so old that it still had some DC electric power in it. My father would take me to work on

days when there was no school. He would show me all around the lab. He did a lot of weighing at an analytical balance. Once he asked if I wanted to taste some distilled water. I was so scared, I said no. I learned a lot about what laboratories were like.

My father would tell me all these scientific, technological, religious, and cultural things. Often I would be able to answer a lot of those kinds of questions at school. People would wonder how I knew them, and I would always say my father told me. I remember once asking him how a radio worked. He said I was too young to understand. I remember when he finally did explain it, and I don't remember it as a very coherent explanation.

My sixth grade was very enjoyable, because I was getting to be a "big kid." Then we moved, in the summer of 1949. We were paying $50 a month rent for our 3 bedroom flat, and the landlord wanted to raise the rent. There had been significant inflation after WWII, but my father's salary did not go up much. We had 5 children with a surprise, my brother Thomas, on the way. We considered ourselves to be poor.

We did own a 1929 Model A Ford during the war. It had "A" gas ration card, which meant the least amount of gas. I would help my father fix it. He patched the roof, put new lights in it, changed tires, etc. The last thing that went wrong was a cracked cylinder head. I helped him take it to a local machine shop in a red wagon. The machine shop welded it. Later, we were getting low on money, and my father sold it to this guy who needed a car to get to work in the outskirts of the city. As I learned how to read, my mother took me to the local public library on 79th street. I learned how to take out books. Ever since, I have read a lot of books from public libraries.


1929 Model A Ford. Ours was not nearly as well maintained.

One thing my father would do to give my mother a rest, was to take us kids on a Sunday outing in the Model A. We would do things like go to the Museum of Science and Industry and the Field Museum, downtown by the lake. I was a well-museumed kid. He would also take us to local railroad stations, where we could watch the trains come and go. The best was the Englewood Station at 63rd and Cottage Grove. On Sunday afternoon we could see both legendary trains, the New York Central Railroad's 20th Century Limited and the Pennsylvania Railroad's Broadway Limited.

The "Century" was an all Pullman status-type train. It had an on-board barber that you could watch. The engineer was this very old guy. The Broadway Limited used a reticulated 4 cylinder steam engine. My father also took us to the 1947 Railroad Fair. It was held on the Lake Front and featured a number of railroad trains in a big show. It was supposed to re-stimulate interest in railroad travel after WWII. It was a great fair, but it didn't achieve its purpose because air travel was destined to win.

We occasionally took the Nickel Plate Railroad to Buffalo to visit my father's family. The train left in the morning, and arrived in Buffalo about 10 PM. For us kids, it was a great adventure. We would plot our progress on the timetable and map. Our aunts and uncles were always very nice to us. The weather in Buffalo was always cool and comfortable in the summer, compared to Chicago. We would visit the zoo and Niagara Falls. My Aunt Amelia would sometimes take me to visit her customers. She once took me to a seafood restaurant on Grand Island, where we had fresh fish. I was shocked at how good really fresh fish tasted. My Uncle John owned a Packard sedan, which I thought was very luxurious.

I went to St. Rita's Grammar School in the seventh grade. St. Rita's was richer than St. Leo's, and had a cafeteria and a nice meeting hall with a stage. The big new church was being constructed over the old one story church. I served as an altar boy while parts of the old church were being torn down, inside the new church. The neighborhood now is poor and the school has become a public school.

I continued playing tuba in the St. Rita's band. John Savonak was the director. I was good enough at the tuba, and my grades were good enough, to earn a band scholarship to Mount Carmel High School. In about eighth grade, I became interested in radio. From a description in a book, I built a crystal radio. I started out using a cat's whisker and a long wire antenna. Then I switched to a germanium diode, which was much more reliable. I could listen to two local radio stations. The closest and loudest one had Sophie Barkus and the Lithuanian housewives hour. It also had McKee Fitzhugh and his band.

Chicago in the 1940's

Life in Chicago in the 1940's was quite a bit different than life today. People got around by taking the red street cars and the elevated train. The effects of the Great Depression were still being felt. There were apartment buildings in pretty nice neighborhoods that were still boarded up. because of financial failure in the investment group. Milk was delivered in electric trucks. Vegetables were sold from horse drawn wagons. Coal and ice for iceboxes was delivered in horse drawn wagons during the war years.

People used a horse team to plow land for a victory garden in a big vacant lot on the other side of our city block. There were huge war plants. Manufacturing, including post-war TV manufacturing, was a big part of the local economy. Labor unrest was ever present. There was a big coal strike, and electricity became short. During the war, large numbers of blacks moved to Chicago from the South. This caused a lot of tension, as they moved into white working class neighborhoods.

High School Years at Mount Carmel

I would travel back and forth to Mt. Carmel on the 63rd Street streetcar line. When I was a freshman, the upperclassmen would haze the freshmen, even on the streetcar. Certain things were de rigueur, such as using a bowling bag to carry your books. The only choice of curriculum was whether you took Latin or Spanish. I took Latin. I do not recommend that people take a dead language in school. For all the effort, you might as well learn something that you can actually use. It was not easy remembering all those conjugations and declensions. I was pretty busy, what with a paper route and studying and playing in the band. I generally got high grades. I think I was second in my class of 500.

I became more interested in radio. The crystal set was upgraded to one with a single type 30 tube in battery powered regenerative detector. This allowed me to receive more stations. I was fascinated with the mystery of radio. With my newspaper money, I bought a shortwave radio receiver kit with my newspaper route money. It came with coils for 4 different radio bands. I could hear ham radio operators doing their Morse code. All this started in about eighth grade.

In early high school, I dreamed about becoming a radio ham. I rented a code practice machine and learned enough code and theory to receive a novice class license, WN9ZWO. I built myself a 50 watt transmitter for 80, 40, 20 and 10 meters. It used a 5763 crystal oscillator and multiplier with a 6146 power amplifier tube. I bought a National all-wave super heterodyne receiver. I had a dipole antenna strung from a pole in front of the house, to a utility company pole in the back alley. I managed to communicate with other hams as far away as Pennsylvania. You could do 2 meter voice on a novice license, so I built a voice modulator and a 2 meter transmitter and a down converter. My first two meter antenna was a simple Yagi antenna with a rotator.

I would attend the meetings of the local ham club, and got to know some of the other hams. I bought my radio parts from Allied Radio and Newark Electric. In those days, they were both located in small stores on West Madison Street, where the hoboes lived. Later Allied Radio moved to Western Avenue and got big in High Fidelity. Now both of them are large national electronics companies with catalogs that people in Silicon Valley use. Eventually, I learned code at 13 words per minute (barely) and obtained a General Class license, W9ZWO.

I continued playing Eb Tuba in the band at Mount Carmel. We rehearsed every morning before class. We had a marching band and a concert band. My social life did not involve girls. Mount Carmel was all boys and I was pretty shy with girls. I did not take a girl out on a date until I graduated from college. I was pretty nerdy. For a while I played bass tuba in the Mount Carmel dance band.

I had a lot of respect for the Carmelite monks who taught us at Mount Carmel. A number were WWII veterans. They were pious, learned and practical. They lived in a monastery that was a couple of converted apartment buildings. We had some lay teachers as well. We had gym classes for 3 years. Our football team was City Champions for 3 of my years. The band went to all the games, and part of the band played for basketball games. Mount Carmel is still a highly ranked Catholic Prep school in Chicago.

In school, I did well in science and mathematics. I had a knack for math and I had learned a lot of science from my father. There had been donations of World War II surplus electronics to Mount Carmel High. The physics teacher Fr. Barry Kline, O. Carm., gave me some of the tubes and things. I also bought war surplus gear from some of those stores in Chicago. I built gear for a 220 MHz and a 440 MHz Doppler radar system that actually detected commercial airplanes that flew over. They flew over pretty low, since we were two miles from Midway airport, which was very busy in those years.

My father told me about Chicago's Main Library and the Crerar Library downtown. I visited them and was fascinated by all the engineering texts that they had. In particular I studied the MIT Rad Lab series from the Main Library. I did not understand all the E&M theory in them, but I was terribly impressed and interested. By the time I graduated from high school, I had a jump start on an engineering education.

My radio hobby expanded to include a big 32 element array antenna for 2 meters. This was pretty huge and was at the top of a 30 foot expanding tower on the roof. I remember riding over to Central Steel and Wire, on my bike, to buy aluminum tubes and rods and sheet to make the antenna. My mother was always worried that I would fall off the roof. When I was in college, a big storm actually knocked down my array antenna, and there was a big mess of aluminum on the roof.

When my brother Tom went off to grade school, my mother went off to work. Her first job was as a night receptionist-secretary at the local Catholic hospital. Life was a little tough for her. She had a tough girlhood, since her parents were divorced. She lived with her father's sisters, rotating from one to another. She did not get along with some of them. Her mother could not support her children on her own. She had converted to Catholicism a few years before she married my father and was a good Catholic. She wanted to have a lot of children, but I think the sacrifices of having them in a big city with a modest income got to her after a while. She used to complain, and we would invariably say that Mommy was grouchy today.

I was pretty busy in high school. I had a newspaper route right after school, a collection route in the evening, band practice in the early morning, and studying before and after the collection route. In senior year, I had this special hobby project to build a sonar controlled model submarine. I made sonar transducers out of pure nickel rods, with a bias magnet and a drive coil. We tested it in the high school swimming pool. Sound signals did propagate. I tried building the submarine out of laminated wood

planks. It did not work out too well. It was very hard to shape the curved surface of the submarine. It was going to run off of a single automobile storage battery in the center of the sub.

One nice thing that my high school had was a special program to get certain students college scholarships. I participated in that. This one priest would have us take all these practice tests, so we got to be good at taking college admission and scholarship tests. Cardinal Stritch of Chicago had become concerned that not enough Catholics were in the leadership group in Chicago. So he set up the Cardinal Stritch youth guidance group. I was tapped for this because of my academic promise. One thing they did, was to get me into the 5 year liberal arts/engineering program at Notre Dame.

The extra year of liberal arts was supposed to make me less of a nerd. I don't know that it succeeded, but it did give me a lifelong interest in history and politics and sociology. It did not have any more tangible benefit. I was able to get a scholarship to the Illinois Institute of Technology in Chicago and a General Motors Scholarship to Notre Dame. I did not get a scholarship to MIT. My father was a Notre Dame Alumnus, class of 1929, which probably helped some. In those days, legacy alumni family members got some preference. He did take me to visit the campus, and we went to talk to the admissions director about scholarship possibilities. Our family was pretty poor, with six children living on a chemist's salary.

Because of my hobby interests in radio and electronics and my good grades in science and mathematics, it was not a hard decision to major in electrical engineering.

College Years at Notre Dame

I remember my father helping me take a trunk full of clothes and a new used typewriter to the Grand Trunk Station at 63rd and Central Park. We took the trunk in a wagon. In 1951, passenger trains still ran on that Railroad. It stopped at the New York Central station in South Bend. I went by myself, and remember walking from the NYC station to the bus stop, where a city bus went to Notre Dame. I had come a little early to start band practice.


Notre Dame was a pretty nice place to go to college.

Things were a bit different at Notre Dame, then on my own. My freshman year roommate was John Marshall. John was from Jerome, Idaho. He grew up on a large potato farm. He studied metallurgical engineering. It was a learning experience, to hear someone with a thick western accent, whose stories were all about farm life. After graduation, he went back to potato farming and has a big irrigated farm near Jerome. He lived then in a double wide mobile home, but now has a big house. In the first few weeks freshman year, the students were really amazed at the strange accents that the other students had.

We had to study calculus. The mathematics department had come out with this new curriculum, with a book by three of the professors, Hasser, LaSalle, and Sullivan. This class tried to teach calculus from the viewpoint of a professional mathematician, who cared about getting the logic right. Actually getting an intuitive feel for and a practical knowledge of calculus was not so important. It threw most students for a loop. I could struggle more effectively than most with it, and quickly ended up being a tutor for a

lot of the students on my floor. It was kind of a funny feeling. I studied hard and got good grades. I had a full scholarship, so in some ways I wasn't as busy as I was in high school.

Playing in the band was quite rewarding. We traveled on trains and buses to some away games, like Purdue and Michigan State. In the spring, we went on a Spring Concert Tour. The first trip was to the South. I remember Wynne, Arkansas and Gape Girardeau, Missouri, and Opelousas, Louisiana. It was a revelation to hear young guys in Arkansas talk about deliberate race-based harassment of minorities. For a naive Northerner, I found it disgusting.

I remember this huge steak in Opelousas. The thing was about 3/8 of an inch thick and 12x10 inches in size. These trips, especially in the 50's when the US was less homogeneous were a revelation for guy from the South Side of Chicago. In other years we traveled to the east coast and west as far as Colorado.

In some ways, college was boring. After the initial learning of a new environment, it became a routine of classes and things. I switched to the 5 year liberal arts engineering program after my freshman year. We had to take a foreign language. I chose Russian because of the Cold War and because it was exotic. We had a good teacher, John Fizer. John was a Ruthenian. Russian is pretty hard for Americans. The grammar is highly declined and there aren't many cognates in the vocabulary. We had to do a lot of conversation, and that is the part that I remember.

I really did get interested in some of my engineering classes. We had to study things like mechanical drawing, strength of materials and AC machines. The drawing and materials courses turned out to be useful later on. As far as advanced electrical engineering goes, Notre Dame was a bit behind the times. I was very interested in physics based electronics for radar and semiconductors. I took a course in "modern physics", which was all about atomic spectroscopy, quantum mechanics and nuclear physics. The topics were really good, but at that time, books that were easier to learn, did not exist. I always remember having a trauma with spin-orbit coupling and the magnetic properties of materials. One of the E.E. students that entered when I did was Mike Cowley, a later friend at HP. His father was a dentist in New York State.

Sputnik was launched in 1957 when I was a junior. In the preceding years, the US was working hard on ballistic missiles to deliver thermonuclear warheads on the Soviet Union. The engineering community was heavily involved in all of this. I was quite worried and depressed about the prospect of nuclear war. I had a bunch of pictures of nuclear missiles on my wall, and used the sad slogan, "Better weapons for better destruction through electronics." I have always remained interested in weapons technology, even though I have only practiced it a little.

I had a pretty interesting series of summer jobs while I was at Notre Dame. Because of the military projects, there was a national "shortage" of engineers and companies were willing to hire low level college engineering students for summer jobs, hoping to get some back after graduating.

Summer Jobs

My first summer job was with United States Steel South Works at 79th and the Lake. I worked in electrical construction. They were expanding a rolling mill and all of the motor supply cables had to be installed. They were installed in heavy steel conduit pipes that were encased in concrete. The job involved being an assistant to an electrician. We moved these heavy pipes around, cutting, threading and bending them. I noticed that the skin on my forearms got tight, and the forearms got hard from all the work. It was pretty educational to see what heavy industry was like, and to work with unionized workers. I have a lot of respect for them. There was a strike during the summer, and during the strike I got a job at Continental Can Company at 59th and Western. My job was loading empty beer cans into

box cars on the night shift. It was something else, being alone inside a boxcar. The cans would be in the shipping boxes and come down a gravity driven conveyor. I had to stack them up inside the boxcar. It could get a little desperate as the boxes came fast and the night wore on. After the strike was over, I went back to the steel mill for a few weeks.

After sophomore year, I worked for the Corn Products Company in Argo, Illinois. This plant processed 50 freight cars of corn every day into all sorts of things like starch, corn oil, corn syrup, etc. I worked for a while in the instrument shop, where I had a chart route. This involved going around to all the recording instruments in the plant, and replacing the chart paper, and bringing back the old paper. People would take some of the steam flow charts and integrate them mechanically, to find out how much steam a certain building used. This information was used for accounting purposes. The other job was to put tags on all the electric motors. This helped in maintenance. The plant had its own steam generation and electric power plant. After the steam went through the steam turbines, it was then used for process steam. They kept some old Corliss piston engines that drove ancient alternators. These were for backup. They also had some piston engines that worked directly as piston pumps for liquids. As a result of this job, I really got to learn how a modern chemical processing plant worked, including all the pneumatic controls.

After junior year, my mother used her old job contacts to get me a summer job with International Harvester Farm Tractor Engineering. The plant was located at 34th and State Street, in an old industrial area. They were testing tractor engines. I put strain gages into cylinder heads and on vibrating crankshafts. Their basic problem was that they were trying to get more power out of existing tractor engines by raising the compression ratio and running them faster, but the souped-up engines would often fail mechanically. They also had casting quality control problems. After my 4th year, I worked for them again. They had moved to Hinsdale, Illinois and I carpooled with a couple of the mechanics, who lived in my neighborhood. At Hinsdale, I worked on my own project, which was a digital rotational accelerometer. It used magnetic pickoffs on the starter ring gear to sense crankshaft position. It took some custom vacuum tube electronics, to work with the vacuum tube counters, to do the job. This was 1959. I also wrote my first program in FORTRAN to model the instability of a tractor engine governor. Harvester owned a decimal IBM 705, which did not have a FORTRAN compiler. We were hoping that IBM would release one soon.

After my last year, I worked for Bendix in South Bend, Indiana, with their Advanced Engineering Group. They were working on ballistic missile defense. There was all this stuff for protecting reentrant missile nose cones, and trying to understand the RF and other properties of the plasma that surrounded the nose cone, on reentry to the atmosphere. I had this project that looked at the microwave properties of an Argon plasma, that was blown across a waveguide at 10 GHz. The principal investigator was Dr. Isadore Hodes. Dr. Hodes was my professor of microwaves at Notre Dame, and really taught the subject in a way that was easy to understand. He was trained as a physicist, and after a few years, left Notre Dame to work for the General Motors Defense Research Laboratories in Santa Barbara, California. I would see him again a few years later.

During the summer at South Bend, I stayed at the house on the Campbell farm near Notre Dame. The Campbells that owned it, also owned a box company in South Bend, and had been neighbors of the Johnstons near Valparaiso. Emma Johnston was my great grandmother. I roomed with John Mantey, who I also worked with at Bendix. His brother was Pat Mantey, who I roomed with at Stanford, and who is now a professor of E.E. at UC Santa Cruz. I first learned how to drive that summer, and actually started to date girls. One was a St. Mary's girl from St. Cloud, MN, and one was Mary Ann Mackowski, a nurse from South Bend.

My sophomore and junior roommate was Fred Mowle. Fred became a professor of Electrical Engineering at Purdue. My senior year roommate was John McFadden. We had some fun projects, like

launching small gun powder rockets from our window. The rockets were made from malt straws, were multi-staged, and had a rubber band boost. They were spectacular. One of the "rockets" was made from an old cartridge casing, and put a dent in the metal window frame. Another project was putting radio control into McFadden's gas powered model boat. I used my ham transmitter at 27 MHz, and built a rudder escapement out of an alarm clock. It worked pretty well. We sailed it on St. Mary's Lake. John McFadden subsequently owned an engineering company in Chicago, that made steel and aluminum processing vessels.

I was encouraged to go to graduate school because of my good grades. In addition, I had this ignorant feeling that I didn't know enough about science and engineering to do the advanced work that I thought was so great to do. I applied at a number of schools, like UC Berkeley and Stanford and MIT. I received a National Science Foundation fellowship and could go anywhere I could get in. It came down to Stanford and MIT. I actually flipped a coin, and it came up MIT.

Graduate School at MIT

Jet airplanes were just coming into domestic service in September of 1960. I wanted to ride in one, so I booked a flight on United's first DC-8 flight to Boston. At MIT, I lived in Graduate House the first year. I roomed with Paul Marto, who I knew from the band at Notre Dame. Paul studied nuclear engineering and heat transfer. He subsequently became chairman of Mechanical Engineering at the Naval Postgraduate School in Monterey, CA.

My sisters, Christine and Marcia were big fans of JFK and put a lot of pressure on me to vote for Kennedy. I was actually leaning to Nixon, but voted for Kennedy in my first presidential election. Prof. Jerome Weisner, of MIT, became Kennedy's science advisor. There was this mystique at that time of what good governments could do. As a result of the Cambridge atmosphere and thinking that the Democrats were the go ahead party, I became a Democrat. I also became somewhat of an arrogant intellectual.

I wanted to study electron devices at MIT. I previously had been also interested in systems work, but then I read an article asking who would do the device stuff, if everybody did system stuff. Since I was good at physics and chemistry, I thought this would be a good idea. I had a full NSF fellowship, so I did not have to work as a Teaching Assistant or Resident Associate to make money. In some ways this was a disadvantage, because I did not immediately become part of a program or a laboratory. I persuaded Prof. Louis Smullin to take me on as a researcher for a master's degree thesis. He was doing stuff with plasmas.

He had done very good work during WWII, inventing TR (transmit-receive) and ATR (anti-TR) gas tubes for radar. In these radar configurations, which used a common antenna for both transmit and receive signals, a diplexer separated the two functions. The gas broke down, when the radar pulse was on. That made a waveguide short circuit that protected the receiver from the big transmitter pulse, while it waited for the microwave echo signal. He had this idea of making an electron gun for microwave tubes, using a hollow tube of oxide coated metal. He wanted me to test it out. It turned out to be a bad idea. I spent a lot of time building a little tube with schemes for reading out the beam's electron density. The focusing magnetic field bent the electrons back into the hollow tube and reduced the emission.

I ended up spending two years, with enough credits and writings to get an Engineer's degree as well. I took a lot of tough courses, including Morse and Feshbach on theoretical physics. I took a series of statistical communications theory classes, that were quite good. There was one course by Moses Goldstein, on statistics for communication, that changed the way I think to this day. The big change is to realize that nothing is certain. All that exists is varying degrees of uncertainty. Of course, if

something is highly certain, then it is an exceedingly practical approximation to assume that it is absolutely true.

The one big thing that I did get out of MIT, is that there is a high powered, world class way of finding problems, thinking about them and attacking them. That was what MIT tried to do. I also think that often they overdid it, neglected the human side, and they overpowered things that didn't need it. They liked to show how high powered they were. They tended to neglect the playful, inventive side of engineering. Yet, on balance, MIT is quite good at what it does.

For a while at MIT, my love life was sparse. A student guidebook at MIT had an answer to the question, "How do you meet girls here?" The book said that the first thing to realize is that girls want to be met. I had become friends with this one, pretty, but platonic girl, named Jackie, from Wellesley and Barstow, CA. She was a literary type, a would-be author, and a bit of a nut. I stayed at her house on the way to Santa Barbara in the spring of 1962. Another girl friend was Evelyn Barron. She was from Scotland and was a chemist in Cambridge, MA. Yet another was Frances Dittmann, who was an undergraduate at Radcliffe and came from Wynnewood, PA. She was tall and beautiful.

Ted Kennedy was thinking about running for the US Senate from Massachusetts. His brother had just been elected president. I guess he thought he should be elected to something too. He had taken a trip to Africa and visited a bunch of countries and government people there. The local people said that he would could come to MIT and give a talk about Africa. So I went over to his apartment on Beacon Hill to ask him if he would give a talk for us. A beautiful woman, not his wife, answered the door and said that if we would write a letter on the club stationary, describing our club and giving some alternate dates, they would see if it fit his schedule. So that is what I did. I was impressed, that they wrote back and accepted one of our dates. Because we expected a lot of people, it was decided that the talk should be at Emmanuel College, across the Charles River in Boston. One of the things that they asked, was that we pick up Ted at his house, and drive him to the venue, so he could get to know us a bit.

I had just bought my first car, a pretty junky green Pontiac. My friend, Steve Piaczek, did not have a good car, so we asked Martin Anderson, who was in the MIT government/economics program to drive us around. Martin Anderson later moved to the Hoover Institute at Stanford and worked as an advisor for the Reagan administration. His research at MIT was in public housing, and showed how the beneficiaries were often the housing owners, not the residents. We went over to Ted's house in the Back Bay to pick him up. His wife, Joan, was not to be seen. The newspapers were spread all over. We were met by one Judge Morrissey. He was a very charming guy, who Ted subsequently tried to get appointed as a Federal judge. It was a big scandal, because Morrissey had been a municipal judge without having a law degree. We picked up Ted, and started driving in the car. They asked me what I did. I told them that I was an electrical engineering student. The judge said that they were "social engineers." I noticed that the judge pointed out good looking women to Ted as we drove along. We were driving onto the Emmanuel College campus and two nuns were walking by. The judge hollered, "Ted, the nuns!" Ted stuck his head out of the car and waved at the nuns with a big smile.

At the meeting, it was my job to introduce Ted. I think I gave him a pretty low key introduction. He gave his talk on Africa, and went to great lengths to pronounce names like Houphouet Boigny correctly. During the question session, I asked him why African leaders wanted to pursue a socialist path of development, and he did not give a very good answer. I subsequently dated a girl who was the judge's daughter's roommate, at Newton College of the Sacred Heart. She was from Miami, FL, and pretty neurotic. I also once met a girl at Harvard, who was Joan Kennedy's roommate at Manhattan College of the Sacred Heart, in Bronxville, NY. She told me how Ted's parents had donated money to the College, and Joan was in some receiving line, as Ted walked through. In later years, after the Chappaquiddick scandal, for fun, I would tell people about how I once drove in a car with Ted

Kennedy. I had a dim view of the Kennedys after meeting Ted. The only good thing about Kennedys, that I ever granted, was that Jack had some good jokes.

I studied Russian for a while at MIT, to prepare for two language exams that were required for the Ph.D. degree in those days. It was hard. I took the PhD. qualifying exams and came in second out of several hundred. The exam was very analytical in nature, and I was good at that stuff.

In the spring of 1962, I took a sailing class at MIT. They had a school outfitted with Tech Dinghies. These were small catboats with a center board. We sailed in the Charles River, where the winds were pretty variable.

I was getting burned out with studying and working on a frustrating research project. I wanted a summer job. In June of 1962, I received my M.S. and E.E. degrees. I could not find a summer job in the Boston area, or Chicago for that matter. However, Dr. Hodes at General Motors in Santa Barbara was willing to hire me. I found a passenger at MIT, to share expenses, and drove my green Pontiac to Santa Barbara. I stopped in Chicago and Scottsdale, AZ and Barstow, CA. I remember driving into the Los Angeles basin and seeing the golden grass and feeling the cool coastal air.

Summer in Santa Barbara

I found an apartment right in Goleta, and a roommate named Joe Crilly, who was taking classes at UCSB. After fooling around a little with stuff for Dr. Hodes, and realizing I was not in any mood to return to MIT, I went to work for Fred Hansen. Fred wanted to make a high energy molecular beam of N_2 molecules to study collision interactions. This was considered important, to understand the plasmas that surrounded ballistic missile reentry vehicles. He had this scheme of making a gunpowder driven piston to compress the nitrogen, and force it out a supersonic nozzle. I tried to make that work, an exploding cannon right in the lab.

It was another bad idea. The piston tore itself up. The amount of gas that came out was small and very highly excited. It was very hard to strip off a bit of fast gas as a sample. The whole thing occupied me for a year. I did get to fool around with a lot of gunpowder, and even some detonating explosives. They had a very high speed gun, that shot little models at 22,000 feet per second. This actually was able to attract funding for a number of years. At GM, I met two guys that I ended up rooming with, and visiting later, Paul Curzan and George Kuipers. They were from Marquette and Purdue and joined when I did.

I moved around a bit. Crilly moved back home. I moved in with two other guys in a two-bedroom flat on Trigo Road. For me, California was pretty wonderful. It was not as crowded then. The Goleta valley and UCSB were in a growth mode, and things seemed new and wonderful for us mid-western transplants at GM. This one man at GM, Waldemar Klikoff, from UC Berkeley, took me and his wife camping in the desert and to the White Mountains. It all seemed amazing. In general though, it was pretty easy to feel alienated and out of sorts in Santa Barbara. I did not have a lot of friends and the society was not exactly open to young men.

The one lasting thing I did, in August of 1962, was to buy a used sailboat from a guy who was visiting from Phoenix, AZ. It was a Blue Jay named Sea Fever. The Blue Jay is a 13.5 foot sloop, made of plywood. This one was covered with one layer of fiber glass. I had more fun with that boat. I would sail it at Lake Cachuma, in the hills behind Santa Barbara. I also sailed at the downtown boat harbor, and I put it in off the Goleta pier. I actually spent the winter of 62-63 refinishing the thing. It was a lot of work. The old finish was cracked, and getting it off was the hard part, especially given all the ins and outs of the construction. I belonged to a Blue Jay club, and we would race off the Santa Barbara

breakwater. The boat was heavy because of the fiber glass, and the sails were old, and I wasn't the best skipper, so I never won a race.

I had seen how all the senior people at GM Defense Research Lab had Ph.D.'s. This spurred my interest in getting my own doctorate. I was supposed to be doing some theoretical work in plasma physics for Prof. Abraham Bers at MIT. This did not fit too well with nice warm weather and sailing. So, I decided to apply at Stanford, where my old colleague, John Mantey, was studying. I drove up in my green Pontiac and applied.

Life in California in the 1960's

Life in California in the 1960's was different from now. The big difference was that the population was not as large. The effect of immigration law changes was not noticeable. Many parts of Santa Clara County were rural and covered with orchards. The Sunset Magazine way of life was much more common. Houses were not so expensive, although Palo Alto was notably more expensive than Mountain View or Sunnyvale. There weren't as many good, low-cost restaurants. The average income was relatively high, since the defense industries, that had just boomed, paid relatively high wages. In many respects, life was better, especially if you liked a more uncrowded, rural environment. It was at this time that the California Aqueduct project and the big expansion of the UC system, occurred. Even at this time, Los Angeles was considered too overcrowded, and in many ways undesirable. The environmental movement was just getting started, with concern about air pollution and over building. Air quality in the Bay Area was worse, since smog control on cars had not started.

Stanford University


You can see one reason I decided to move to California.

I wrote John Mantey's brother, Pat, to see if I could room with him. He was living with Ron Pyzska and John Hopcroft in Stanford Villa Apartments, along Alma Street. They did have an opening, since another student had left. At Stanford, I hunted around for an advisor, and Prof. Hugh Hefner agreed to take me on. He was not related to the Playboy Hugh Hefner. He had done some work on the channel capacity of optical communication channels, and on parametric amplifiers. I started to do a theoretical thesis, since I had done an experimental one at MIT, and thought a theoretical one would be quicker. I also was good at theory.

Some of my colleagues at Stanford were Hardy Sonnenberg, who eventually moved back to Canada, and worked for Xerox in Ontario as a lab manager. Another was Jack Marburger, who became president of S.U.N.Y. and President George W. Bush's science advisor. Mike Porkolab studied applied physics, and did a very nice experimental thesis with cesium plasmas, for Prof. Gordon Kino. He became a professor at MIT, and later director of the plasma lab, doing research on plasmas for energy production. Barry Stallard also did a plasma thesis. I took a number of courses in quantum mechanics, because I thought understanding that theory, would allow me to invent new categories of electron devices. I took quantum electrodynamics, which studies how the electromagnetic field works at high energies. In that class, I would work the QED homework problems with Dick Chang. Dick later became the vice president of the Semiconductor Products Group at Agilent Technologies, where I

work. Dick was born in Shanghai, and was raised in Hong Kong. He would read Chinese adventure books and practice his golf swing in the hall. One of Prof. Hefner's other students was Mike Cowley. I knew Mike from Notre Dame electrical engineering. Mike subsequently became the Division Manager of the Optoelectronics Division at Hewlett-Packard. He was also the president of Cielo Communications, which was a startup in Colorado, that later shut down.

My thesis was called, *"Quantum Theory of Single Gap Electron Devices."* It wasn't any great thing, but it did show that the Monotron Oscillator had an elegant quantum model. They let me finish in November of 1966, and graduate in June of 1967.

As far as my love life went, things were pretty dry for a while. I had this one girl friend, Anne Trammel, who became Mike Porkolab's girl friend, and still is. He is at MIT, and she lives in Menlo Park. There was another girl named Claudia Bertucci, who lived in the Stanford Villa apartments. Then, my lucky day, I met Roberta Flynn at a Catholic Graduates Club dance. She had another boy friend at the time, but she later broke up with him. She gave me the eye (I like to think) at Easter, outside St. Anne's Chapel and things developed after that. St. Anne's was the off-campus Catholic chapel for the Stanford students, and I attended Mass there.

After my first year at Stanford Villa apartments, I collected 3 new roommates; Ed Jones, Dennis Forbes and Len Bunyan. One thing we had, being engineers, was a very organized approach to apartment living. There was a work schedule and each guy knew his responsibilities for cooking, washing dishes and cleaning the house. The whole system made life predictable and comfortable.

My last year was spent in a rented house on Concord Drive in Menlo Park, with Earl Petersen, whom I knew from GM, Maury Barnhill, Len Bunyan and George. This house was not too far from Roberta's apartment on East O'Keefe, so I would often just walk over for a "social call." George would often be visiting his girl friend in SF on Sunday night. I would see that there was "surplus food," and invite Roberta over to eat. I think she liked being the only girl, with four men at the dinner table. Earl is a professor at U. of Minnesota, and Maury is at U. of Delaware. They both were real particle theorists.

In my Stanford years, I took Sea Fever on a lot of different waters. The main sailing spot was the south bay, launching at the Palo Alto marina. This marina has subsequently been closed. I also sailed out of Redwood City. I put the boat in at Santa Cruz a number of times, and in the delta, and in Tomales Bay. We would camp on Hog Island in Tomales Bay. It also went in at Alameda and Richmond. The reservoirs above San Jose, Chesbro and Anderson, and another one all felt the hull of Sea Fever. I belonged to a Blue Jay club, and we would race in the south bay, and have outings elsewhere. On our first date, I took Roberta to a club outing at Alameda. I really enjoyed sailing Sea Fever and have fond memories of a young adulthood well spent. Another interest that started in graduate school was back packing. I only remember going once, but it was a great trip to Vogelsang in Yosemite Park.

2. My World of Opto-Electronics

Varian

In 1966, I began looking for jobs as I was about to finish Stanford. I interviewed with Bell Labs at Allentown and Murray Hill. I interviewed with Jim Early of "Early Voltage" fame at Allentown. I also interviewed with GM in Santa Barbara and GTE in Mountain View and with Varian in Palo Alto. I elected to take the job with Ron Bell at Varian. Of all of the places, Varian seemed to me to have the most interesting job, with the best prospect of actually succeeding. Roberta was working at Stanford Hospital, for Dr. Halstead Holman in the Department of Medicine. She would not have to find a new job, if I worked at Varian.

The work at Varian involved trying to engineer a practical photocathode out of gallium arsenide. Scheer and van Laar, at Phillips, had shown superior quantum efficiency using cesium on freshly ultra high vacuum cleaved p-type gallium arsenide. My work involved a lot of ultra high vacuum engineering. I made a special vacuum crystal cleaver, various heaters, cesium evaporators, did LEED measurements, as well as Auger spectroscopy.

All this resulted in 4 significant documents. One described the interfacial barrier between cesium and gallium arsenide. Another described the behavior of cesium oxide as a low work function coating. The third was a paper showing the effect of carbon contamination of photocathode efficiency. The fourth was a chart of the Auger Electron Energies, with new measurements for a number of elements. I also invented the scheme for introducing clean gallium arsenide material into image tubes. My colleagues were my boss Ron Bell, George Antypas, Larry James and Ron Moon. The work provided part of the scientific and technological basis for so called Gen III photocathodes, which are still in production for night vision devices. This work was my first experience with real research. I really enjoyed a lot of it.

The work was funded by Army and Air Force contracts. Then came a funding lull, and I got shipped off to the Varian Instrument Division. At the Instrument Division, I worked for John Helmer on his X-ray photoelectron spectrometer. I put in a huge amount of work on a Helium discharge, low energy spectrometer for gases, as well as on a large signal modification of the X-ray device. The spectrometer had a minicomputer that ran it, so I programmed that to get more information out of the system. The whole thing was not a very good business idea, and the program was eventually cancelled.

I managed a short stay in the Varian Vacuum Division, designing a new Auger Electron Spectrometer. But by this time, I had gotten disappointed with Varian's lack of business success and decided to look elsewhere for employment.

Marriage

After a period of indecision, Roberta and I became engaged in the summer of 1966. My mother had shipped out my grandmother, Mary Uebbing's, engagement ring, and I gave this to Roberta. I thought it was wonderful to give her an heirloom, but I think she would have liked a new big fat diamond.


Roberta and I were married at St. Anne's Chapel, the Stanford Newman Center.

Roberta and I were married on November 26, 1966, at St. Anne's Chapel in Palo Alto. Roberta's cousin, Rev. Donald Turner, S.J., performed the ceremony. We went to Mexico for our honeymoon. I had read about Yucatan, and wanted to see it. We flew from San Francisco to Mexico City on a British Comet jet. We then flew to Merida and stayed in this old small hotel near downtown. It was pretty spooky. The next day, we caught a bus for Chichen Itza and crawled all over the ancient Mayan temple complex. After a day in Merida, we flew to Cozumel Island, which was a type of tropical paradise. We took a ferry and bus back to Merida, stayed a night and flew via Mexico City to Acapulco. We stayed at the Las Brisas Resort. We then rented a Volkswagen and drove to Zihuatenejo, further down the coast. Both of those places were tropical-paradise-like, as well. It was a hectic honeymoon, but it surely was interesting and rewarding. I was more adventuresome in my youth.

We moved into a garden apartment at 4298 Wilkie Way in Palo Alto, which was close to Varian and Stanford. I think Roberta was disappointed that I spent so much time studying new science for work. I learned a lot about semiconductor physics at home. But our weekends were pretty free, and we typically spent them being California tourists. We drove all over the northern part of the state. We backpacked in the Ventana Wilderness area, south of Monterey, and in the Sierra. We sailed in Sea Fever. One time we were really bored, and took Sea Fever over to the other side of the south bay. Bad idea. The wind had really come up, the water was shallow, and the waves were practically vertical. It was pretty hairy, and we were so happy to get back home to our apartment.

Mary Frances

Mary Frances, our daughter, was born March 18, 1969, at Stanford Hospital. We went to these Lamaze classes, where expectant parents learned how to do childbirth. I was in the delivery room when Frank was born. My special nickname for Mary Frances is Frank, as if she were some special kind of male buddy. Roberta's parents visited some days after Frank was born, but there were still times when Roberta was home alone with our newborn.

I remember the time early on, when Roberta decided to go out for the first time, leaving Mary Frances with me to take care of. She was lying on the floor of the kitchen, squawking, and I was alone with her. I got this big feeling that I was responsible and needed to really pay attention. It is not clear at all, that a lot of engineering education is very useful for raising and caring for children.

Jack

Jack came along as a bit of a surprise. He was born on October 29, 1970, at Stanford Hospital. He was born about 9:00 AM, and all the medical students filed into the delivery room to watch. Roberta's parents came right away to help with the baby.

Roberta remembers the time when Jack was little as the happiest time of her life. Her father died suddenly in 1974, and life was not as good after that. Roberta did go back to work part time at Stanford fairly soon after Jack was born, and there were the usual difficulties with child care.

Our House

I spent a fair amount of effort fixing up our house. I painted the outside two colors called martini and olive. I planted an apple tree, and tore out part of the brick walkway in the back. Mr. Youngman, my neighbor next door, and I replaced one fence, which was pretty rickety. I redid the front with the help of a landscape designer. There was new concrete, and new plantings, and a new brick wall, that I built in front. We papered three bedrooms, put in paneling in the den, put in new linoleum in the kitchen, bought our present furniture set. Eventually I put in a deck in the back, after taking out a lot of concrete. It is amazing what you can do when you are young and motivated.

Church Life

Both Roberta and I are practicing and believing Roman Catholics. We have worshipped at our Lady of the Rosary Church in South Palo Alto. Roberta is president of the Palo Alto St. Vincent dePaul Society, which does hands on charity for poor people and people down in their luck. It keeps her pretty busy.

I have been a member of the Palo Alto Knights of Columbus since 2003. I was Grand Knight two years running. I also am a regular minister of the Cup at the 10:30 Mass. I personally have a pretty complex religious philosophy, but that would take quite a few pages.

ESL

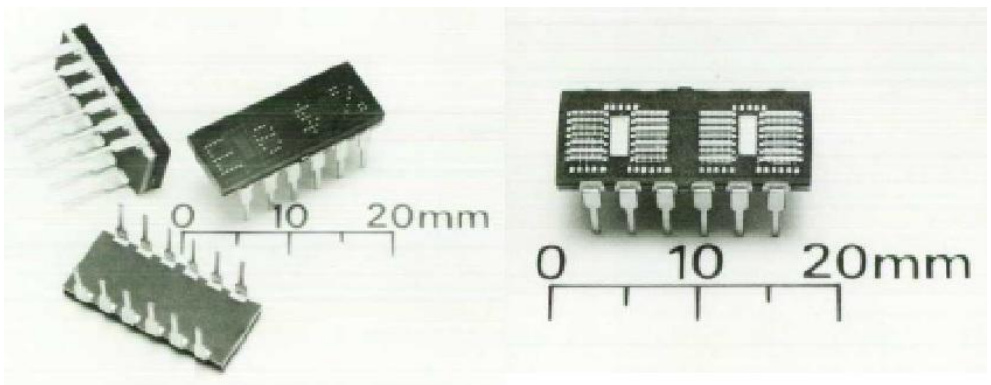
By 1972, I was pretty unhappy with Varian and looked around for another place to work. Paul Chestnut, of Notre Dame and Stanford mathematics, wanted me to work at ESL, his lifetime employer. ESL was a military systems contractor for Electronic Warfare programs. I had called up Mike Cowley who was at Hewlett Packard, HPA Division, and asked what might be available. While at Notre Dame, Paul had received two job offers and took the ESL one. It promised excitement, since the work involved exploiting electronic intelligence for military purposes. I had to get the special clearances that take 9 months, to really start work. We did this study on the suitability of satellite-born synthetic aperture radar for intelligence gathering purposes. The people at ESL had this big glamour thing with their work, but the reality turned out to be very prosaic, and their pitch to me had been misleading. I didn't stay long.

HP

I decided then to reopen the offer at HP and asked if the job was still open. It was, and I took it in August of 1973. I worked for Roland Haitz, who was the R&D manager for the optoelectronic part of the HPA Division. HPA had begun as a semiconductor startup, with HP as one investor, along with a few other key individuals. It was later acquired by HP, and set up as an operating division. My job was to be project leader of the small alphanumeric display (*SAN*) project. I started in August, and by November, the project got put on hold, while I ran the *Glowworm* project. *Glowworm* was a copy of a display from a competitor, Litronix, who used a magnified calculator numeric digit with an air gap plastic lens.

Project *Codenames* will be in *Italics*.

I had to come up with a computer program in BASIC, to trace light rays to design the lenses, since nothing was available that would do the job. The program ran on a teletype-based time share computer, located at the HP headquarters complex. I also had to procure a new type of high temperature substrate, not currently available. The project was quite successful, and there were 3 follow-on projects for HP LED display products; *Birdseye***,** *Bugseye* and *Catseye,* that were also well received.



The Small Alpha-Numeric (SAN) was a 4-character cluster with 2 strobing IC drivers in between characters 1-2 and 3-4. It had a pleasant 5x7 font app earance and could be stacked end to end for long character strings.

Then I went back to the *SAN* project. Twelve different companies had tried to make a monolithic 5x7 LED display, meaning 35 emitting spots on one single GaAsP substrate . So did HP. It turns out that this was a bad idea, the problem being the isolation diffusions. The available mask layers were porous, and the required deep zinc isolation diffusions would short out the LEDs. Roland insisted that we do it that way, but I could tell it wasn’t working, so Bob Teichner started secret work to use substrate slivers.

We eventually made this work. But in the long run, automatic die attach and wire bond equipment became so good that using 35 individual LEDs became the best way.

The driver ICs were a problem. Our IC design staff and tools were pretty weak, with young and inexperienced guys involved. I started pointing out their problems. They did not like it, but eventually they fixed the ICs. The *SAN* products became a very successful product line, that went through a number of changes, and lasted a long time. The final product was a gem, used on the 9825 desktop calculators, with a fine font style. With a significant portion of the operating strobing and memory electronics on-board the display unit itself, the it is easier to integrate into a system than earlier strobing dot-matrix displays. This type of product is even used today.

The HP 9825A Desktop Calculator was the first major HP project to use the SAN displays. Since it featured powerful programming functions, the alpha characters were required.

Promotion at HP

There was a big need at HP for a more professional approach to the packaging of optoelectronic devices. The package always made up a large fraction of the cost and reliability impact, but the engineering methods for reliability were not developed. And, being semiconductor products that needed visual output instead of a metal can, the epoxy technology was crucial. Some of the other projects were having real technical and management problems, and I volunteered myself to be the manager of a packaging group. I had always been strong in mechanical engineering, and could see that there were a number of challenges that would be good to tackle.

One of the immediate problems was epoxy. Clear epoxy was crucial to the performance and reliability of opto devices. The composition of the stuff varied from lot to lot, and we would fail reliability in the field and in testing. I bought a Dupont thermo mechanical analyzer to track epoxy properties. I hired Phil Johnson to take over epoxy QA. Phil loved the bureaucratic life and brought order to things, but was not that able to get outside his white-shirt idea of being a manager, and imaginatively contribute to other problems.

One of the problems with this is that packaging group generally oversaw the final product specifications, while the LED and IC guys did their specialized thing. This meant a big crucial interface with marketing and manufacturing, since the products had to meet customer requirements, as well as be engineered for manufacturing. There was a fair amount of rivalry between different groups, power plays and politics going on. In addition, the industry was new and there were hardly any experienced people available. This did not make my life any easier. Recruiting was hard, and the available good people had plenty of other job offers.

I designed a bar code reader as an input for the HP-41 Handheld Calculator, for use in loading calculator programming.

At about the same time in 1976, there were two requests from the hand held calculator people at HP. They wanted a small, very cheap bar code reader and a small very cheap optical shaft encoder. The first was to be able to read in calculator programs out of a magazine. The second was to be able to control a pocket paper plotter drive motor. The motor drove a grit wheel technology to move the paper. Perry Jeung started on the barcode reader. The

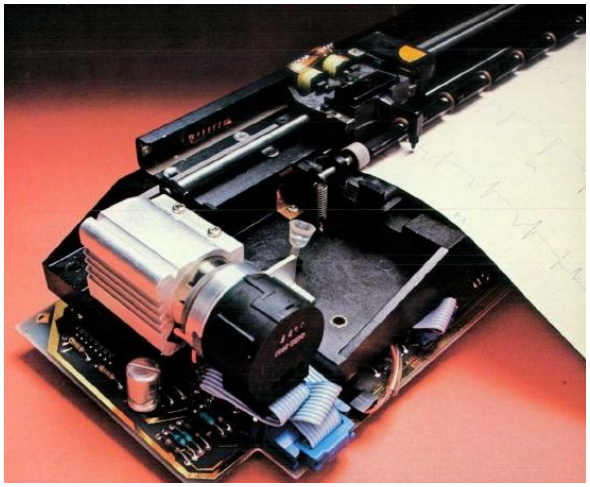
component sensor was called *Spotlight*. The encoder was called *Scorpion* after the plotter and I hired Howard Epstein to be the project leader for that.

The *Bugseye* was a small immersion lens calculator display for the HP wristwatch calculator, the HP-1, intended for technical users. Introduced with a lot of fanfare, at a seriously high price for a wristwatch, the HP marketing department concluded it would likely need to be sold through fine jewelry stores. Not a good fit for traditional HP sales distribution. Because the monolithic calculator LED digits were immersed in epoxy on a ceramic substrate, there were real temperature cycle reliability problems. Bob Teichner and his team built a lot of devices and we were given the luxury of really studying the thermo mechanics involved. This work, plus a lot of other work on different LED products allowed me to write a paper on, *"The Temperature Cycling Reliability of LED Displays."* I gave it at the Reliability Physics Symposium in Florida, in about 1979. I am proud of the work and results. I believe a lot of people consulted it in subsequent years, and it was certainly the first comprehensive work on the topic. The original reason for my thermo research, the HP-1 wristwatch, didn't last long, and was discontinued within a year.

HPs wristwatch calculator, HP-1, used tiny monolithic digits, and a stylus for inputting calculator data.

One nice little success was the Bar Of Light Device or *BOLD*. The BOLD was used to back light legends on instrument and other panels. It was a simple adaptation of the stretched segment display technology to the back light business. The geometry just happened to work nicely, and the product was ready for transfer in a short period of time. I remember it was the only time that this happened, where the lab got well ahead of production availability. Of course, manufacturing was swamped with other things and in this case, wasn't able to take up this easy winner in a timely way!

At that point, management decided to go from a functional organization in the R&D lab, to a product organization. I took over bar codes and encoders. The marketing manager for the Emitter Detector products was John Sien. I picked up some IC people and lost display people. Life was still pretty difficult. The projects were late, the people involved were not super stars, and I was pretty frustrated. I had two secretaries, one of whom was very good. She moved to Corvallis, and the next one was competent enough, but ended up fighting with one of the other secretaries. HP made it difficult to move people around, and so I was stuck with problems.



HP was pre-eminent in photo-detector applications. In this case, we offered an optical shaft encoder for use in a plotter drive motor. The paper was driven with "grit wheels"--seen in upper center--that speeded the paper back and forth for pen plotting.

I eventually lost my management job, the immediate cause being my frustrated comments about some low grade engineering work. Of course, the people involved were out to get me, since I was not making their lives easy, with all my pressure and frustration. In looking back on all this, I would lay it on three issues; first, was my excess impatience and wanting to get things done, even at the expense of people's feelings. The second was my naiveté, about engineering talent. It is a lot harder to be a good engineer

than you might think. I would hire people out of hope that they would work out, rather than being convinced of it. I subsequently became more conservative in hiring, and have never been disappointed.

Finally, my boss, Roland Haitz, was a good practical physicist, who contributed a lot to HP. He was not one for systematic engineering management. Organization and documentation systems and training did not appeal to him. He also was a lot like me, smart and impatient and not too strong on human relations. He lost his lab manager job about a year after I lost mine. He then became the non managing group R&D manager. His big claim to fame in later years was helping to found OIDA, the Optoelectronics Industry Development Association and the promotion of LEDs for general purpose lighting. The global growth in semiconductor-generated light output versus time is now called Haitz's Law, just like Moore's Law.

I might add that there were a number of optoelectronics lab manager failures over the years. One success was Bob Steward, in his reinvention of the rotary optical encoder, driven by a VERY clever interdigitated detector invention by Mark Leonard. Another success was Bill Sullivan in fiber optics. The failures included the outsiders who took over the display group, Stan Gage and Jim Leising. The failures tended to run losing projects too long, rather than cutting their losses. The successes had a nice innovation or two to run for market success. Del Hanson started out the fiber optics group, and then lost his job, basically because he did not understand the non-trivial mechanical issues involved in fibers. He did became a long term successful fiber pathfinder.

A Little Politics

In those years, Palo Alto City politics was divided between the residentialists and the business faction. The residentialists did not want high rise buildings. And there were plans to raze an entire block of houses to build what was called the "Superblock." Palo Alto already had 3 high rise buildings left over from the days of the business faction. Recall that HP's manufacturing manager, Ed Porter, had been mayor during those times. I joined a faction called ABC, Association for a Balanced Community. I worked and delivered fliers and went to meetings. Tom Passel recruited me to be some kind of organizer for a school board faction, that wanted to prevent one conservative, Royce Cole, from getting elected. He was supposed to be doing something awful, that I cannot remember. I worked on Becky Morgan's campaign for school board. I got to know her and her manager, Jan Fenwick, who both lived around the corner. Becky's husband was Jim Morgan, CEO of Applied Materials Corp, a preeminent manufacturer of semiconductor materials processing automation. Becky subsequently was elected State Senator, and Bob Fenwick has been the mayor of Los Alto Hills. I had been a liberal, but I sure noticed that I was starting to think that conservatives had the better of many arguments. I did not continue on in the political activities.

Children and Home

I wasn't the most involved father with my children's development. I loved to play with them and rough house and talk with them, but mainly Roberta raised them. We joined the Eichler Swim and Tennis Club, and Roberta would take them swimming almost every day. One thing that was nice was Indian Guides. This was a YMCA scheme where fathers and six year old sons would do things together in a group. We would meet at someone's house and do various projects. We did some hiking outings. One thing lead to another and Jack and I plus Bill Morrison and Andrew and Doug Owen and Dai would do back packing into the Los Padres National Forest, in the Ventana Wilderness, as well as Point Reyes in the spring. We would hike in the Sierra in the summer. These would be weekend or long weekend type hikes. They were quite rewarding for both fathers and sons.

Roberta became unhappy with our house on St. Michael's because it wasn't that big, but also because some of the neighbor women seemed to wanted to push their children off on Roberta, to mind at our

home. We hired an architect to seriously remodel our house with a big add on for with a second story. While we were in the process of doing this, we looked at other houses. We were serious about a new house on Ensign Way, near the new Mormon Church, but it was a bit far away, and we thought Jack in particular should stay with his old friends. A house came up for sale on Towle Way, two blocks away and we bought it. We moved in the summer of 1979, and have been there 35 years.

Jack and Mary Frances both went to El Carmelo School, Jordan Junior High, and Palo Alto High.

HP Labs

For a year, I hung around OED, managing the bar code part of my old job, but things weren't exactly wonderful. I ran into Fred Kahn, from HP Labs, on an airplane trip. He talked to me about his laser addressed, liquid crystal display project. He was looking for someone to be the technical leader of it. Fred worked for Bob Burmeister in the Solid State Lab. He was a liquid crystal expert who had invented the LLCD (Laser-addressed Liquid Crystal Display) at Bell Labs. I decided to do something different, and moved up to the labs.

The laser addressed liquid crystal display had very high inherent resolution, since a small spot of focused infrared laser light would "melt" a thin layer of smectic liquid crystal material that was held between two glass plates. The recondensed liquid crystal material would scatter white light. With the proper optics, a nice, high resolution, black on white, projection display could be made.

The *LLCD* was kind of fun. It involved galvanometer-driven mirrors and lasers and liquid crystal cells and building things. It also involved software to drive the lasers and galvanometers. I really felt pretty ignorant about the software system that Greg Cutler had put together to do this. I mentioned this to Roberta and she encouraged me to spend some time and learn it. When you make learning something an official project, it becomes a lot easier to do. I eventually became pretty good at using BASIC and PASCAL to control the *LLCD*. I hired Charles Young to help with the *LLCD* work. He was a very smart guy, trained as a physicist.
We used the very latest HP desktop computers to do the laser-positioning control. The *LLCD* project was successful in that we convinced the San Diego Division, SDD, to take it up as a good tool for engineering computer aided design. I was somewhat dubious, because I was tracking the price of video RAM and it looked like CRT displays would soon get good enough and cheap enough to do a better job, especially since the *LLCD* was slow. I kept pushing the SDD to assign some marketing talent to the project, so we could go and talk to customers. The result was that we found out that nobody really wanted it. I plotted cost versus volume with what I could learn. However, in no product regime did the LLCD become competitive. The project was cancelled at SDD.

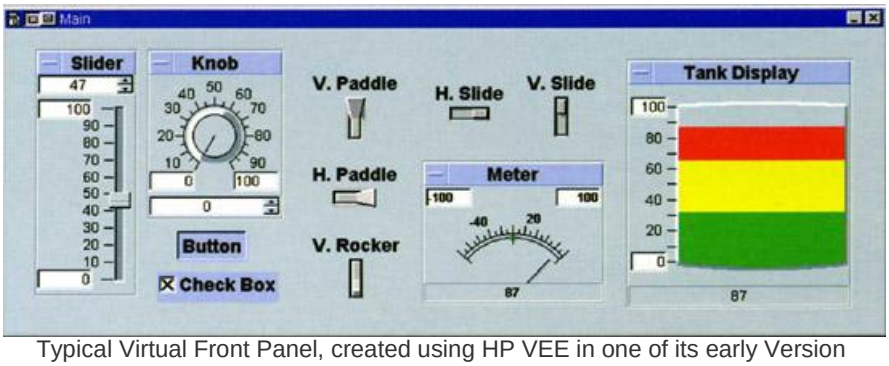
RMG--Realtime Measurement Graphics

As I was looking at one of the small CRTs on our desktop computer, it dawned on me that the CRT could be used as a virtual instrument panel. There was an article in a magazine about the same thing, and since HP was a major instrument company, getting on top of this opportunity faced no opposition. Greg Cutler was a genius at getting assembly code to run fast. I joked about the Gregorian calendar, where every nanosecond counted. Charles Young soon proved to be very skilled at writing software. We started making high performance displays on HP color desktop computers.

It was 1981, when the PC had hit the market hard, and the technology was exciting a lot of people's imaginations. Two new operations were set up, one at the New Jersey Division to make low cost PC Instruments and another called Instrument Systems Labs in Loveland, CO. We worked with ISL. They had decided to use a new object oriented language called Objective-C to make more component-oriented software. Our portion of this effort was called RMG for real time measurement graphics. We

had an early initial success in making display software for the speech research group. It would display speech spectra versus time, with a scrolling display. The speech waveforms could be annotated with descriptors. Everyone was pleased and happy with these wonderful new tools. The Chem-Station people in HP's Analytical Group also were interested in the software, and part of our code made it into an HP product.

The work at ISL eventually turned into HP-VEE, which is being sold today. VEE stands for visual engineering environment. It competes with Lab View, and represents the HP/Agilent/Keysight version of the CRT based instrument front panel.



Typical Virtual Front Panel, created using HP VEE in one of its early Version

Our work eventually got rolled into a Measurement Systems Lab under Dave Ricci. We tried to make a more advanced version of what ISL was doing, using Objective-C. Things were slow at one point and Charles Young, who was working for me, didn't have anything to do. There was this medical doctor, Paul Tang, who worked upstairs on things like artificial intelligence for medicine. He wanted some display work for a critical care patient's flow chart. Paul and Charles got along very well, and Charles made a very impressive critical care flow chart for Paul. This almost chance beginning led to a long and lasting cooperation between the two. Paul is currently in charge of the Palo Alto Medical Clinic's digital medicine effort and Charles is working with him. Paul Tang is still at PAMC, and has had a major role in computerizing the medical industry.

We had good UNIX workstations to use, and our concern with visual quality and speed always made our screens very lively. Others would wonder how we made it so fast, and compared with two other, more traditional HP efforts, ours really looked good. I learned a lot about C and UNIX and networked workstations at a time when they were very state of the art things. The company that invented Objective-C invited me to the OOPSLA conferences, and had me be in charge of a session on, *"Making Products using Object Oriented Programming."* I contacted all sorts of people, all over the country. We used UUCP, the dialup software in UNIX, that preceded the internet, to make meeting arrangements and send around the text of the proceedings. I got a lot of recognition out of the effort and we definitely learned things about how to do Object Oriented Software Engineering.

A description of the origin of HP VEE in the Oct. 1992 Hewlett Packard Journal.

HP brought in a new manager for our lab, Tom Kramer. Tom had some shortcomings. Charles Young and I were having a lot of ego clashes. HP labs was not the place to make software products of the kind that were needed. I was unhappy, so I called up Mike Cowley to see about coming back to OED. The RMG effort was something I initiated and ran, and it was great fun while it lasted, We showed some innovative things and influenced the company, but I decided that managing software projects was not a field that I had unique strength for, compared to other people.

Back at OED

OED was now in San Jose, and I moved there in 1988. The first project was a grayscale LED printhead for Kodak xerography. The name I gave the project was *Grayhead*. This was fun at the beginning, but the project and business died, because Kodak really did not understand what it was doing. The semiconductor laser plus polygon scanner had dominated the whole business of laser printing from the beginning. Kodak used the LED for some printers because their photoconductor would not respond well to the laser wavelength and the laser took up more room. Mike Cowley was OED division manager and he lost his job because he would not trim his staff when he started to lose money, or at least not make enough.

After that, Jim Leising took over from Stan Gage as R&D manager. He had us work on flip chip LED attachments. The idea was to eliminate wire bonding, to make very tiny surface mount LED devices. This was called the *Beast* project. Several of us actually got the whole thing to work pretty well. The problem was that the solderable end contacts blocked some of the light, and so they were not as luminously efficient. I invented a new die attach method for this scheme, and it was amazingly successful technically. Milt Liebhaber was the division manager by this time. OED spent a lot of money building all these automatic processing machines for this product line, only to have it be a commercial nonsuccess. They eventually sold the whole line to a Japanese company, who valued the much higher temperature cycle reliability that you could get from soldered LED chips.

Switch to OCD

I had always wanted to redo the *Spotlight* sensor. I was amazed that the product line had survived as long as it did. I heard that the *Spotlight* was still being manufactured in 2003! I had to switch to the Optical Communications Division to do it. The bar code product line had suffered a big defeat when they tried to compete with the scanning laser with a sophisticated laser/fixed detector scheme. Sadly, the project didn't make it, and John Sien and much of his team lost their jobs. The remaining product line team was very supportive of redoing the sensor and had a long list of specs for the new sensor. I developed a somewhat complicated, but very small, bright and low power consumption sensor. George Smith designed a special CMOS sensor front end for the thing. It was elegant, but the barcode business had finally started to die, and the darn thing really did not read bar codes that much better. It was my "second project." There is a symptom in engineering, where a first project is brought out quickly and efficiently, and somewhat underperforms, but is perfectly adequate. The second one picks up all the bells and whistles that the first one missed, but is too complicated, and turns into a flop.

At about this time, I was talking to George Craford and Frank Steranka at lunch, about the problem of capturing the downward traveling light from their new, light-efficient AlInGaP (Aluminun-Indium-Gallium-Arsenide-Phosphide) red and yellow LEDs. The LEDs were grown, lattice matched on GaAs substrates. The GaAs absorbs visible light, so half of the light generated was lost in previous generations. I remembered George Antypas at Varian, inventing a wafer bonding system where he bonded thin GaAs layers to borosilicate glass, for transmission-type III-V photocathodes. I suggested that they etch off the GaAs substrate, and wafer bond a transparent GaP substrate to it. This gave them twice as much light output. After some hesitation they agreed to do it. A new hire from Illinois, Fred Kish, became the project manager. It turned out to be a huge success. High brightness auto-market tail lights and side markers were made with it. A Taiwanese company, Liton, violated the patent and I made some money testifying against them.

I had done some simple optics design for the IRDA infrared data sensor, and that work continued on a consulting basis over time.

After the barcode wand business was shut down, I was project leader for the so called *Beauty* project. This was an attempt to make a small surface mount optocoupler, using "sheet processing" or putting all

the chips for many components on a special PCB (printed circuit board), encapsulating them enmass and then sawing up or singulating the parts. This died because it was too difficult to get a reliable, optically efficient cavity and because there wasn't that much of a market for tiny optocouplers.

It was just after this, that I had a little triumph in low cost infrared modules. I had a new boss who insisted that we should not make the low cost IR modules, by using "sheet casting." What I proposed was actually a copy of something that the Citizen Company was doing. I built a bunch of prototypes in an unauthorized way, and passed them around to interested parties in HP. The whole thing turned out to be a success. Using this technology has been crucial to making money in that business.

Management decided that we had to have our own production processing in Singapore, as a backup for Citizen, with whom we had contracted to actually do the packaging for us. They sent me to Singapore to help set up an R&D process there. I spent two months living there in a serviced apartment near the Hyatt. It was on the 23rd floor of the Ascot apartments, right near Orchard Road. I tried to set up a social life, doing little tourist things with people that were visiting. I would put on little dinner parties for 3 HP guests on Thursday night. I would cook Italian food with wine. The parties were very nice and winey.

I was there with Bob Black, who was the infrared applications engineer in Singapore, to Malacca in Malaysia for a visit. After a while I rented a car, having tired of standing in the rain, trying to hail a taxi in a zone with few available in the evening. Roberta came for the second month. The cooking parties stopped, we ate in the food courts. The two of us went on a long weekend holiday to Bali. It was plenty hot there because it was not the best season. Bali is definitely different, a Hindu island in Indonesia with its own language.

Foreign Travels

After the children were grown up in the 1980s, Roberta and I did some foreign travel. Our first overseas trip was during the Reagan years. We went on a European tour that went from London to Rome, by way of Paris, Lausanne, Venice, Pisa and Munich. This trip was a nice eye opener for me, seeing the glories of Western Civilization for the first time up close. We left the tour in The Hague, took the train to Amsterdam, rented a car, and drove to Bocholt in Westphalia, the ancestral home of the Uebbings and the Eilers. We stayed at Schloss Anholt, and tried to find Uebbinghook, or Uebbingville in the local language. We couldn't find it. It turns out that Uebbinghook was a crossroads, and is now a neighborhood in Bocholt.

My father's second cousin, Anna Eilers Sanz, had kept in touch with the editor of the Bocholter-Borkener Volksblatt newspaper. He liked to keep track of all the people who had left from the area. He sent a reporter out to the castle, where we were interviewed. They published our picture and story on the front page. I subsequently heard that two old ladies came to the paper the next day to see about their long lost relative. I don't know who they were.

Later, we took an Eastern European tour that went from Frankfurt to Berlin, Warsaw, Cracow, Budapest, Vienna, and Prague. This was when the communists were still in charge in Eastern Europe. In Warsaw, we had this really strange feeling, of a lot of money in our pockets, and there was nothing to buy. We left the tour in Prague, rented a car, and went to visit Roberta's distant relative Monika Bartunkova. Monika was retired and lived in Kolin. We found her and her house, but we had no language in common! It was the strangest feeling trying to converse with someone, very much like your mother-in-law, in sign language, bad German and bad Russian. We stayed in Kutna Hora, an historic silver mining town. We also drove around east Bohemia and saw a very different world. We almost ran into a motorcycle road race outside of Kolin.

In later years, we took our daughter, Mary Frances on a two week tour of Great Britain and our son on a similar tour to southern Italy. On the latter, we visited Pompeii, Mt. Vesuvius, and Mt. Etna in Sicily.

Roberta and I went on a do it yourself tour of Paris, Giverny, Reims, Metz, Brussels and Bruges. We then went on a two week tour of Ireland, which included kissing the Blarney stone. In 2001, we took both Jack and Mary Frances on a Russian tour. We flew to Moscow on Aeroflot, and on to St. Petersburg on another flight the next day. We were on a cruise boat from St. Petersburg to Moscow by way of Petrozavodsk, Kizhy, Yaroslavl and some others. It was something to see such a different world.

In 2002, John went on a canal boat trip in Alsace, with the Ashleys, and then went on a Palo Alto Neighbors Abroad visit to Albi in southern France.

Domestic Travels

We also went on trips to the Canadian Rockies, Toronto, Montreal and Quebec. We visited the Carolinas on one trip. Early in our marriage, we visited Virginia and Williamsburg and Washington. DC. We would visit my sister Jane in Inverness, IL a lot, and my brother Tom in South Bend, IN. Also my sister Marcia in North Andover, MA, and my sister Christine in Fairfax, VA. We visited Arizona and New Mexico and went canoeing in the Boundary Waters Park in Minnesota.

Prostate Cancer

On March 6, 1996, I was diagnosed with prostate cancer. 18 months prior, my PSA had been 16.2, which is pretty high and generally indicates cancer. But the biopsy at the time was negative. This can happen if you don't take enough samples. In 1996, the PSA was 40.3, and the indications are that it had spread and was incurable. I went on hormone therapy for two years and had a series of radiation treatments at Stanford. The doctor said that I had an excellent chance of living for 10 years or more with this treatment, since prostate cancer is slow growing. Of course, if Kaiser had caught the cancer earlier, I might have been cured!

I went on a vegetarian diet and took a lot of vitamin and other supplements, in hopes of beating it back that way. The PSA went down to 0 after the treatment and then returned to 0.1 for a while. The shock of the diagnosis was pretty heavy, but I resigned myself to a relatively early death. I kept a happy attitude and started to realize that a lot of things were not that important. One thing is important and that is family. This autobiography is part of doing the important thing.

In 2000, my PSA started to rise again, and I went back on hormone therapy. This knocked it down to 0.2, but the side effects of the Lupron shots were not nice. I noticed symptoms of peripheral neuropathy in 1998. These got worse after going back on Lupron, so I was caught between cancer and its treatment. Even in 2014, 18 years after treatment, my prostate cancer is not too bad. The peripheral neuropathy has gotten worse, and the prostate is enlarged, but I can still urinate okay at 2-4 times per night.

Fiber Optics

Continuing on in 2004, while working on infrared optics, I was asked to consult on some plastic optics for fiber optic transceiver modules. A transceiver is a package with a fiber optic transmitter that turns electrical signals into optical ones, and couples the light into the outgoing optical fiber. There is a complementary receiver that turns the incoming optical signals into electrical ones. I came up with the well-received periscope design, which connected light from two TO cans to two fibers in a cable spaced 0.75 mm apart. TO cans are small, industry-standard hermetic semiconductor packages. Our TO cans had glass windows to transmit the light. This was a nice innovation that the competition could not meet.

Because of this, they went for a more expensive LC fiber connector solution. The funny thing is that the competition thought we had a patent on the periscope design. We had failed to get the patent because the project manager was swamped with work, and didn't pursue the second round of negotiations with the patent office. Yet, the non periscope design actually became the more popular standard.

I also invented and pushed the angled window can (AWC), hyperbolic transfer lens concept. This was actually adopted as Agilent's standard scheme for doing VCSEL laser power monitoring and for focusing the light onto multimode fibers. The same solution was invented by our competitors at about the same time.

At about this time, the fiber optics business was booming. Agilent had specialized in the datacomm part of the trade and ended up dominating the transceivers for this part of the business. I worked on an ill conceived cost reduction for one of those projects.

There was the *Dos Equis* project, to do 2.5 GHz transceivers. My claim to fame here was running a VCSEL (Vertical Cavity Surface-Emitting Laser) users group to exchange information within Agilent on the performance of these VCSEL lasers, and how to tame them for use in transceivers. The early VCSELs were temperamental beasts, and there was a lot of different activity within HP regarding VCSELs. I wrote a tutorial article that was well received on this fairly arcane topic.

Because of the incredible Internet bubble, of the 2000s, all sorts of people were leaving Agilent for jobs at startups. To keep us happy at the height of the bubble, the company flew all the engineers to Las Vegas for a boondoggle "conference."

The Champagne Bubble

Agilent had started this fiber optics matrix switch project that used a vapor bubble to switch signals in a fiber array. The thing was called *Champagne,* and was supposed to be needed to groom fiber optic networks, in a regime where this huge amount of fiber traffic was sold on a wavelength (bandwidth) basis. The switch would take light signals from a closely-spaced array of 32 optical fibers and selectively switch the light from any one input fiber to any one of 32 output fibers. If the particular light channel was not switched, it went on to the non-switched output fiber array. All the optical beams travelled through a transparent liquid, and switching was done by creating a tiny bubble in a narrow channel, etched in the quartz switch block. The bubble was "blown" by an array of heater elements.

The thing was not working well at all. The device physics had not been worked out adequately. Funding at Agilent Labs had been kept down, and the team, headed by Julie Fouquet, could not afford to hire the special talent to really understand the device physics. The project had been moved to the components group and Bill Sullivan, the group General Manager, thought I would be able to figure things out. I moved to the Stevens Creek site in Santa Clara in March, 2001.

It was a fun project for me. I started to work with Flow Science, of Santa Fe, NM, to acquire some more advanced fluid mechanics modeling software that would handle this type of bubble. I invented a new type of immersion optics, called the Peeker Lens. This lens allowed us to look at the shape of the bubble in much greater detail and from the side. Julie had given a grant to Prof. Bud Homsy at Stanford and UCSB to do some math modeling. I worked closely with Dale Schroeder, a very creative engineer, who had been on the project a long time. After a bunch of lab and computer work, and a lot of head scratching, we really started to figure out how the bubble worked. The unfortunate thing was that the bubble was naturally unstable and not well suited to acting like a switch. When a given light beam switching function depended on a reflection performance of a bubble, the idea was already problematical. But when you needed to preserve that one bubble perhaps permanently, as required by

your fiber optic network demands, it was asking for reliability problems. You could modify it and turn it into a dry wall bubble, but even this type of bubble was quite difficult to achieve. It was also quite expensive to fabricate the needed experimental devices, so progress was hard.

Dale, in particular, was able to invent some elegant and complex ways around the problem, but we never found a practical solution with the time and money we had. Finally, we found out that the market for fiber based switches was not really that big. It was more practical to convert the optical signals down to electrical ones, and do the matrix switching in that format, then convert back up to optical. The conversion transceiver modules had become a lot cheaper.

I did write a scientific paper called, *"Heat and Vapor Flow in an Optical Bubble Switch."* We discovered four different things, new to science, that were quite interesting. The paper was finally published in JMEMS in 2006. Stephan Hengstler really pushed for publishing it after the first round of reviewers rejected it. I thought it was a pretty interesting paper with new science.

By October of 2002, the big "economic downturn" was in full swing. I survived two rounds of personnel cuts in the Bubble Group and two further rounds in Fibers.

Back to Fibers

Ron Kaneshiro had saved a place for me in Fibers, since I liked working there, and had a pretty good reputation. I went back, working for Kit Cham in the optics group, but there wasn't really a lot of good work to do. The first round of cuts sent me off to the Sensor Solutions Division, at the Bowers site in Santa Clara, to work on a New Business Initiative in optical sensors.

Sensor Solutions

In 2003, it was turning out to be very hard to find a new business to get into, that isn't either very small, far away in time, or filled with plenty of competitors. I worked for a start up veteran, Mammad Safai. Agilent had to lay off 4000 employees because of poor orders, and the fact they when they spun off from HP, they accepted too many employees to go with the move. Their sales forecasts had been too optimistic, because at that point they were working on some large order backlogs, which quickly disappeared. The company came back to the same size it was 10 years before. The telecomm bubble basically wrecked the company for a time. The whole mess is a tribute to human over-optimism and sales forecast mania. Mammad's ideas at the time were not successful, and he eventually left Agilent.

While at Sensor Solutions, I was laid off from Agilent, one month shy of 30 years of service at HP/Agilent. That seems like a bush-league way to treat a 30-year veteran, with a dozen successful creations behind me. They would not even give me a 30 year service award. Of course Agilent was going down the drain at the time. Looking back on that treatment, would I ever take my first job at HP again in my youth? Yes, I suppose I would, but pay more attention to internal politics and management personalities.

Editor's Note: That WAS bush league management. It would never have happened with Dave and Bill.

Lumileds

Luckily for me, I was able to immediately obtain a position at Lumileds, which was a joint venture between Agilent and Phillips. I worked for Paul Martin, trying to fix the V_F shift (increase) that occurred when blue LEDs were soldered into their mother boards. This turned out to be a very difficult problem that was associated with hydrogen mobility in the InGaN epi layers of the LED. The atomic

hydrogen would neutralize the magnesium P doping. High P doping is essential for low contact resistance via a tunneling mechanism.

I hired an experience technician, Joseph Hai Nguyen, who had previously worked at Lumileds. He was a great help. We were slowly making progress on the V_F shift problem, when Paul reorganized his lab, which he really had to do. I was put under Dan Stiegerwald. This was not a marriage made in heaven. He eventually became so abusive that after talking with Roberta, I decided that whatever I did in life, working for him would not be one of those things. I thought I would be able to get another position in Lumileds, as had been suggested by Paul's boss, Frank Steranka. That did not work out. I was terminated with a good severance package, since I was over 40 and they did not want an age discrimination lawsuit.

Logitech

I also had a gig with Logitech, working out the optics of an IR sensor for a dance sensor for video games. This was not commercial.

Spudnik - Prysm

The day after I heard that I was out the door, my old colleague, Vijay Albuquerque, called up and asked me if I wanted to go to work for a startup that his friend was involved with. Spudnik was a stealth mode startup, that was in the display business. Roger Hajjar, a very talented and amiable engineer, had invented a new type of display called Laser-Phosphor. A bank of violet lasers were scanned across vertical phosphor stripes and modulated to make a color display. He wanted someone to work on scan lens optimization. I had experience with Zemax from my fiber optics days, and knew about displays from my early LED work. I started as a half time consultant on a Monday evening, while my last day at Lumileds was the following Friday. The work was only half time. I was able to make progress and they were pretty happy. Roger was a great guy to work for.

The work got boring. I was 70 years old and wanted to remain a consultant. I did not have a lot of faith that the technology was commercial and lost interest. They eventually noticed this, and found this Chinese immigrant engineer to take over my job.

Spudnik is now Prysm and is going strong in 2014, and seems to sell a lot of their large area displays. The displays still have thin black lines between the panels that don't look too good, but they are skilled and have made good progress.

Apple

Pete Mahowald, a friend from HP, had me come work for him at Apple half time. He wanted to model, using LightTools, how light traveled in diffusant filled light guides. After doing some experiments and putting the results into LightTools, some pretty satisfactory results could be had. Because cut and try methods were fast and cheap in that business, the whole affair came to an end after four months. I was very busy, working at both Prysm and Apple at the same time. I tore around the San Jose freeways getting from Apple in the morning, to Prysm in the afternoon.

When my cousin, Susan Ferguson, came out for a visit a year later, I took her to Apple headquarters where I visited my old colleague and had lunch in the Apple cafeteria with Susan and Roberta. Susan had bought one of the first Macs and owned stock in Apple.

Lightwire

Vijay also got me a short consulting job with an outfit called Lightwire, that was doing integral silicon modulation of a laser driven multichannel fiber optic transceiver. I got to go to Allentown, PA for a meeting. Roberta came along. She enjoyed some things in Allentown and we both went to Philadelphia for tourism.

Cisco purchased Lightwire in March, 2012.

QuarkStar

In 2012 and 2013, I had LightTools based work for an outfit called QuarkStar, which was inventing new types of LED fixtures. They rented me a LightTools license and I did some fairly original work modeling remote phosphors for LED fixtures.

The best part of QuarkStar was working with my old HP colleagues, Roland Haitz, George Smith, Chris Lowery and Bob Gardner. We had some nice social meetings after work, getting together in one another's homes.

GLO

In 2012 and 2013, I also had a consulting job with GLO. GLO is a Swedish company with an office in Sunnyvale that is making a new type of LED using little fibers of InGaN. They had me model the optics of their white plastic packages. Ron Kaneshiro, my old boss from Agilent had moved to GLO.

3. My Life in Review

Diversions and Entertainments

Since being diagnosed with cancer, we have gone on a mainly vegetarian diet. I learned how to cook Italian vegetarian food, because it tastes good and is congruent with my western culture. I specialize in cooking focaccia with vegetable toppings, but also do soups and salads. Roberta has taken up the same thing, and manages to make some very tasty and healthy dishes. I have noticed a very similar trend in the restaurant industry. We have enjoyed going to the many local restaurants, and even to some 5 star French restaurants in the U.S. and in France. In later years, we became less vegetarian.

I used to have a heavy electronics hobby, but electronics as a pastime has been too much like work. We early on went for good computers and DSL internet service. I bought a large screen high definition CRT projection TV rig with a satellite service. I have a small hobby of photos and videos. One thing you notice with pictures and videos. Content is king. There is only a small amount of really good things that people actually want to watch. You have to edit the stuff very hard. In recent years, we have been happy with what we have had, and have not advanced to the more modern technologies.

Reflection on Life

I am currently 76 years old and have recently been diagnosed with CLL, Chronic Lymphocytic Leukemia. At my age, the life expectancy for half the people dead from this disease is about 6 years. My disease is relatively advanced and the symptoms have come on in about 12 months, so who knows how long I will be around. I have just finished chemotherapy.

Dr. Liu said that I had 5 to 10 years to live, and that was 16 years ago. I have a number of physical ailments that are distressful. Nowadays, I do have arthritis pain. I have had some modest professional success, with 32 patents and papers. I have been respected at work for my analytical talent, my honesty and track record of invention, but am not a famous guru. I have not been a very successful manager and

have not made a lot of money. I have not done anything of great moral heroism. I have not done anything very bad. I have been happily married to Roberta for 48 years.

My daughter got married in 2006, and we now have 2 granddaughters, Flora and Madeline, non-identical twins. I am somewhat selfish, but when called upon to do something that is needed, I almost always respond. My life, in fact, has been very similar to my classmates in technical fields. It is a kind of middle class life, neither heroic nor evil. People like me seek out diversions and experiences, but most of it is pretty ordinary and similar.


Our twin granddaughters are the light of our life. They live n San Francisco, close enough to enjoy.

The times I have lived in have seen great technological progress, with the progress in semiconductors being the closest to my experience. The progress has been wonderful, and I am sure God is pleased with his semiconductor engineers. The internet and cell phone has started to change human life. The technological progress has made it possible for the earth to support more human beings. How well it will continue to do so is a good question. When I was in college, there was this great fear that nuclear war would put an end to civilization. So far it hasn't happened, and may not for a long time. It does depend though on humans being more sensible than they have often been.

Civilizations come and civilizations go. The American civilization has been around about 250 years, which is close to the usual life span of average cultures. I can certainly see where the population increase and the decline of public spirit does not bode well. The fact that the oceans tend to keep foreign armies away, may prevent a complete collapse, but a general decline may well happen.

I hope to leave this life without too much pain and with honor. I hope that you, the reader, will have learned something about life in the high-tech sector of the late twentieth century in America.

--John Uebbing
Palo Alto, CA
May, 2014

HP Memories

This memory of John Uebbing's career at *hp* results from the work of the www.hpmemory.org website of Marc Mislanghe, who with John Minck (and John) edited and published his Memoir.
One of the main objectives in starting this website five years ago was (and still is today) to get in touch with people who have worked at *hp* from the birth of the company up to today. We are interested in hearing your memories no matter what division or country you worked in, or whether you were in engineering, marketing, finance, administration, or worked in a factory. This is because all of you have contributed to the story of this unique and successful enterprise.

Your memories are treasure for this website. While product and technology are our main concern, other writings related to the company life are highly welcome, as far as they stay inside the *hp* Way guidelines.
Anybody Else? Please get in touch using the Contact US form at "http://www.hpmemory.org."