Moving on

Draft, Gio Wiederhold, 30 October 2022

I have often been encouraged to describe my life or specific aspects of it. Here is a lengthy summary, interspersed with observations on life, science, and computing, as in any tale I would recount.

My friends know that I have worked on many different topics, and colleagues from specific areas may consider me flighty. They are right, but I believe that my efforts have followed a sensible progression. This note is intended to put those pieces together. My current, stable life is the confluence of many factors and events. Originally, I tried to explain my life's outcome middle-out, thinking that as when assembling a jigsaw puzzle it is best to start from an easily recognizable element. That central element was my emigration to the United States in November 1958, a major move. But that event occurred in the middle of my life, and it turned out to be too hard to use as a starting point.

I have now arranged my history chronologically, recognizing major moves and their significance. So in order to get to specific stories you will have to click on the blue Hyperlinks as:

13. Some notions about teaching
14. Consulting
15. Travel in India, China, and Indonesia
16. Taking care of parents
17. Hobbies
    a) Genealogy
    b) Cars, early adventures and
        - my Armstrong Siddeley: purchase, repair, accident, and restoration.
18. I also include some brief notes about people that influenced me
    a) Most important is my wife, Voy
    b) A computing pioneer, Harry Huskey
    c) An early proponent of artificial intelligence, Edward Feigenbaum
    d) Joshua Lederberg, a leading scientist with broad interests

To illustrate this biography I often use pictures from Internet sources, since I have only a few personal photographs. I also added hyperlinks to public files, such as Wikipedia, and a Wiederhold genealogy.

My Name

I am known primarily as Gio Wiederhold, which has been my formal name since 8 March 1989 when I was naturalized in San Jose as a US citizen. Everyone agreed that the name given me at birth, Giovanni Corrado Melchiore Wiederhold, which satisfied nationalistic Italian regulations of that era, was too much to bear. In Germany the name had been officially translated to Hans Konrad Melchior Wiederhold -- too Germanic for me. But everyone knew me simply as Gio since about 1951, as that was the name I used when I entered the Grotius Lyceum in Holland.

When I got my US Social Security card in November 1958, I had to change my given name to Giovanni CM Wiederhold, since the full name didn't fit on their IBM cards. That's still my SSN name. When I became a citizen in 1989 I actually wanted to change it formally to Gio CM Wiederhold, but the official did not accept double initials, so I dropped the CM. In an academic tree I am still Giovanni Corrado Wiederhold.

I use multiple email addresses. Before IPv4 I was simply gio@earth on the ARPAnet. Now I am gio@cs.stanford.edu for Stanford work, gio@db/... for database work, Gio@haring.../ for some business-oriented research, gio@earth/... for genealogy work, and gio@pluto... for mail to get lost in space. The domain earth@stanford.edu is now used being used by the Earth Sciences department of Stanford, but I can still have an email account there, although I am not a member of their faculty. For my consulting I became Gio Q (for quant) when I opened a mail account for consulting for MITRE. I did not want to use an address that looked that I was beholden to MITRE.

1. Early years -- from Italy to Germany

While born in Italy, I spent most of my childhood around Frankfurt, Germany, affected by events related to World War II (1939-1945), until attending school became a serious issue, and in 1949 I left for the Netherlands.

I was born 24 June 1936 in the Clinica Rovera in Varese, Italy, a pretty, small town in Northern Italy. When my parents needed to marry they were living in Frankfurt, Germany, where the rules of the Nazi party were being enforced. My mother had come as a student from the Netherlands East Indies and did not have documents to prove that she was not Jewish. As such she was not allowed to marry a German citizen there. My father had been fond of Italy, so they went there to get married in June 1936.

In Italy, at that time, had a strong nationalistic fervor. Newborns could only be given Italian names. So instead of Hans Konrad Melchior -- names my parents selected from my ancestry –- I became Giovanni Corrado Melchiore Wiederhold. The local catholic parish was impressed, since my birthday, 24 June, was the feast day of San Giovanni in their liturgical calendar. My parents received a beautifully inscribed certificate. I was not baptized then.

Mother

My mother, Cornelié Eugenié Tuybens, was born in 1913 in Tasikmalaya, Java, in what was then the Netherlands East Indies and is now Indonesia. The town, about 6 hours by train southeast and uphill from Batavia, now Jakarta, was a common escape venue from the heat of coastal Batavia, the home of her parents, Andries Tuybens and Jacoba Punt.

Like many colonial daughters, at age 21, my mother was sent to study in Europe. She planned to study history. A family member she met then was Malchen Tuybens-Triesch, the ex-wife of an older step-brother, then giving piano recitals in Frankfurt. Malchen's son, Otto, then 12, had stayed behind with his father in the Indies.

My mother soon moved to Frankfurt and enrolled at Johann Wolfgang Goethe University there. One motivation was that the German government, being in need of foreign currency, gave a double exchange rate to foreign students. She soon met my father there. Many years later I boarded with Malchen in the Netherlands.

My mother's family had been in the Indies a long time They had been trading in cloves, an important product in the 16th century, on a small but significant spice island, Ternate. As part of my genealogical research I was able to trace that family to Germany and the Netherlands.

My mother with her grandson John in 1972

My grandfather Andries left Ternate as a young man to attend school in Java. At age 24 he married the young daughter of a colonial family of German descent, Marie Philippine Winkelhagen. They had three children, Johann Frederick, Wim, and Jaqueline. Marie died in 1909, a year after the birth of her third child. A year later Andries married Jacoba Punt, my grandmother. Soon after my mother's birth he was promoted to postmaster in Weltevreden, a largely European suburb of Batavia, the capital, now Jakarta.

My grandparents on my mother's side, with their children, in 1920. My mother is with the dog.

My grandmother, Jacoba Punt, was the daughter of a manager at a Dutch Navy wharf in Soerabaja (Surabaya), Java, who had come with his family to the Indies from Schiedam, the Netherlands, shortly after Jacoba's birth. She married my widowed grandfather at age 25. They had two children, but Jacoba died in childbirth during a home leave in the Netherlands, when my mother was 9 years old. The family, with the baby André Eugène, returned to the Indies. My grandfather married again soon after, in 1924, for the third time, a widow, Louise Margaretha Leunissen, who then took responsibility for the 5 children from the prior marriages. She was just called Moes then. My grandfather Andries died in Batavia (now Jakarta) in 1926, when my mother was 13 years old. My mother's brother, André Eugène died in a Japanese prison camp in 1944. Moes outlived the Japanese occupation. I met Moes in 1956 in what had become Jakarta and subsequently in 1958 in The Hague, Holland.

The family house in Jakarta was also fairly large and in earlier times there must have been a number of servants to help with the household, but when I visited Moes in 1956 there was only one. My mother's life in Germany was drastically different.

One stepbrother from the Andries' first marriage, my uncle Wim, survived the 2nd World War and its aftermath and settled in Amsterdam. During the war, being an engineer, he worked as a prisoner of war building airfields for the Japanese, which likely contributed to his survival, but it seems that the rough treatment made him unable to have children. When Malchen's son, Otto Tuybens, died in Rotterdam in 2004, the Tuybens branch that had gone to the Indies died out.

We planned to go to Ternate with our children in 1998, but there were anti-Chinese riots on the island Sulawesi. Singapore Airlines had canceled its flights to Menado there, the nearest large airport to Ternnate. We went to China instead. Voy and I tried again to visit Ternate in 2011, but a smaller eruption had caused the airport to close. We just enjoyed Menado, which has volcanic features as well.

Father

This picture (about 1939) shows my father standing on the left, my grandmother Clara, her sister, my mother with me, the second son Günther, his son Jürgen, and his wife Rie. As of 2022 I am still in touch with Jürgen.

Johannes Erich Günther Wiederhold, was born in a suburb of Frankfurt am Main, Germany, 1901, and hence was 12 years older than my mother.

His father, Erich Wiederhold, known as Opa, had been a successful engineer and became co-owner of a factory in the West of Frankfurt. He was also very strict and expected that all of his three sons would become engineers.

The story here of my father's life before he married is assembled from many impressions and factoids, but will convey a generally valid history.,

My father's education. After a couple of years studying engineering at the Technical College in Greifswald my father became bored with those studies and wanted to switch to physics. To calm his father down and keep parental support my father explained that *Physics is the basis for engineering*. He was allowed to switch. Like many students at that time, he had been fencing and had gotten a wound in his right check. The fact that physics was taught locally at the Johann Wolfgang Goethe Universität in Frankfurt might have helped getting Opa's approval, also reducing Clara's worries. After about another two years my father decided to switch to chemistry. A new explanation was required: *Chemistry is the basis for all the material engineers use*. Note that Materials Science was not a recognized field then; even today any field that needs the postfix `science' is suspicious to the purists. My father was allowed to continue his studies. When, around 1930, he decided to switch to biochemistry, no explanations could garner support.

Opa reading

My father moved into a basement room of his zoology professor, Dr. Hermann Giersberg, near the University, and found other means to support himself. He used his increasingly broad background to edit PhD theses for others. He became the house master of a girls' dormitory and a supernumerary for the Frankfurt Opera. He moved on to study biology and botany, where his technical background made him a valuable assistant, and started attending some courses in medicine. And then he met my mother, who had just moved into the same Beethoven street.

My mother's background and looks were obviously very different from his experiences. As a student she did not have the documentation needed then to marry a German and went to Italy.

My impending arrival triggered their marriage and ended his studies. The expectation of a German husband was that he'd provide support and the wife would care for everything else. That arrangement did not match the life that my mother expected. That already became obvious when my father had to return to Germany. A long train trip with a baby seemed to be too much of a hassle, so she decided to fly back to Frankfurt. I spent most of my early childhood in Frankfurt.

Flying

My mother took a Lufthansa flight from Milano back to Germany. I was told it took some convincing at the airport to let her board with a baby in her arms.

Ju-52 Survivor

The result is that I flew as passenger first in August 1936 on a Junkers 52 tri-motor from Milano to Frankfurt. It had an airspeed of 265 km/hr (165 mph), not much more than modern trains. Inside were 17 simple chairs, no seat belts required. I was told that they were wicker chairs then, but I cannot verify that. The wheels did not retract.

I was the youngest passenger to fly then. I still have the newspaper article from the Frankfurt newspaper: "Kommt ein Baby geflogen" (*A baby comes flying*). That unremembered experience may have contributed to wanting to study aeronautical engineering.

Back in Germany we did see my father's parents regularly. They lived in Oberursel, a small town in Hessen north of Frankfurt. A nearby train and a suburban tram station provided easy access to Opa's factory work and visits from the city.

My grandfather's home in Oberursel

The factory made air compressors and related machinery. I recall seeing it from the railroad station in West-Frankfurt. Opa had several patents for such machinery. He would be upset when competitors tried to design equipment around them. During the war the factory was bombed and subsequently integrated with the MAN combine. On our 2019 trip it appeared that the factory had been razed.

Visits were formal occasions, but pleasant. At Christmas the tree would have real burning candles. I once caused a scary accident when I crawled under the tree and some curtains caught fire. Opa quickly doused them using water from the dining table.

Childhood in Germany (skip to Holland or to the USA)

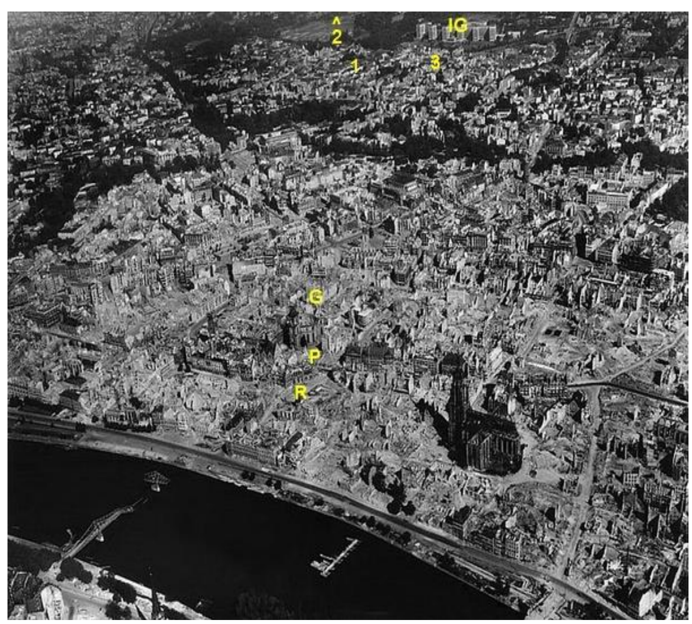
After my parents got married all parental support from Opa Wiederhold was discontinued and my mother's study stipend was terminated, so both had to adjust to a very different life. They moved into a fourth-floor walk-up apartment at the Feldbergstrasse (picture) near the Frankfurt Botanical Garden and the huge headquarters of the large German Chemical combine, IG Farben (IG). As a student, my father had worked for one of their businesses (Hoechst). After the marriage my father got a job at another one of their subsidiaries, focused on eradicating pests in food factories. His broad education was perfect for that work, since it required considering the biological effects of the chemicals being used in the machinery of flour mills, and possession of a technical understanding of the machinery used for food storage, processing, and shipment. The work involved frequent travel, leaving myself and my mother at home. She was able to make friends with some neighbors and stayed in contact with them for a long time.

My earliest recollection is from a thunderstorm there. Looking out of the attic window, I saw balls-of-fire (St.Elmo's lights) rolling along the gutters. I later heard about that phenomenon, but never found a scientific explanation.

Also around that time, I was told, but don't recall, that I stuck two of my small fingers into the large 220-V round outlets used in those times. I yelled and pulled my fingers out. My mother said calmly "well, he won't do that again", upsetting my concerned father yet more.

I do recall that we had a crank-operated coffee grinder mounted on a kitchen wall. This memory helps me realize how difficult it must have been for a young woman raised in such different surroundings to assume the myriad duties of a German `Hausfrau'.

In March 1944 the apartment building (1 on the arial photograph of Frankfurt) was bombed. The inhabitants had huddled in the basement during the raid and were able to escape over the burning embers. I started stuttering and did so for many years. We fled to the new house of my father's professor, Prof. Giersberg (2), on the other side other side of the University's Botanical Garden—easy to cross because my father had a pass key. We moved into two rooms there. Since everyone had to take in refugees, the professor's family was happy to take in a former student. The bombing was to destroy factories and chemical plants, as Hoechst, farther west, but wound up obliterating the historic center of the Frankfurt. A few major buildings as the Römer (R), where the rulers of the Holy Roman German Empire were elected, the Paulskirche, in 1848 the seat of the abortive first German parliament (P), and Goethe's mansion (G) have been restored. In 1945 the I.G.Farben building (IG) became the headquarters of SHAPE.



Frankfurt in 1945, the ring of parks is the former city wall

Living in Prof. Giersberg's house provided a very pleasant environment, even though It was a bit formal. For instance, the professor's wife, having her own PhD, would be referred to as Doktor Frau Professor Doktor Giersberg. They had a daughter, Evi, a few years older than me. Later their parents, displaced from Sileszia, moved in as well. Their elderly maid, Emma, came also, and I spent much time with her in the kitchen. We try to visit when we are in Frankfurt, most recently in July 2022.

Education

I never went to primary school after the move. One reason seemed to be that with a school registration, the new location of my father would be noted, and checked against the military draft. He had managed early on to avoid conscription by faking or exaggerating a particular knee injury, having studied enough medicine to know that such an injury could not be objectively verified in those days. As the war continued it became harder to escape conscription. In the end, even the elderly Professor Giersberg was drafted, but he also never got to serve.

During the war my mother also had to go to work in a local instrument factory, VDO. To be less visible I stayed during school hours in the professor's house, or in their large garden. Mrs. Giersberg wound up teaching me and her daughter Evi at home. She had a degree in English philology, so there was a large collection of English books, including all the children's classics such as *The Wind in the Willows*, *Dr. Doolittle*, *The Waterbabies*, and many more. The result was that I learned English at age 8 in Germany. I also had time to try to read many of the scientific books on the professor's shelves. The house was located just off the Zeppelin Allee, named after the dirigibles made in Germany. To my surprise, when visiting the house in 2001 during a sabbatical, there was a dirigible flying overhead. At that time I was also given a sculpture of my head, sculpted by their friend, Fräulein Moser around 1945. That head is now on the top shelf in my San Francisco office.

My father's job required travel to a variety of food factories, which also meant he had a reason to cross borders into Switzerland and Vichy-France, confusing the draft authorities yet more. By maintaining a link to his grandmother's origin, her Swiss Heimatgemeinde in La-Chaux-de-Fonds, he was able to be away when another round of conscripts was inducted. He was one of the few German men of his age who were able to stay out of the war. After the war he appeared to be a pacifist, but I am sure fear of being shot was a major motivation.

As a child, and not going to school, I was able to travel with my father at times to his jobs. That meant that I saw a fair amount of Germany as a kid, riding along in his Opel Kadett filled with gadgets and chemicals. When towards the end of the war gasoline became hard to buy, my father obtained a vehicle, likely from Switzerland, that had a wood-burning gasifier sticking about 3 feet high out of the trunk. Wood chips could be obtained from farmers. It might have given my father a competitive advantage. After the war that job continued. As a specialist he did a fair amount of international travel. He never switched employers his entire working life.

Car with Gasifier

Professor Giersberg's house did not have a substantial basement. During the Battle of Frankfurt (March 1945) we stayed mainly outside, under a huge willow-tree in the garden. Artillery shells were flying overhead. We were closer to the German positions, so that bang-shish sound meant it was a German shell and shish-bang a US one. Soon the war was over. Some neighboring houses and a mansion were used by US troops, but we could stay where we were.

After the war food became even more scarce, but the professor's botanical expertise was useful. We'd go into the forests north of Frankfurt and collect plants that he knew to be edible. I recall that nettles, which hurt when touched, were quite tasty when Emma boiled them carefully. I kept contact with the family and visited the daughter in the same house whenever I could, most recently in 2022. We went to the Palmengarten, next to the botanical garden where her father had his laboratory.

Evi with Voy in 2016

As soon as the war was over my parents divorced. No wonder. It had been quite a mismatch of expectations. A German husband expects that a wife can take care of cooking, washing, and children. My mother had no idea and little interest. Living with the professor's family and Emma had helped fill the gap. My mother got a job working for UNRRA, the United Nations Refugee Resettlement Agency program, actually managed by the US Army out of a camp in Oberursel, the nice suburban town where my grandfather lived, just north of Frankfurt. I was often able to go with her to work and, for instance, see the Abbot & Costello movies being shown to the soldiers in the evening.

Schools restarted about 1947 and I entered the Wöhler Real Gymnasium near the University. Being in a regular school was tough at first. Having an atypical background and family situation kept me isolated. It did not bother me too much, although I did wonder why I had to learn Latin when English seemed to be so much more useful. I had little interaction with the other students.

On my birthday in 1948 the Russian government halted all transport from Western Germany to Berlin followed by the US and British forces halting all transport to East Germany. Four days later the Berlin Airlift was initiated, a radical concept that a large city could be supplied by air, eventually shipping over 4,500 tons of food and fuel per day. The French built an additional airport, Tegel, in Berlin. The Soviets lifted the blockade in May 1949. The excitement generated by these events contributed to my wanting to fly and study aeronautical engineering.

My father soon remarried. Ilse Dietze was divorced herself, fairly independent, having run a clothing store, but was still the supportive wife that a German husband of that age expected. They settled in Frankfurt, a few blocks east on the same street where my father had lived with my mother and me. After I left for Holland I'd see them just about once a year, at Christmas. Since in Holland the gift-giving for the Christmas holidays is on St. Nicholas day, December 5th, I could take advantage of both venues, although I can't recall substantial gifts from my father. Tante Ilse would provide some clothes.

Ilse had a son from a prior, unhappy marriage, Klaus. He was a couple of years older than me. He was starting out in life as a salesman in a clothing store. Over time he became a manager at one of the largest department store chains in Germany, the Kaufhof chain. Although we had very different interests we became and remained good friends.

Twenty years later, on a visit to San Francisco in 1969, Klaus became the godfather of our son, John André Wiederhold.

Klaus with John André Wiederhold

After my father's retirement around 1966, he and Ilse moved to Italy. Klaus, Ilse's son provided a small house for them in Germignaga, a community just south of the town of Luino, right on the shore of Lago Maggiore. Germignaga is just 26 km north of Varese, where I was born, but given the crooked mountain roads, it's about an hour's drive, or two hours by two local trains. I recall as child being allowed to stand next to the driver of the electric train, more like a heavyweight streetcar.

We stopped by there whenever we got to Europe, and he and his wife visited us three times, traveling in passenger accommodations on freighters going to California.

Voy, relaxing in Italy.

After being settled in the United States Voy and I were able to visit my father and his wife several times, mainly in Italy. We saw him last in November 1987, before returning to Stanford from a sabbatical in Stuttgart.

My father died in Italy 4 June 1988, aged 86 without having had any serious illness. He died at night after still having worked in the morning stacking firewood. I was already on the east coast, consulting. Voy grabbed our passports, met me in New York and we flew over to Italy.

My father had not signed up with a cremation society, and in that case, the laws in Italy (being a catholic country) require a burial unless prior arrangements had been made. To resolve the impasse we had to ship his body in a sealed casket across the border to Lugano, Switzerland. Ilse, his wife, wondered if we had to show his passport at the border. In Switzerland they'll do most anything, including cremation, as long as you pay. We put the urn with his ashes in the trunk of the car and delivered it to the Melaten cemetery in Cologne. His wife's son, Klaus Dietze had obtained a nice burial plot there which we and our kids have visited at various times. Ilse moved in with her son in Cologne. We visited her there at times, the last time in 2000, shortly before she died.

We still visited Klaus in later years when we could. He died in 2019 and is buried with his mother and my father on the historical Melaten Friedhof in Cologne. We visited it during most trips to Europe.

Leaving Germany

The interactions with my father's family described above with my occurred later in my life. I lost regular contact with my father when I moved to the Netherlands.

By 1949 the immediate effects of the war had dissipated. My mother realized she could not work, take care of me, and have a reasonable life. In the fall of 1949 she brought me brought to Holland.

Being largely by myself had not bothered me much, but something had to change. I was falling behind a standard educational schedule. My mother thought it would be best for me to get an education in the Netherlands. I don't know if my father go involved in that decision.

2. Life in the Netherlands – 1949 to 1958 **(skip to the USA)**

My life in the Netherlands started in late 1949, when my mother boarded me with an aunt in The Hague and ended in late in 1958 when I left for the US**.**

Boarding

Arrangements were made for me to be boarded in The Hague with an aunt, Amalie Triesch, but always referred to as Malchen. Malchen was born in Frankfurt and had traveled the world with her German-Hungarian parents. She had married my mother's half-brother, Johann Frederik Tuybens, referenced above, in the Indies in 1922 and had one son, Otto, with him, but their marriage had broken up. She had been a concert pianist, often playing in the Far East, but now eked out a living teaching piano while supporting a daughter, Christa, two years younger than me. My mother knew her personally since Malchen had lived in Frankfurt before the war; Malchen had introduced her to my father.

Not knowing Dutch outside some of my mother's expressions I went for two years to a Christian elementary school, the Visser-Smits school. I had to learn Dutch rapidly. While Dutch is similar to German, there are crucial differences and misunderstandings are easy.

Many people in Holland were not very accepting of Germans after the war, but the teachers and some students were quite open. Some kids did resent having a German kid in their class. The major effect was broken eye-glasses from schoolyard fights.

Luckily I was fairly well prepared in other topics, and in 1951 managed to pass the exam that allowed entrance to an academic high school, the Grotius Lyceum, now Segbroek College. I was a bit older than my school mates, but also a bit more mature.

As companions I had the two sons and daughter of a friend of my mother, Annie Kamphuis, known to me as Tante Annie, who had also moved from the Indies to the Hague after losing her husband in a Japanese camp just a few days before the end of the war. Her oldest son, Evert, was close to my age. Soon Annie reported to my mother that my living arrangement with Malchen did not work out. It appeared that Malchen had insufficient income to take care of the needs of her daughter. It was best to move out. Annie herself, taking care of her mother and three children, did not have space to accommodate me, so she placed me to board with her cleaning lady, but she also had little space. I just had a bed in the hallway under the stairs in her ground floor apartment, but spent much time outside school in libraries and with Annie's family.

That situation could not continue and my mother gave up her job with UNRRA and came to Holland. She obtained teaching credentials and got a job as a primary school teacher in Scheveningen, originally a fishing harbor and now also a beach resort. My mother was able to rent two rooms from a couple, Mr. and Mrs. van Delder, whose children had grown up and left. It was in a nice neighborhood: my mother would bicycle to work, and I could walk to school. The husband was a head waiter at a famous restaurant in the Hague, the Hotel des Indes, and always looked very distinguished. Mrs. van Delder did some cooking, simplifying life for my mother. I recall the green-grocer's horse and cart coming by and was impressed that the feed for the horse were the leftover greens: a shortcut for biofuel.

While life was comfortable for me, it was less so for my mother. The Dutch weather depressed her, the children in the fishing village were hard to teach, and the only outside life she had was going to a neighborhood movie once a month.

We saw a call for teachers at a school for oil company employees in Sumatra, Indonesia. My mother and I discussed the alternatives. It made sense for her. I could stay with the van Delders and go to the nearby Lyceum. The arrangement was that she would get home leave after two years and I would be able to visit her the other years. My mother went off to teach back in Indonesia, in the middle of the Sumatran jungle. I continued to stay with Mrs. Van Delder until I left for further study in Rotterdam.

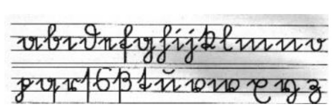
About 60 years later, a fellow car enthusiast drove me past the building, which seemed completely unchanged. Being the only boarder there was I had much flexibility. Studies were easy, and I could socialize with my fellow-students, although some of their parents were surprised that I lived essentially by myself.

Within a year my mother met and married the engineer in charge of the power company there. Nicholas Longo was divorced and had a son in New York from an earlier marriage. My mother reduced her work commitments, and the arrangement was that both kids were expected to be independent by age 21. My independence also motivated me to take on jobs, mainly during the long summers, which substantially complemented the amount my mother sent me.

Grotius Lyceum

I had passed the admittance exam and starting in 1952 could attend an excellent academically-focused high school in the Hague. I made many friends there, although I lost contact with all of them, except Evert Kamphuis, the son of my mother's best friend, Annie Kamphuis. I do remember several teachers. I can now only thank post-mortem. The geography teacher, Mrs. Labordus-Glerum, introduced us to the novel theory of tectonic plates, now of much relevance to California where we live. She enjoyed the little paper model I made in my exercise book aligning Africa with South America. The crucial paper on plate tectonics was not published until December 1967, and now it is fully accepted and taught.

Even more important for my future was Prof. Abrams, referred to as Brammetje, who taught mathematics. My handwriting was as bad then as it is now, which I blame on having been taught several styles of writing. For a brief period I was subjected to Sütterlin, which is likely the worst, emphasizing regularity over legibility. On one assignment Brammetje wrote, to embarrass me, "Could not read one word of it, but it's probably correct, grade 10". Grading at the time in the Netherlands was 1 to 10, with 10 signifying perfect, reserved for the "dear lord in heaven", 9 was for the teachers, and 8 being the most a student could normally expect. I assume there has been grade inflation since then in the Netherlands as well.



Sütterlinschrift

Rotterdam

I did not complete the Lyceum. In order to assure that I would be employable by age 21, when my support would stop. I switched to a technical school, the Technicum in Rotterdam, studying Aeronautical Engineering for two years. I had become convinced that it was a good idea to move on from the routine Dutch studies to specialize in aeronautics technology. It am sure that my exposure to the capabilities of air transport during the Berlin Airlift motivated my choice.

In Rotterdam I wound up renting rooms jointly with a remote family member, referred to as Henkie Heng, who was studying at a business school in Rotterdam. Now we had to cook for ourselves. My nominal Italian background meant that I would cook spaghetti three days per week, and Henkie, being Chinese, would cook bami, Chinese noodles, the other three days. On Sundays we'd travel by various means to The Hague (Den Haag), where three ladies, one of them being my step-grandmother Moes, would open their house to family and serve a rijsttafel, a large variety of Indonesian dishes. Moes had outlived her husband, Andries Tuybens, already by 30 years and had just repatriated to Holland, living with two other elderly aunts. Much of their family had not survived the Japanese occupation of Indonesia.

It seems that they devoted much of their lives to those Sunday dinners, eating the leftovers early in the week then making and sharing dishes for next Sunday the remainder of the week.

Farnborough 1957

England

At the end of the summer break of 1956 I used the money I had earned earlier to attend a summer aeronautics course in the UK, at Farnborough, and also to watch the preparation for the annual airshow. England had developed a magnificent range of innovative aircraft, in part due to the threat implied by the cold war. A favorite was the 1952 delta-wing Vulcan bomber. The early model was powered by Armstrong Siddeley Sapphire jet engines. The cold war never became hot, and the Vulcan only saw service in the 1982 Falklands war.

I rented a room in a boarding house there and had time in the evenings to read some of the history books their kids had left behind. I was dismayed to find that the heroic admirals I had learned to admire in Dutch schools were described here as nefarious pirates.

I was impressed by the British postal service, which allowed my hosts to mail an order in the morning to the local grocery store, for delivery that afternoon, so that the food would be at the door before dinner time. Now it is hard to assure such delivery speed even with orders submitted on the Internet.

Riding on a Solex

Transport

Being independent I needed a means to get around. I had of course a fiets, the basic Durch bicycle. I did manage early on to visit an aunt, Tante Annetje, in Nijmegen, biking all the way across the small country. After my mother left I was able to upgrade my means of transport with my allowance and income from summer jobs.

I started with a Solex, a bicycle with a small 45cc 2-cycle engine, that drove the front wheel through a friction wheel. I soon moved up to a larger Austrian brand, Puch, motorized 50cc bicycle, called, imitating its sound, a bromfiets, and finally acquired a Vespa scooter.

I also obtained my driver license. In Holland that required going to a driving school for training and tests. They used Morris Minor cars, and I got my license after a few lessons.

Later, while in Delft, I met a student, Wim van Brugge, whose father had a car dealership in the Hague. I helped there with various odd jobs, and a few us were able to acquire a very- well-used Hillman. We did the maintenance ourselves. I learned much from failures, such as failing to secure bolts, so that once the driveshaft dropped down on the main highway while we were taking some girls to a party in Rotterdam. We were able to put it back, hook it up somehow and continue. Those girls were brave.

More Flying

Taylorcraft L-2

In 1957, after finishing at the Technicum, I was able to go to a flying school in Sisseln. Switzerland, near Basel. Somehow I was able to invoke my father's Heimatgemeinde (native town registration), so that my cost, for a potential candidate to join the Swiss military, up to and including the first solo flight, was only $80.-, still minimal when converted to current values. Passing the eye exam though required remembering the letters on the line I knew I could not read.

The school's planes were Taylorcraft L-2 Grasshopper observation craft, leftovers from the war. They were somewhat worn, but maintained with Swiss care. For instance, holes were drilled to terminate every crack in the Perspex windscreens. The school also had a Tiger Moth biplane mainly used for towing sail planes, and I was able to fly it as second pilot, in the front seat, perched under the fuel tank which made up the center section of the top wing. Placing the fuel at the center of gravity kept the balance invariant as the fuel was consumed. The primary pilot sat behind.

Tiger Moth biplane (updated with a pitot tube, ours had just a flap on a spring to indicate airspeed)

Important points made included not to fly into narrow valleys, since the mountains were higher than to maximum altitude for these planes, and, in emergencies, not to try to lnad on water, since the plane would flip once its landing gear hit the water. The small airport at Sisseln has since been replaced by a freeway. It was great fun, but I was more interested in building than flying aircraft.

Most of my subsequent flying was just as a passenger. I had over a million miles on PanAm when they went out of business in 1991, and now have over 2 million on United, who took over PanAm's Asian network.

More than 80 years after my first flight, in February 2017, we returned from Bombay, India, via Frankfurt. The leg from Frankfurt to San Francisco was via one of the double-deck Lufthansa Airbus 380 aircraft. Amazing changes. The Taylorcraft L2-A Grasshopper has a length of 6.9 meters, a wingspan of 10.8 meters and carries a maximum of two persons: pilot and observer. The Airbus 380, by contrast, has a wingspan of 79.75 meters (limited by airport restrictions), a length of 72.72 meters and typically carries 575 persons in addition to the cockpit crew of 2 [John Sauter].

Technical education In Holland

Technicum

The move to the preparatory engineering college in Rotterdam, the Technicum, was encouraged by Nick Longo, my mother's second husband. Nick wanted to be sure I could take care of myself. I planned to emigrate to the US, and a regular university education would exceed the time and finances available.

A particular strength of the Technicum was the dean's, Prof. Pajecka, specialty in gear design. A class challenge were hypoid gears. Transmitting force in such a geometry without having the surfaces slide over each other and cause wear, is a fascinating application of mathematics.

A hypoid gear is a spiral bevel gear whose mating gears' axes do not intersect.

My graduation project though was the overall design of a small two-engine pusher turboprop airplane, for which I graduated cum laude. The modern airfoil shape I specified required that rivets would not stick out above the surface, as is common now, but considered very fancy then. I enjoyed the drafting work, and still love drawing airplanes. I completed the course, roughly equivalent to an Associates degree.

I had applied, like many of my peers, for emigration, an approach supported by the Dutch government. The effects of the war and the subsequent influx of colonials, once the Dutch government had recognized Indonesia's independence in November 1949, placed a heavy load in its resources. I now was 21, ready to work, but could not effectively apply for a real job while waiting for my emigration papers to be completed. That could have taken a long time. The US 1924 immigration act, not repealed until 1965, limited immigration ratios to the proportion in the U.S. population. Being born in Italy I would have been in the very long Italian queue. I had anyhow opted out of my birthright to become an Italian citizen several years earlier, otherwise I'd first have to submit to military service there. A sympathetic lady at the US embassy told my mother that I, being a displaced person's son, could be considered a refugee from Indonesia, and it took just a bit more than a another year to leave for the U.S. The fact that my mother was then actually living in Indonesia was ignored. During that period my mother and her new husband, Nick, continued to support me as needed.

Delft

After the summer I moved to Delft to take courses at the Technical University there. Delft was at the time the only technical institution of higher learning in the Netherlands. Completion of prior schooling was sufficient for admission then.

Delft City Hall, at sunset

Delft has beautiful historic center. I was able to rent a very nice attic room in a very old house just south of the center beside a canal from a very strict Dutch reformed (Calvinist) couple. Luckily, when I came to inquire, I was accompanied by a friend who happened to be the daughter of their pastor in a prior church, so I was immediately accepted. I wallpapered the old room and had a wonderful setup there, with good radio reception to BBC broadcasts. The house had been modernized with indoor toilets, so that old erkers with holes above the canal were no longer used.

Joining the Mensa eating club provided nightly dinner at shared tables. Afterwards we could go drink beer on the beautiful Delft central square. I also joined a debating club. I made many good friends at the time, stayed in contact with them for some time, and still meet a some of them here or there. Jan Doting, who is a super gadget builder, made me a portable radio, using two rejected transistors –- a technology that had just appeared. That radio is now on exhibit in the Stanford Gates building history display. I did introduce him to Anneke, who became his wife. Anneke was in a nursing college there. The girls were under strict supervision. Once, when we stayed too late, we had to escape through their attic window and climb over adjoining roofs until we got to a building where another friend was renting a small room. His room could only be entered through a toilet, requiring some scheduling for him to enter and leave. Housing was a scarce resource everywhere, but in this college town even more so.

The Technical University Delft had, I think, only one female student at that time. I attended a class that she took as well. Her presence forced the professor, after entering through his dedicated door, to start each class with (actually in Dutch of course): "*Good morning gentlem... , oh beg your pardon, good morning milady, good morning gentlemen*". That went one for the entire semester. As a woman one had to be tough to go through a technical curriculum then. Luckily for all, that aspect is changing.

Jan Doting, Anneke, Gio, friend, Wim van Brugge

With my prior study having focused on the mechanical aspects of aircraft I started with lectures in aircraft construction. Unfortunately, the tenured faculty member at the time in that area had not upgraded his prewar curriculum. When he started telling us what kind of wood to use for the spars, I switched to aerodynamics, taught by a young faculty member using US material, much based on research sponsored by NACA, the National Advisory Committee for Aeronautics. While tenure is a good concept in fields that have political liabilities, it should not be an excuse for inadequate teaching in technology or science. Solving problems in airflow stressed my mathematical competence, which turned out to be very beneficial throughout life.

Arthur C. Clarke. CBE FRAS

Space fight was not an academic topic at the time. But change was in the air, or rather in space. In October 1957 the Soviet Union launched Sputnik and in 1957 NACA, which now had to deal with new initiatives, was incorporated into the new NASA, the National Aeronautics and Space Administration. Exciting times. I read voraciously on the topic. An inspiring talk to our aeronautics club was given by Arthur C. Clarke, who introduced such concepts as space flight, geo-stationary orbits, etc. Soon I could get support by working in Utrecht in a university laboratory for electronic music, measuring and computing frequency mixes to simulate traditional and virtual instruments. Such computations are simple now, but without computers, just using paper and a slide rule made it a challenge. Being enrolled in one Dutch University gave my access to all Dutch State universities.

Delft was at the time rather narrowly focused, so I also attended a course on Jungian psychology in Leiden. Jung's interests extended to vision, which were extended to encompass space. In Leiden I could also meet with another friend, Erik Tasseron, from prior days in den Haag, who was now studying medicine. I missed many of these friends when I moved on.

At the end of the semester I obtained a more relevant and even more challenging position, as a computer at a NATO science center, SADTC. The work I did there is described below. I never returned to classes. The two semesters in Delft were the last formal education I had until I decided to get a PhD in 1973. But I had a number of jobs where I learned much in between; the combination of work experience and education made me well-prepared for a productive life.

Early Work in Holland

While studying I had an adequate allowance from my mother, and Nick after they married. I recall it was about $80.- per month, which equates to about $640.- in 2018, and that provided even more value in Europe in those days. Still, I wanted to do more exciting things and had no summer obligations, so I worked every summer after my mother left. <duplicated text>

Selling ice cream

At age 17 I had my first paying job, selling ice cream around Scheveningen from a three-wheeler bicycle. Unfortunately, the Dutch weather made it often useless to go out. When the maintenance man at the ice cream plant quit, I offered to take on his job as well, easy, because nobody expected me home at any particular time. For repairs I had to interact with the refrigeration firm that supplied parts and made major repairs when needed, a contact I exploited the following year.

On the docks

The next summer I used the contacts I had made with the refrigeration company to get a job on the docks in Rotterdam. At least in those days, Freon was too expensive to use as the refrigerant for cooling the large holds on ships. Ammonia was used instead. Having leaks in the plumbing of refrigeration systems was truly awful for repair workers. To reduce the effect, ventilators were used to exhaust the fumes; now much more effective breathing apparatus is available. The company was happy to have a young foolish worker. The worst case I remember was a repair on a submarine--little ventilation was possible, and one could not work more than a few minutes at a time. But I also learned much, and even if I do little major metalworking and plumbing now, at least I understand what is involved.

Machinist's mate

During the summer of 1955 I became a machinist's mate on the MS Trito of the Holland-Ireland Line.

The size of the Trito was just over 1,000 gross tons, just under 80m (245’) long with a beam of 12m (40’). That is actually about 2/3 of the length and the same width as modern river cruise ships. The Trito was of course much taller and had a draft of 4.3m (14.5’). It could also take on 10 passengers. I was lucky to find that the Trito had been the subject of a painting by Frits Hoogstraate, who allowed me to share it here.

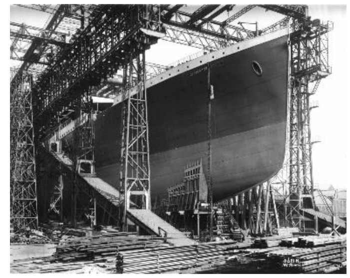
I qualified as a machinist’s mate because I had worked on the docks in Rotterdam the year before. Still, I was surprised that I obtained a berth instantly and could join the crew of about a dozen sailors. Not until much later, well after completing my travels, did I learn why I was so lucky. The job gave me *sea legs;* I still don't get seasick.

I made three trips to Ireland. I sketched the ship's regular route here: starting in Rotterdam, we’d have machinery to deliver to Belfast, Northern Ireland. Going around Land's End, Cornwall, to get to Ireland was actually quite dramatic for a ship of its size. Cornwall’s southern end, Lizard Point, sticks out into the Atlantic Ocean and has to be rounded to reach the Irish Sea.

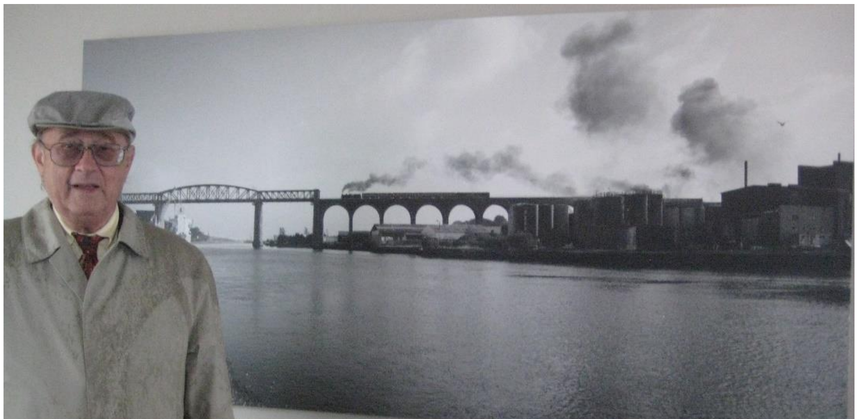
After the world war dock-side offloading facilities were limited. The Trito had three sets of double masts to allow loading and unloading anywhere. That equipment made it a bit top-heavy. Much of the cargo were piece goods: crates and barrels, as well as live horses. Note that my experience occurred before containerization, which so dramatically changed shipping, lowering volume shipping costs dramatically, a major factor driving today’s globalization.

The reason it was so easy to get a berth turned out to be that a smaller sister ship of the same line, the MS Carpo, had capsized 27 November 1954 at Lizard Point with the loss of the entire 13-man crew.

In Belfast we'd unload the machinery at Harland and Wolff's ship-building wharf[1]. At that time the huge crane gantry that had been used to launch the MS Titanic and many subsequent ships was still there. It has since been replaced by a pair of modern, yellow movable cranes, Samson and Goliath, that also can be seen from far away [Moss:86].



The Titanic being built



Picture of Drogheda railroad bridge, the Blue Bonnet factory is on the left bank

Then we'd turn back south to Drogheda, to unload barrels of whale oil at the Blue Bonnet margarine factory. I never would use margarine after that. Of course, whale oil is no longer used for that purpose and the entire factory is gone now, replaced by a shopping center. But that shopping center had a photograph of the factory it had replaced when we visited it.

In Drogheda we would also take on horses. We assembled wooden stalls on the middeck, separating each horse. I assume, but the records don't show, that the Carpo also carried horses when it capsized in 1954. If, in a violent storm, one of the planks would break, a disaster can ensue, since the planks were unlikely to withstand two horses banging against them. The chain reaction could certainly unbalance a small coaster that was already top-heavy. Some pieces of the Carpo were picked up at Penzance – known for the Gilbert & Sullivan operetta. The captain of a passing ship did not try to pick up the seamen, resulting in a major marine scandal, which I was unaware of when I mustered on. I had no reason to worry then.

Leaving the small Drogheda harbor was slow. We first had to wait for a rising tide to escape the mud in the river Boyne, and then for a low tide to clear the railroad bridge and a rising tide to avoid the shoals where the river entered the Irish Sea. I took advantage of the delay on one trip by borrowing a longshoreman's bike, likely in exchange for some ship chocolate, and cycled through the Irish countryside to Dublin. I just had to be there before the ship arrived, so I would be available to help install the wooden horse stalls.

Economics and sensibilities were different in those days. For instance, today no use of whale oil is acceptable, but I wonder what the substitutes are. In any case, I have avoided any margarine ever since. The Irish, who love their horses and are horrified of the thought of eating horse meat, seemed to have few compunctions about raising the horses for export, although their fate must have been obvious.

Dublin Custom House

In Dublin we also picked up Guinness stout. In those days we could moor not that far from the brewery. The ship would be moored right by the 1791 Dublin Custom House, a spot that is now awkward to reach by real ships, since the Samuel Beckett bridge over the river Liffey to the new Financial Services Center was built in 2009. Being close to downtown Dublin we all had adequate time to explore the city. Most of the sailors would head to the pubs. Being young and innocent I got to hold on to the guy's wedding rings while they explored the local entertainment.

On leaving we'd head back into the Irish sea, then the Atlantic, through the channel and up the Schelde river to Antwerp, offloading the horses at the local abattoir (slaughterhouse), then back home to Amsterdam to deliver the crates of bottles of stout, pick up a new load of whale oil, and then Rotterdam and do the next round. I learned that in 1968 the Trito was sold and started serving West-African ports as the Sea Saga. Containers had taken over all major cargo shipping.

Dutch ships would serve their sailors a regular menu, with some choices likely related to Holland's colonial history. On Saturday it included chocolate and Fridays it would be `indisch', Indonesian. Few of the Dutch sailors liked it so I would spend Friday evening munching a huge bowl of krupuk udang (huge shrimp chips). Voy still makes them for us.

It was a great time for a teenager. In addition to pay and unlimited good food, I joined the other sailors in stashing in some nooks a bunch of cartons of cigarettes. At that tome cigarettes were cheap in Ireland, and highly taxed in the Netherlands. Even if found on board, they could never be traced to an individual. On arrival in Rotterdam the longshoremen would buy the cigarettes, splitting the profits, while our sailors would carefully unload the crates of stout. One crate would always hit the ground at angle, causing all the bottles to spill out to be shared by us and the longshoremen. The hoist operators would be proud that nary a bottle would actually break in the process. The loss of the crate was less than the shrinkage expected in shipping anyhow.

That was my last job that required more brawn than brain. My next job required little physical effort and today only one of my hobbies challenges me physically.

Visiting Indonesia

In 1954 I also got to fly to Indonesia, to visit my mother and meet her new husband. He was in charge of the power plant for the Caltex oil company at Rumbai, just north of Pekanbaru, in Central Sumatra. Caltex was a joint venture of Texaco and Standard Oil of California. The flight to Singapore, by a KLM Lockheed Super Constellation, took two days. After stops in Rome, Beirut, and Tehran, there was an overnight stay in Minwalla's Grand Hotel near the Karachi airport (still looking for picture) – at that time no longer that grand. Then one traveled via Calcutta and Bangkok to Singapore, where Caltex put me up at the Adelphi hotel. I was supposed to take a company plane from there. Schedules were pretty relaxed. The response to a call to the Caltex travel office might be: "Oh, the plane did not come today, it will probably come tomorrow". Less relaxing were the morning newspapers that appeared on my table, without me having heard a servant come in. It was the time when Malaysia sought independence from the British starting 1948, gaining formal independence August 1957. The papers would report on planters in outlying areas having been killed by Insurgents. But the delays gave me a chance to explore Singapore and taste marvelous food from the seaside stalls.

Central Sumatra

When the ex-military Dakota arrived, we would sit on the fold-out canvas benches, with parts for the oil-well machinery lashed in the center.

Clearing Indonesian customs required a detour via Palembang, tripling the travel time. The Palembang airport had been greatly improved as a hub for KLM before Indonesian independence in 1949, but events had made it nearly redundant. In the airport restaurant we received printed chits that allowed us to select from an extensive choice of drinks. After the chits, obviously left over from earlier days, were collected, everyone was served orange crush, that being the only drink actually available. The landing in Pekanbaru was also exciting. The plane would barely clear the trees, to assure it could stop before the end of the runway. After leaving the plane I saw that the electricity for radio communication was generated by a motorcycle whose rear wheel had been replaced by generator. No wonder schedules were unpredictable.

Interior of a C-47 or Dakota transport

I learned now that Pekanbaru, due to the oil boom that started then, has become a major city, with over one million inhabitants. But it also appeared on a list as Indonesia's least interesting city. Indeed, outside of walking around and trying to see the noisy monkeys in the trees, the most interesting thing for me in Rumbai was spending time at the power plant with Nick Longo. I learned how to adjust the frequency so that by the end of a shift exactly 8×60^3 cycles of alternating current would have been generated. I assume that a radio signal was used as the base. The company's clocks depended on that, although synchronization was likely more important than precision.

I also got to fly with my mother to Jakarta, where we stayed with her stepmother, Moes. It was embarrassing to be squeezed on a rickshaw with her considerable mass and my mother, to be pedaled along canals to the markets by an overworked driver. Moes left soon after for the Netherlands, I saw her often while I lived in Rotterdam.

Bicycle rickshaws

Minankabau Family house

With Nick we also flew to Medan in Northern Sumatra, staying a few days at Lake Toba. That lake, about 62 miles long and 19 miles wide, is the caldera complex of what is considered the largest volcanic explosion in the last 25,000,000 years, about 74,000 years ago. That eruption may have wiped out a large fraction of humanity at that time [Julia Rosen: Thinking the Unthinkable; Science, 15 July 2016, pp. 232-237]. On the center island is a Minangkabau village, with houses that were extended as the families grew.

Playing chess was a major activity of the population, often just played on the ground with the squares scraped in the dirt and small whittled figures. I could never beat them.

Hitchhiking

I had applied for a summer job position at the SHAPE Air Defense Technical Center, but it took time for the required security clearances to come through. Jan Doting and I decided to tour a bit of Europe, by hitchhiking, a means of travelling not considered then as risky as it is now. It took us a couple of days to reach Frankfurt, where we could stay with my father and his wife Ilse. From there we went west. We reached a rather desolate place in Alsatia, devoid of traffic For dinner we collected the local mushrooms and cooked them, on reflection one of the most risky things in my life. The next morning we located a local farm, run by a Mennonite family, and had a healthy breakfast there.

Going on we made it to Brussels, Belgium, where the 1958 World Exposition had just started. I managed to sleep comfortably in a sleeper railroad car, that was being exhibited.

When we got back I could start work. Jan finished at Delft with a degree in electrical engineering. We stayed in contact. In 1972 he worked for a year or so in in San Leandro, across the San Francisco Bay area for the Friden division of Singer, a calculator business trying to get into the personal computer market. We could visit him at times when I went to the Philips factory in Eindhoven, The Netherlands, as representative of Stanford Industrial Forum, to which Phillips contributed. Most recently we met in 2022 in Arnhem, the Netherlands.

NATO SADTC - 1958

While waiting for my emigration papers to came through, I worked in a fascinating setting. Early in 1958 I had obtained a summer job as a *computer* in an analysis facility supporting NATO, the SHAPE Air Defense Technical Center (SADTC), with the acronym SHAPE standing for "Supreme Headquarters Allied Powers Europe", the joint military command structure founded in 1951 by then General Eisenhower to follow up on the organization set up to support the invasion of Europe in World War II.

Human Computers

At SADTC I joined a group of 12 individuals as a Computer, the job title for a person doing computing by whatever means. Our task was to manually compute short-range missile trajectories, mainly into the Fulda gap (map), an area without natural border defenses northwest of Frankfurt. It is also the area where the Wiederhold ancestors came from. That valley was where any Russian invasion of Western Europe was considered to be most likely to happen. The border itself was fortified with fences with cleared areas on either side, protected by manned watch-posts.

There was still a strong Cold War mentality. To put that setting into context, although the Russian Blockade of Berlin, requiring the city to be fully supplied by air, had ended in May 1949, the Hungarian Liberation movement had been put down by Warsaw pact forces, led by the Russian general Marshal Ivan Konev, in November 1956. The reunification of Western and Eastern Germany, and the removal of the Berlin wall and fortified fences dividing German families, did not occur until 1990.

SADTC was located in the dunes behind Wassenaar, north of Scheveningen on the Dutch coast, in barracks left over from German efforts to attack England using V-2 ballistic missiles. Now there are modern buildings with a freeway tunnel underneath. Work there required a high-level security clearance, covering all NATO countries, which I received surprisingly rapidly, likely because of my age.


Monroe calculator

Computing low-level missile trajectories is much more complex than that of ballistic missiles. Those travel much of the time above the atmosphere. Its inertia and gravity control the flight path. Low-level flight paths require consideration of aerodynamic effects, the oblateness of the earth, and even likely wind conditions. All our calculations were done using 10×10 electric Monroe calculators. For multiplication, one factor is entered via the keyboard and remains available in the carriage as the digits of the second factor are entered; the carriage shifts with each entry. Division is similar, now subtracting, and stops when the result becomes negative, then reversing the last step. The machines represented a triumph of mechanical engineering. A room with a dozen machines in use becomes quite noisy.

I met a similar Bentley in 2012

Target analysis was directed by a British expert, whose name I don't recall, but I do remember his daily arrival in an open Bentley tourer, parking right at my window, and then jumping out. The car had a long lever outside the driver's compartment –- no door there -- to control the handbrake. When it was raining his arrival always caused some concern, lest he wouldn't reach the lever through the plastic flap and would go through the building where I was working. That vision might have affected my taste in cars.

My prior studies in Delft had provided a good background and allowed me to work with the aero-dynamics expert on the project, Dr. Topakoğlu from Bilkent? University in Turkey. I learned more working there than in school, which I could exploit later.

Electronic computers

An LGP-30 computer used at Manhattan College in 1965

During the summer SADTC obtained an electronic computer, a Librascope LGP-30. It used a 4096 32-bit word drum memory, i.e., the equivalent to 16K bytes. The drum rotated at 4,000 rpm. That meant that 15 millseconds were used per instruction. So that fetching the operand for the instruction would not take as long, they were placed about about ¼ revolution away. (I recall a fast auxiliary memory of 256 words as well, but that may have been another computer).

Input and output was via a Flexowriter teletype machine with paper tape. The holes punched in the tapes were read by mechanical sensors, either coming through those holes or blocked by the tape, at 6 characters per second. One 31-bit computer word contained two 15-bit instructions, since 8 bits were adequate for addressing any data in that small memory.

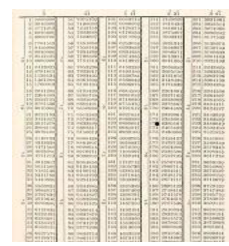


Table of logarithms

With the computer came William (Bill) Olle, who had had experience with a Ferranti Mark 1, a machine of similar size designed in the UK. The LGP-30 could not replace us human computers, but it was useful to generate interpolation tables that were needed at various steps in our calculations, since the printed log-tables only provided 5 to 6 digits of precision and an interpolation indicator, requiring minutes for a single computation to get the 8-digit precision required for our calculations.

Having worked on those trajectory equations I was able to move on to programming. Learning to program meant reading listings of existing programs, since there were no textbooks nor manuals. That seemed quite normal--after all, one learns real languages first by reading and understanding, and in due time one is able to start writing. Now, programming is taught by letting students write programs by giving them a manual, with at most small program excerpts, and then letting the computer find errors. I still believe that reading good programs is instructive, but there is certainly a question of scale.

We wrote our programs on paper forms, then numbered the lines, and finally translated codes and references to octal for punching onto paper tape. That sounds incredibly tedious, but for a program, after say allocating 200 memory words for data, there was only space for 2 × (256-200) = 112 program instructions, an amount that was quite manageable. A few standard instructions were needed to start any program and read or write the paper tapes; there was no operating system, and no library or compiler overhead.

Editing programs required first erasing bad code sections on tape with DELs by punching all holes across. Even now the ASCII code used today uses the code 127 (binary 1 111 111) to indicate DEL. For 8-bit bytes the name is EO (eight ones) and has the same effect. Today few people know why, but a disastrous typo I made much later was related to that coding. New code could then be inserted by cutting the tape and carefully gluing in sections of replacement code, using a special *sellotape* that also had all holes punched so that no DELs or real characters would be covered.

My instructor at SADTC, Bill Olle, also wound up in the US, developing software for RCA, which was making the Spectra 70 series of IBM System/360-compatible machines starting in 1965. RCA was potentially a significant competitor to IBM. Later Spectra models were also built in the UK as English Electric Model 4. Voy and I visited him at his home near London in 1971.

Fortran

By the end of summer 1958 IBM had installed a 704 computer in Paris. It had 8,192 36-bit words of memory, and we were anxious to use such a large machine. It came with the French version of Fortran, IBM being aware that French sensitivities had to be considered. That just meant that the 26 Fortran commands and the manuals were translated from English to French. However, the much larger collection of diagnostic messages had not been translated. The compiler was reliable with correct programs, but failures would occur when programs were not perfect. The Fortran compiler would then report those failures as if they required compiler fixes. Users, who did at times write erroneous programs, soon created cheat sheets, sharing information such as "Program stop at location 3456 in phase 5" actually meant that there was an extra comma following a DO command. About two years later I encountered the designers of Fortran and learned that their initial assumption was that programs would be correct, given such a simple language, and that failures to compile would be compiler failures.

Program pickup

The coding sheets containing our attempts to program were shipped in secure pouches by Marechaussees to be keypunched at the NATO facilities in Roquencourt near Versailles (later the site of INRIA). They would race on their motorcycles to the nearby Ypenburg airport (EHYB) which just was becoming a military facility, having been a minor commercial airport before, then be flown to Paris using Dutch Navy Dakotas, the military version of the Douglas DC-3. Then the cards were brought to the IBM offices, at times when the building could be made secure. Errors – more frequent than output – would be brought back to Roquencourt, where a secure telephone line would allow us to tell them that we had missed that comma. The inefficiency was further increased by an edict that we could not use meaningful variable names, to provide more protection in case our programs fell into enemy hands. That was just too much for us innocents, so we decided to use as mnemonics abbreviations of Turkish terms, figuring that no Russian spies in France would assume that computer programs out of the Netherlands would be encoded in Turkish. I retained a limited and biased Turkish vocabulary for a long time, covering such terms as velocity, earth diameter, pressure gradient, etc., because we'd also then use those words in our discussions. Not having ever had to use that vocabulary since, it is largely forgotten, but likely remains in some hidden niche in my brain.

Paris

When our superiors realized the inefficiency of our work methods, we actually were moved to Paris for some time. The NATO barracks were in Roquencourt, near Fontainebleau. Those offices later became the site for INRIA, the French informatics research establishment. When I visited INRIA in 1984 not much had changed – maybe the cafeteria food was better.

I rented a cheap room in an apartment west of the Eiffel tower. All apartments on the same floor used the same pair of toilets and bath. With the extra money and the limited access to the computer I had plenty of free time to roam about Paris. I identified and took all Metro sections that ran above ground.

I recall seeing in a left bank outdoor theater the 1949 movie “The Third Man”, which recalled the postwar tensions of which we were cognizant. Entrance to museums such as the Louvre was costly, but free on Thursdays, when French schools had the afternoon off. There were incipient labor strikes, eventually leading to the ascent of de Gaulle between June and December 1958; some I took advantage of, as when the Metro ticket collectors were on strike, but the train drivers continued to work, providing free transportation. Paris remains one of my favorite cities. On Bastille Day 2016 Voy and I celebrated our 50^{th} wedding anniversary there.

While I was working for NATO the Brussels World exposition had opened and we went there as a VIP group. I met the families of my coworkers--happy families, although all living now in places far from their origin. Their lives provided a model for what I looked forward to in the future.

3. Move to the United States – November 1958

For a young and ambitious person, the perceived opportunities in the United States versus a crowded Europe were great, greater than the risks of leaving home and known settings. In my case home had already little meaning. I was living in the Netherlands, had a German Passport, my mother had moved back to work in the land where she was born, then the Netherlands East Indies, now Indonesia, and there married an American engineer, Nicolas Longo. Having been born in Italy I was subject to the Italian quota for US immigrants, competing with thousands of Italian immigration candidates, people that had family already in the US, and as such had priority. A sympathetic US consulate official decided I could be considered a refugee from the Netherlands East Indies, being dependent on my mother, disregarding the facts. Even though I was not a Dutch citizen, as I was a legal resident the Dutch government paid for a flight on a KLM Lockheed 1049C Super Constellation to New York.

I packed my books, thesis, and some other items in a sea-chest and shipped it to my goal, California, care of my aunt Annetje, who had emigrated with her children a year earlier. By the time it arrived she had moved and I never saw the stuff again. But essentials, as my slide rule and table of logarithms, I took with me in person. They are now part of the historical computer science displays at Stanford University.

Friends and family (Oom Wim Tuybens, his wife Dien, and Tante Annie) saw me off.

Lockheed Super Constellation
4 18 cyl. 30 liter piston engines

Arrival in the US

I arrived in the US as an emigrant, applying immediately for a social security card so I could work. To fit my name on the card I had to shorten it from Giovanni Corrado Melchiore Wiederhold and I chose Giovanni CM Wiederhold. Later I shortened my name even more.

On arrival at JFK airport I was welcomed by the family of Nick Longo. They even arranged a job for me as a stockboy at a local grocery. But I went off for something more exciting and applied to be a Christmas temporary worker at Macy's, `*the world's largest department store*' in mid-Manhattan.

My mother provided some means to get me started. On a prior trip to the US she and her husband had appeared on an early TV show, 20 Questions, and won some money, I recall $800.- each, but am not sure. They shared it with their kids.

Working in the US 1958-1965

I applied as seasonal employee at Macy's in Manhattan. Within a few days I was tested, and, being found good at arithmetic, was assigned to their "emergency" squad, rather than to a specific department, to be deployed wherever there was a problem. One emergency I recall was in the Art department, where one of two customers, arguing about a copy of a Blue Boy painting, had framed the other one with the now unsalable painting.

Within a week Harry Diamond, another newly trained seasonal Macy's sales employee, and I were able to rent a small apartment on 179th street in Manhattan, near the George Washington Bridge.

Of course I also searched for more exciting work. That occurred rapidly, so that I never experienced the actual Christmas rush at Macy's. An advertisement in the New York Times, by a recent subsidiary of IBM, enabled me to move on.

IBM-SBC 1958-1961

IBM was building and selling computers, but nowhere was the programming needed to use them being taught. So, in addition to having courses, IBM spun off a subsidiary, in 1957, called Service Bureau Corporation (SBC), to write substantial programs for customers, so they could use – and would lease - those expensive machines. I applied and was hired instantly as a mathematician. The title programmer did not exist then, the term engineer did not seem appropriate for people just working with paper artifacts, and continuing to call us computers would be confusing.

The fact that both "rocket" and "computer" appeared in my résumé, and that I had a security clearance, made me nearly essential, because SBC had just been awarded a contract from the Defense Department's new Advanced Projects Research Agency ARPA (now DARPA). I believe it was ARPA order no. 17. The task was to compute the specific impulse, essentially the power, of solid rocket fuels, an alternative to the liquid-fueled rockets used by the Germans against England, and further developed in the US.

Solid-fuel rockets

While the words in my background matched, the actual work to be done was very different. The science here was chemistry, not aerodynamics, and the methods required solving non-linear equations, not forward integration. But I had no reason to complain and started on the work with enthusiasm. A Dr. Ching Chang Tsao, hired by IBM, provided the mathematical expertise and a Dr. Robert Potter, from American Cyanamid, the chemical insights. The calculations, while simple in principle, required many ad-hoc adaptations.

Computational problems

While liquid-fueled rockets essentially burn compounds of hydrogen and carbon in oxygen and emit just hot gases, solid-fuel rockets contain binders. The binders make inadvertent explosions of the fuel assembly less likely. During storage, cracks can develop inside traditional solid fuel charges. When, in use, the flame-front reaches a crack, the amount of gas generated increases rapidly, causing it to explode, and with it the vehicle it powers. US nuclear submarines were to be equipped with Poseidon missiles, and in a submarine, storage of large quantities of very volatile liquid fuels was not an option. But unpredictable solid fuels, even if the explosions occurred after the pneumatic ejection launch, were not desirable either, so the fuel had to be made crack-resistant by rubberizing it by adding binders to the fuel mix.

Ashes as well as gases are emitted, making the computation quite complex. The solid particles are characterized by having negligible volume, but a relatively high weight, while the gases had the opposite characteristics; relevant ratios were such that they could not be captured within the floating-point range of the IBM 704 computer. Back to using logarithms! Now multiplications became additions, and additions required testing of significance prior to exponentiation and piece-wise addition.

The Newton-Raphson methods we used to find a stable result have now been much improved, since they are also used for finding optima in multi-dimensional systems. However, we had to deal with a problem that, as far as I know, has not yet been addressed. During the computation, parameters such as pressure and temperature change as the rocket burns. Some new chemical components become possible and others disappear, changing the dimensionality of the search space. We dealt with that issue in a fairly ad hoc way, by redistributing the elemental components.

Imprecise results of common library functions could create failures to converge. Our heavy use of the functions stressed the compiler's function library. While courses in compiling stress the challenges of translating source text into efficient code, the amount of code in the associated libraries is greater than that of the actual compiled code, and the number of functions made available keeps increasing. I had to become familiar with the ingenious ways library functions were actually coded. The results for most mathematical functions are defined by a series expansion. For efficiency the series expansions are rarely computed iteratively, as defined in textbooks, but rather as explicit terms, up to a limit where further terms should not change the result. Creating stable results required dealing explicitly with the capability of the given computer's floating-point capabilities. We had to circumvent some library limits by explicit testing. That experience enabled me later to move out of numerical work to developing compilers.

Engine test

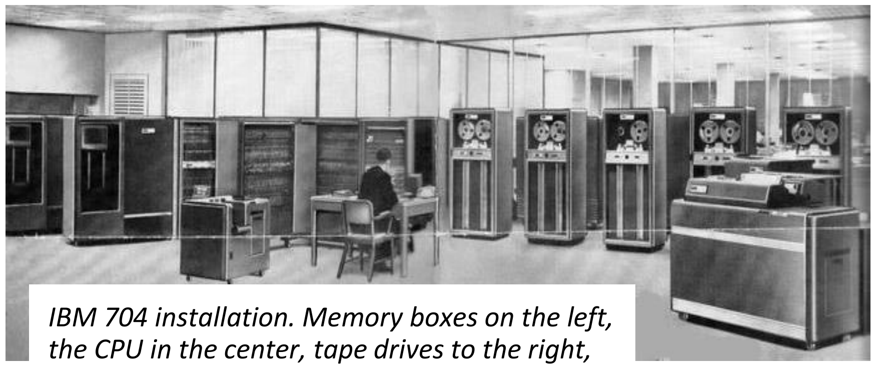
The work on rocket fuels led to my first publication. I also became a member of the American Rocket Society. I now had formally become a *rocket scientist*, an expression used as a pun in popular discussions. That organization later merged with the Society for Aircraft Engineering, becoming in 1963 the American Institute of Aeronautics and Astronautics.

Security, again

Once we got our test cases working, another problem arose. Dr. Tsao, still having family in China, had not received the required security clearance to learn what actual fuels were to be evaluated. I would receive those specifications and run the programs, but when the numerical methods failed, I had to describe the problem without actually revealing what was being burned. Promising fuel compositions were tested at a hidden test site in the California foothills. We did not get to go there, but at times received photographs.

We learned that when our computations had been unstable the performance of the fuels would be unstable as well. Computers could model the physical world better than we expected. That linkage provided confidence in the modeling effectiveness of our computations, and pleased Dr. Tsao, even though I could never tell him what the fuel formulations were. That abstract computations could model otherwise unpredictable real-world events was an important lesson.

Computing hardware

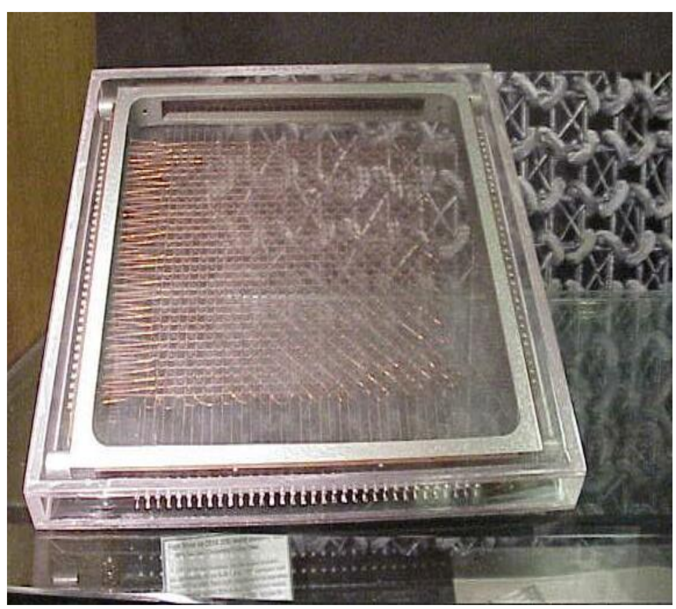

IBM 704 installation. Memory boxes on the left, the CPU in the center, tape drives to the right, the card reader and the printer in front

The major computer at IBM-SBC was an IBM 704 with 16,384 36-bit words of memory. The logic was implemented using vacuum tubes, but its main feature was its use of core memory. Each bit of storage required a small magnetic ring (core) through which three wires were threaded. A 16,384-word memory for a computer with 36-bit words required 16,384 × 36 = 589,824 such cores. For character storage, that storage capability is equivalent to 98,304 6-bit characters. Fancy 7- or 8-bit bytes, allowing lower-case letters, were not in our vision. Memory was expensive!

Upper-case only character printing remained standard for computers. Even in 1981 a paper I submitted with output samples using lower-case was nearly rejected as being faked, because the journal's editor knew "that computers could not print lower-case text".

Core Memory

Core memory had been demonstrated by 1953 at MIT by [Jay Forrester](). The cores are mounted in planes and each core is then addressed by an x- and a y-address. To store a one bit requires a current *c*. Sending a current of ~0.6*c* through both an x-and a y-wire will set the core at the x-y intersection without changing other cores in the same row or column. A third wire, going through all the cores of a plane, reports the previous state of the bit addressed. Having a stack of multiple planes allows storing an entire word. A stack of 16 Whirlwind memory planes, as shown above, could support one bit for each of its 1024 16-bit words. Soon larger stacks and stack assemblies were built, but the assembly costs remained high.


Core plane, holding 32 x 362= 1024 bits

Input preparation on an IBM 650

For creating the card files needed to specify the chemical compounds we used an earlier, very popular type of computer. Announced in 1953, the IBM 650 is considered the world's first mass-produced computer, since nearly 2000 were built. It was a decimal machine, with an internal data bi-quinary format, using 4 bits per decimal digit: 3 bits for 0-4 or 5-9, and one bit to select among those. Other combinations allowed plus, minus, etc., but alphabetic characters and instructions required two digits.

IBM 650 front panel, showing 5-bit digits

It was built before randomly-addressable `core' memory was available, instead it used a 4,096-word drum memory of 10 digits per word, recorded in up to 80 bands of 50 words. Input and output was via IBM punch cards, that then were loaded onto tapes to save time on the much faster 704 binary computer. While the 650 was more effective for routine processing, its programming, always in assembler language at that time, was more challenging. The IBM 650 did not execute instructions sequentially, but each instruction specified the location of the next instruction. To avoid wasting too much of a drum revolution (4.8 milliseconds) a programmer would estimate the duration of the execution of the current instruction, and then place the successor instruction just beyond the position where the drum would be at the time, using a drum band in which that position was not already occupied. It was quite a competitive sport to write fast programs at the time, an exercise soon after eliminated by smart software .

Tape Storage

Our programs were always kept as punched cards, which were easier than paper tape to copy, edit and securely store in our cabinets. Data that defined the properties of the fuel could be used for all computations and were placed on magnetic tape. Our machine had 10 large magnetic tape drives, one dedicated for input, several for output, while two were used for the compiler and to hold its intermediate results. We needed the other ones for recovery from computer failures.

The length of our analysis runs was quite unpredictable: they could be as short as 15 minutes or take over 12 hours. Since that exceeded the mean-time-to-failure of the early computers, we preserved the intermediate result of each major iteration by writing it out on tape to allow a faster restart in case of failure. Disk storage was not yet available, but we had the joy of seeing a tape move every so often as it indicated progress. Sometimes we could quickly change a burned-out tube and continue, because the cores used for memory could retain their magnetization.

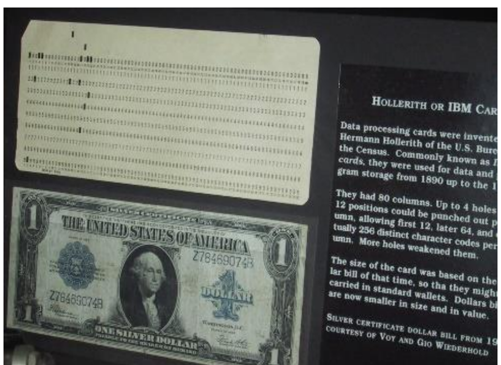
The unpredictability of our computer usage later led to a problem with charging customers. IBM had always billed for computer time used, but we developed an alternate scheme to bill for services, described later.

A-format

Another communication problem we encountered was that the early Fortran, designed as a *formula translator*, could not manipulate letters. A fixed string of letters for titles could be read in or composed using H-for Hollerith format. By 2004 the Fortran standard omitted the H-format, which allowed reading and writing of text. For simple text output quotes can be used. I show an example from an early manual.

```
C AREA OF A TRIANGLE - HERON'S FORMULA
C INPUT - CARD READER UNIT 5, INTEGER INPUT
C OUTPUT -
C INTEGER VARIABLES START WITH I,J,K,L,M OR N
 READ(5,501) IA,IB,IC
 501 FORMAT(3I5)
 IF(IA.EQ.0 .OR. IB.EQ.0 .OR. IC.EQ.0) STOP 1
 S = (IA + IB + IC) / 2.0
 AREA = SQRT( S * (S - IA) * (S - IB) * (S - IC) )
 WRITE(6,601) IA,IB,IC,AREA
 601 FORMAT(4H A= ,I5,5H B= ,I5,5H C= ,I5,8H AREA= ,F10.2,
 $13H SQUARE UNITS)
        STOP
        END
```

Early sample of Fortran code, showing H-fields



Silver certificate dollar and Hollerith card

Herman Hollerith had devised the IBM card for the 1890 census, making its size equal to the dollar bill of that time, but never considered text processing, and neither did the early developers of FORTRAN, who focused on highly efficient computation. Their design objective was to show that compilers could equal hand-crafted programs composed in assembler coding.

But programs used in chemistry applications also needed letters! We could not use fixed input texts to identify complex chemicals. Our initial solution to identify chemical data was to use their atomic weights; for instance, 2 would denote hydrogen and 16 oxygen. But it was not a unique code: was 18 Nitrogen or water (H_2O)? Also, the rocket fuels got more complex. With compounds as Butyl (C_4H_9) - atomic weight 66, our numeric coding became mysterious.

Having had to understand the Fortran libraries I wound up adding an A-format to FORTRAN. Since memory was scarce, I was proud to be able to reuse most of the existing Integer I-format code; I believe I added less than 12 words to the code to allow the reading of letters into manipulable cells and enable their printing. The definition is very inelegant, and I would be embarrassed today about its design. It did become part of the standard library, was widely used, and is certainly the most used code I have written, since other compilers and some other languages adopted the same input-output libraries. When I saw the code about 30 years later in a DEC library the same variable names were still used. However, at the time the compiler designers received some negative feedback, because some programs, carefully constructed to fit into 4,096- or 8,192-word machines, no longer fitted into memory when the library became 12 words (~50 bytes) larger.

Travelling to use computers

Having adequate memory for our complex programs was always a problem. The largest computer IBM had available internally was the 16,384-word_Memory 704_Memory. But we did get access to a 32,768-word computer. Standard Oil of New Jersey or Esso (now Exxon) was setting up a new research facility, and such a facility certainly deserved a new computer. Esso management had considered a 16,384-word 704 sufficient, but an enterprising IBM salesman proposed a good deal to them. If Esso would purchase a 32,768-word computer, IBM would buy 10 hours of nightly computer time for its own use at the going rate of $1000/hour for 3 months. The amount to be paid, $900,000.-, would make up the incremental cost of the 16,384 words of additional memory. The salesman got his commission on the increment, and we, among others, got to use that huge computer.

My future wife, Voy, was working for Esso as a programmer then. Later we determined that we shared bits: she used them during the day, and I at night. We may even have met at the White Tower Hamburger joint, as our team took a break there before going back to New York and she would come in for morning coffee and a doughnut.

When our programs had progressed to being able deal with actual candidate fuels, we needed yet more computing capability, and the contract with Esso was running out. We would borrow time from other IBM customers, for instance the Smithsonian institute, <check> associated with MIT, driving many hours to Boston for a night's worth of computing work.

At times I was asked to support sales calls, but that did not always work out. I recall visiting an engine manufacturer, Pratt & Whitney I believe, where the sales team had proposed using computers for monitoring and controlling jet engine testing. Given the relative reliability of their engines and our computers at that time I could not support the proposal. Although I think I prevented an embarrassing disaster, I was never asked to go on joint sales calls again.

A project that also presented novel challenges was at the Electric Boat Company in Groton, Connecticut. They were developing nuclear-powered submarines. Since they could stay underwater for a long time, they would also be without communication and location information for a long time. A technology called dead-reckoning had to be improved, where speed, changes of direction, and data about currents has to be combined to estimate the sub's position. Directional changes were obtained from a new generation of gyroscopes, which provided a greater degree of precision, so that paper plotting was no longer adequate. Those were large instruments at the time, and it still amazes me that now they have been scaled so that several are found inside any smartphone. Here again having clearance was important. Our computers were only used to develop the algorithms; smaller, specialized navigation computers with hand-coded identical software were then placed on-board.

By September 1960 IBM had installed a large, 32,786-word, computer in its new factory in San Jose. Since having enough resources for the rocket fuel analyses was critical, IBM decided to move our group to California. That move broke many important personal relationships and is described in the next section. But many projects continued.

People

At work and outside of work I had made many personal contacts. I stayed in contact with some of them, and I recognize the names of others now when reading historical accounts. There were some amazing people, from a wide variety of backgrounds, all having learned computing and its potential on their own. I learned much from other colleagues, all at the forefront of computing.

Lucille Lee

An impressive person in the office was **Lucille Lee**, who was working on the original flight reservation system, SABRE, to be used by American Airlines. Having a centralized resource that could be accessed using teletypes by many reservation agents at a central location was seen as major advantage. Prior to that time reservations would be handled by distinct operators, each being responsible for some set of flights and dates, using card files for each flight. When I worked in India in 1964 I still had to call different phone numbers for the flight to Bombay and the flight back.

SABRE became operational in 1960. Development was costly, over $40M, and IBM retained the rights, although it was provided without charge to its customers. Over time was made available to other airlines and the sales of computers, at about $2M each, to use the SABRE system became an important source of revenue for IBM.

Now, that computers are cheap the software is charged for. Writing and selling software as a product by an independent company originated with Cullinane, a company selling water treatment products nationwide. They had invested in developing a database system for their own use, IDS. It was an early implementation of the CODASYL specification. They started selling it 1972.

Stan Poley, a very senior programmer in an adjoining office, was writing a new assembler, SOAP. for the IBM 650. When I saw a section of the code he was writing I was horrified. Stan just placed instructions in sequence, so that each instruction would use a full revolution of the drum, even if execution time would be much less if placed earlier on the drum. Then he explained to me the principle of bootstrapping. Once his SOAP program was complete, Stan could reassemble his code with SOAP. All placement of instructions would now be optimized, and the placement values in the fields in the code would be ignored. This was an important lesson for allocating effort in my work and life. Many years later I mentioned Stan Poley to Donald Knuth on the Stanford CS faculty. Don had studied much 650 code and considered Stan Poley the best programmer he had encountered.

Paul Loewner was supporting General Electric in their efforts to automate design for manufacturing. That work is cited now as the first Computer-Aided-Design (CAD) system.

Paul was born is Slowakia as Pavel Graf. He was a survivor of Auschwitz and Buchenwald, is parents and older brother having been murdered there in the holocaust. His mother family, a mathematics professor at Syracuse adopted them. Later they all moved to California. He graduated from Stanford with a BS and MS and later studied at UC Berkeley and NYU. Discussions with him helped me lot, since I lacked formal education.

IBM itself did not participate in CAD work at the time, maybe because the early machines were not very suitable for a factory floor. Soon after, General Electric, later Honeywell, produced computers that were suitable. In 1961 Paul moved to IBM's research division when IBM opened up its Thomas J. Watson facility in Yorktown Heights, about 35 miles north.

Goodwin Sammel joined SBC-IBM shortly after I came. He had a background in both mathematics and music from the university of Chicago. He was not only a polymath, but also a classical pianist, who had studied from 1945 to 1950 with Claudio Arrau. Afterwards he did his cold-war stint at the University of Chicago, analyzing aerial photographs of fighter aircraft, returning to New York in 1955 to teach music. He then joined IBM 1n 1959. When I left New York to continue my work on the rocket-Fuel program in California, my responsibilities relative to Fortran were taken over by Goodwin Sammel. But he left soon after moved to Norway, where he worked for Sperry Rand, the makers of UNIVAC computers. I assume he moved for some personal motivation. We stayed in contact, and in 1962 he gave up computing for good and we shared a house in Berkeley, full of musical instruments and visiting mathematicians.

When I left Berkeley for a year in India, he organized a farewell party. Voy came up from Los Angeles for it. A high point was Goodwin's playing Bach's Farewell for a Departing Brother (*Capriccio sopra la lontananza del fratello dilletissimo, BW 992*). He stayed in the house, but shortly after I returned from India, he bought a house nearby and I moved in temporarily with a friend in Sunnyvale, and soon after bought the house we still own on Kings Mountain, above Woodside. Goodwin continued to study, teach, and lecture on piano musicianship. He died January 2020 in Berkeley, at the age of 94, having stayed there for over 50 years.

Other people I interacted with included Michael Collen, who gave up becoming a Benedictine monk. We spent boring meetings playing chess using the squares of coding sheets. Other might have thought we were correcting each other's programs. Some more names appear in the section on my social life in New York.

Social life

IBM was a very conservative setting at the time. Even the elevator operators in IBM's `World Head-quarters' building, where we could go for lunch, wore white shirts and ties, as did everybody else. It was a bit too much sameness for me. I found out that they tolerated, barely, yellow shirts, and I wear yellow shirts to this day.

Lunch trays had to be stacked and bussed in the IBM cafeteria, another novelty for me then. Having lunch in the many little Manhattan eating places was always rushed. The waiters would bring the check before one had finished eating. I wound up joining the Museum of Modern Art nearby, which had a dining room where one was served more in the European ways I was used to.

Except for my apartment mate, Harry Diamond, my social life initially revolved around my coworkers. We were all hired as Mathematicians, which implied in those days that most were Jewish and would leave Friday afternoon in time for Shabbat. When Ramadan came around I tried to claim, because of my Indonesian visa status, that it was now my turn to take off early for the 29 days of Ramadan. That did not happen.

New York has many entertainment options. The New York City Ballet was in its heyday with Ballanchine as the leader and Tanaquil Le Clercq as his principal dancer, a wonderful venue for a date. I recall that Toby Rosenberg's parents were not all that taken with her going out with a fellow from Germany. Toby and I stayed in contact. In 1965 I visited her and her husband, a devout Brahman, in New Delhi. On my return I stopped at her mother's notion store on lower 6th Avenue to report on their life, and she considered that I was less far from her expectations.

In general, I was much more naïve than my colleagues. I had not experienced the social life that a family and colleges provide. My co-workers had substantial and broad educational and social backgrounds. I recall a disastrous date with Cora Diamond, who soon left IBM for Oxford and became a professor of Philosophy, specializing in the works of Wittgenstein. By 2016 she was the Kenan Professor of Philosophy Emerita at the University of Virginia. She must have considered me a country-bumpkin at that time.

There were also innovative off-Broadway plays. I recall gong to Genet's `Chairs' with one of the programmers and having dinner before at the kosher Chinese restaurant on Lafayette street. There were musicals; I remember "My Fair Lady" and "How to succeed in Business without really trying". That latter theme hit home, since IBM had many ambitious managers. In the rapidly growing computing field it was easy to get promoted to management levels before one had absorbed enough experience in a prior stage. IBM dealt with that by then shuffling failures from line positions to CATTAC, so that they no longer had the authority to do damage. The term CATTAC (chief assistant to the assistant chief) derives from a popular British show at the time, the Reluctant Cannibal [Flanders and Swann: *At the Drop of a Hat*; 1959], so that they no longer had the authority to do damage. I have always tried to minimize my management responsibilities and tried to avoid administrative duties altogether.

Other projects.

Other major programs going on at IBM that I assisted with involved seed selection for corn crops in Iowa and a program to recompute the Standard `commissioner's ordinary' tables, used by life insurance companies. As more women were smoking now, their expected lifetimes shortened, and their premiums had to be increased. The rules for the computations were all defined in terms of decimal precision, so we now had to write packages to perform specified-digit decimal arithmetic on a binary machine. That allowed traditional actuaries to check the accuracy of our work and compare it with the values used in prior years.

Production of the life tables required printing layouts that were beyond the computer's capability. But since the printers were adapted from traditional accounting machines (IBM 407s) they could also be controlled by wiring plug panels. That was common craft in those day, also used in the ENIAC and IBM CPC machines to control the sequencing of steps. A small panel is exhibited in the Stanford Computer Science historical displays. I became at whiz at wiring. For New York Life many large wiring panels were required. I found a supplier that provided lower-cost panels than IBM. When I ordered some for our project, I was rapidly informed that minimizing costs to the customer was not our objective.

While working with New York Life, the principal customer for our life insurance work, I obtained some useful economic insights on the side. For instance, I learned that when assessing companies, they penalized companies that were hiring too fast, because too much existing resources will have to be devoted to training new hires. That factor was then, and remains, important in our rapidly growing industry and is reflected in a paper I wrote 50 years later. Today, companies count on the educational system to provide workers that are adequately prepared. That leads to some majors that are narrowly focused and underestimation of the value of the knowledge embedded within the company.

Programming as a profession

The demand for workers to do programming increased rapidly. Many people educated as teachers entered the field, and one good friend, Michael Collen, actually had abandoned his intent to become a monk. Soon it became clear that considering them all to be mathematicians made no sense. In order to test diverse candidates for suitability as programmers, IBM developed a test suite to select potential hires. I was one of the sample cases tested to provide a good match.

The field was growing so rapidly that extrapolations indicated that by some year in the future most of the US population would be engaged in programming. That extrapolation was clearly impossible but has actually become true in an unforeseen sense. Now anyone with an iPhone performs tasks that then would have been considered programming.

A First Marriage (skip)

To continue my aeronautics education I enrolled in Brooklyn Polytech, just a short subway ride across the East River, taking a challenging course in aerodynamic vibration analysis. In the end, working took precedence over studying, and I never finished the course. But at Polytech I met Bill Graves, who became a good friend, and through him met his sister Jane, who was living on the lower East side. She was smart, well-read, and lively, working as an assistant in a New York animal hospital and keeper of two smart Siamese cats, Peevie and Bobo. While she expressed disdain for people she considered “professional Europeans”, as for example the then very visible cultural historian Jacques Barzun, I assume she liked my unsophisticated energy. We soon fell for each other, and that implied in those days getting married. My mother and her husband Nick had returned to the US by that time and were living in Weehawken in New Jersey while they were looking for a place that would support an early retirement. Jane and I went there to meet them. On 6 Aug 1959 we quietly got married in New York City Hall and went for a wedding dinner in the Chinese Rathskeller nearby.

68 Carmine street, in Greenwich village

I was able to rent a nice, unpretentious apartment in Greenwich village (Dutch *Groenwijck*) on Carmine Street with a roof garden. We lived the New York Bohemian life, except for my conventional and de-manding work. On Saturday night we’d be in line for picking up the Sunday times for morning reading. Jane was fond of the American idiom and style of the English language. Her mother was a proof-reader for the Wall Street Journal, but her father did not think much of me, so we had little contact. Jane had many books and we also subscribed to the Book of the Month club. Jane is the reason my command of the English language improved greatly. I developed a habit of writing, which has served me well. Writing forces one to organize ideas and concepts, rearrange them, and deal with complexities of interactions that look too confusing to address without having a structure. I would not be able to handle the complex issues of intellectual capital transfer without writing and rewriting, although computers made the editing easier.

I realize now that I was I fairly callow husband. When IBM told me they’d move me to California I accepted without hesitation. It had been my dream already, and I never checked with Jane. And IBM, also known then as “I’ve Been Moved”, didn’t wonder either what moving could do to families; after all, they were generously paying all the costs of moving.

Hood ornament: a Sphinx with jet engines on its wings

My first car. Going to California meant having to drive, and we borrowed Bill’s MG TD, taking the ferry to Staten Island for practice. For the exam we borrowed a plainer car. In California we’d need a car, and the chance to buy a big version of the TD came up in the form of an Armstrong Siddeley Sapphire saloon parked on a Chevrolet lot in Bethlehem, Pennsylvania. We all squeezed into the MG – no seat belts were required at the time -- and bought it on 23 July 1961. Jane referred to as `a future classic’, i.e., interesting, but impractical. Fascinating for an airplane guy were the jet engines attached to the wings of the Sphinx hood ornament, advertising Armstrong Siddeley’s main business line.

The price for the car was only $695 since the owner of the lot was not able to demonstrate the car to potential buyers. Siddeleys have an optional, unusual pre-selector transmission. If the left-hand gear selector pedal is used as if it were a clutch while shifting, the car will shift into neutral. I don't know why I knew about that type of gear box – maybe because it was used in WW II tanks by both armies. One has to select a gear first and then depress the gear engagement pedal. With that knowledge we could drive it off the dealer's lot and to New York City. In New York, Jane organized a parking space in a depot on MacDougall street, where the push carts were kept for the weekly Greenwich village market on Bleeker street. We just had to keep the car out of the way at the start and end of market day.

When our year's lease at Carmine street was up we were nearly ready to go to California. Jane rented a 4th floor walk-up at 154 Bleeker street, likely built around 1860, now gone. It had not yet been converted from the original Edison DC electric supply, so we had to buy the small DC refrigerator and I had to use a battery- operated shaver. The old Edison power station was nearby, since low voltage DC power cannot be transmitted over long distances, but it had been converted a long time ago from using steam power to having an AC motor and a DC generator. A few years later, when all DC customers were gone, the power station was converted to quite attractive apartments, since the thick walls made the units just about soundproof. We visited one apartment there many years later when a friend (name, girlfriend of xx in Mountain view) moved back to New York.

In renting a cheap place Jane may have had a premonition that living outside of New York would not work for her. We did start driving to California, with as much as would fit into the car while leaving space for our three cats. We stopped in Cairo, south of Albany, New York, to say good-bye to my mother and Nick, who had invested in a vacation cottage operation there. Not long after leaving, the engine broke down. Since the trip was already longer than IBM wanted me to be not working for them, all arrangements changed. I and our cats flew to San Francisco and rented a car, Jane went back to Bleeker street, and the car was put on a train for delivery to San Jose, at a cost nearly 3x its purchase price.

New Almaden

IBM had rented a motel unit for me in San Jose. I rented a car to drive to San Jose and to rejoin Dr. Tsao, who had already moved West with his family. Since my car was to come soon, I had to look for a house and found one by the creek behind the old, quite large miners' club building, in New Almaden. I found the place from an ad at the local grocery store and gas pump. New Almaden was then a sleepy town, with as its main interest the old abandoned mercury mine, which gave it its Spanish name. It was about 12 miles south of the IBM plant, with a one-lane bridge at one spot, potently dangerous, since one would drive quite fast over the empty roads.

The small, somewhat derelict house came with 5 steep acres, creek rights to serve any cattle, a shed, but no garage. But the rent, $75.- per month, was reasonable, and the landlords would pay for any material I purchased to fix it up. The major task I undertook was putting on a new redwood siding. With the advice of some local folk, who liked the improvements, I became an adequate carpenter. Wonderful quality redwood was still available in those days; I still have some remnants in use for bookcases.

For transport I had to buy a car immediately. San Jose had 24/7 used-car dealers then. I bought a Chevy fastback for a few hundred dollars which served me adequately. When the Armstrong Siddeley came, it was hauled under a large oak tree in the driveway. I elevated the car using some metal supports so I could work under it. I took the heavy cylinder head off using a block-and-tackle from a tree branch. It turned out that a main connecting rod bearing had given out. I contacted the factory and a few months later I could pick up a couple of crates with well-wrapped parts from the docks in San Francisco. I still have the invoice. The replacement crankshaft cost 23£ 15sh 6p; quite a bargain, especially since the British pound had gone down to $1.30, about half of what it was when I visited England. It took me several months to put it all together. It was driveable then, but the pre-selector gearbox also required a rebuild.

I got another bunch of parts from the factory, but that work was done by a fantastic local Italian mechanic, Tony Prevedello. Later he managed the Ferrari repair shop in San Jose, a good business I assume as the area got more well-to-do with IBM and Stanford spin-offs. In the meantime I had also bought a used 1949 MG TD from the son of an IBM executive, when the son went off to school in the East. My granddaughter decided in 2021 to restore it.

I was working many hours, but sometimes I'd join colleagues and go out to local joints. I was still officially married. After much correspondence and a visit by Jane to California it became clear that we should get divorced. No-fault divorce did not exist then in New York, but Jane readily agreed to state that she had been unfaithful, and that was a sufficient reason to proceed. I got to keep what was then in California: the cats, some books, and the Armstrong Siddeley, and sometime later I stopped supporting her.

[Dutch gas station attendant]

[Chevy broke down coming back from San Francisco. Help from a Mexican family. Bought a Nash as a daily driver. Woefully under-powered.]

Working and learning at IBM

I had been promoted to senior programmer at IBM and given increasing technical management roles. The rocket fuel analysis program was a success and motivated sales of several 704 computers to industry. For organizations that could not justify the million-dollar outlay for an entire computer we would do the computations. That raised the issue of charging, since a solution could run anywhere from a few minutes to several hours, and at $1000/hour of computer time getting flexible purchase orders written was hard. We devised an alternative, basing our price on the number of gaseous compounds plus ten times the number of solids in the exhaust – the latter caused computational problems. Those definite parameters were more acceptable to customers. It also was profitable for us. While we'd ignore the actual charges, even when they were much more than our estimates, as we gained experience we'd start the calculations at a point that was near the expected result based on our prior experience, so that many runs required little time. Disconnecting price from cost is a good strategy in many situations. I used similar concepts later at the Stanford ACME project.

We hired half-a-dozen students to help with running the computations. To make it attractive for them they could come in after classes, and work as much as they could spare, although they always had to complete a setup task for a computation. That arrangement frustrated some IBM personnel that were used to more regular ways. The solution was for IBM to rent offices for us outside of the plant area in a newly-built medical office complex in Willow Glen, a nice suburb, which was also easier to access by the students.

The freedom that came with this work arrangement also pleased me, since it was now easier for me to attend some classes at UC Berkeley to broaden my understanding of the rapidly growing field of computing. There was no computer science department or even curriculum then, and the courses were mainly taught by people that were just discovering the issues themselves - teaching forces one to clarify and organize notions that need structure to make them useful. One course described Perceptrons, a concept that presaged the neural nets that that are now the essence of much Artificial Intelligence (AI). I have searched in vain for the name of the person who presented that course – It might have been Joe Weizenbaum, who was working at the time on magnetic character recognition with SRI and General Electric, but soon after joined the faculty at MIT. A course related to compiling code was given by Bill Wattenburg, a broad-thinking individual who at the time was a PhD student of Harry Huskey. He died in 2018 after a life as an inventor, author, and host of a popular radio show where he promoted himself as `The Smartest Man in the World'.

Leaving IBM

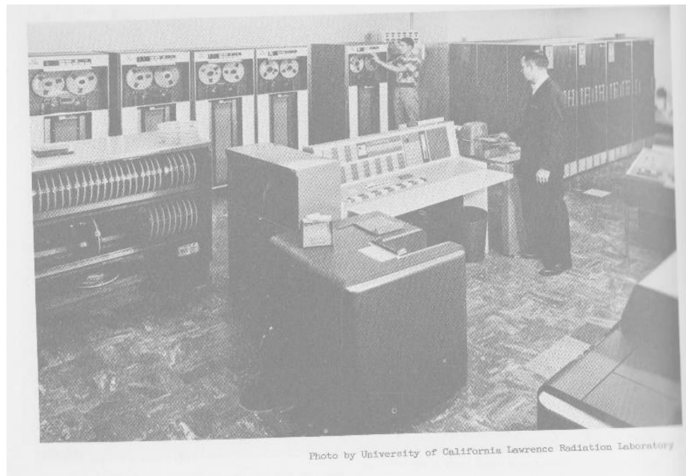
When the space program got into full gear IBM offered me a job as assistant manager at their new Houston research facility, which was to support NASA's space program. In 1973 NASA's Houston facility was renamed and known then as the Lyndon B. Johnson Space Center. But Houston was an unattractive location for me. Furthermore, I had made social contacts around Stanford and UC Berkeley. I was offered jobs at SRI, a research institute that had been spun out of from Stanford University, and at the University of California , located in Berkeley. Even though it paid less, I took the UC Berkeley position, primarily because it offered better learning and growth opportunities.

Since the UC Berkeley position was an academic job, I was able to take a leave of absence, preserving retirement benefits in case it did not work out. Since IBM did not value software as a product at the time, I was also able to make the arrangement that I could consult with existing and potential users. I did so and may have helped IBM sell a few more computers. Outside of some stock distributions, IBM did not provide any vested benefits then. The concept was life-long employment. Now such a view is untenable, and people carry retirement accounts from job to job.

My father was surprised that I would leave a stable company for a non-tenured position in academia. He held to the tradition that once one started a job it was for a lifetime. He did not consider that he only started having a stable job when he was 35, having rambled around in academia up to then. I was just 25 years old and had made much progress during the 2½ year at IBM.

4. UC Berkeley 1961-1964

In the fall of 1961 I accepted the newly created position of Chief Programmer for the University of California. The university, with a large discount provided by IBM, had just obtained a double memory (65,536 words or 393,216 6-bit characters) 7090, being installed on the Berkeley campus, in the basement of Campbell Hall, a building housing mathematics and astronomy faculty. The huge computer was expected to be adequate to support research at all UC campuses.

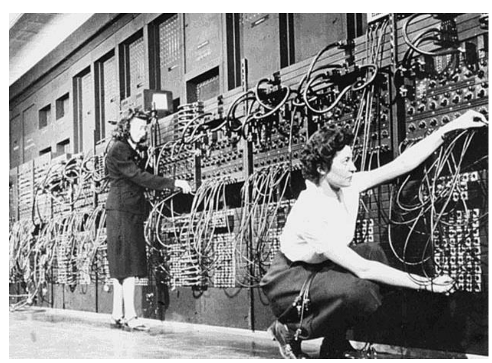


Berkeley RadLab 7090 installation

That computer model (originally named the 709T) was a transistorized version of the prior IBM 704 and 709 designs. The initial conversion was sponsored by the military. Not only was it six times faster, but not having the unreliability inherent in vacuum tubes made it a major success.

The commercial number version, 7090, with 32,768 words of memory, sold for $2,898,000. Most were leased at an average of $63,500 a month. The 7090 show is a similar machine installed a year later at the Rad lab, up the hill from the campus [Weik:61].The 7090 and its successor, the IBM 7094, became the dominant large computer in use for about 5 years, making the name IBM nearly equivalent with computing.

Since the large machine was to serve all campuses, my job involved travel to other UC campuses as well. Travel to San Francisco, where the UC Medical School is located, was fun. I worked with a professor of Psychology there, John Starkweather, on measuring interview reactions. Later professor Starkweather developed PILOT, a language to write teaching and interview protocols. Yet later, in 1973, he became my PhD advisor. I also maintained contact with UCLA. Soon after, though, UCLA obtained its own computers by establishing WDPC in 1961 and a bio-medical computing facility as well. I was able to convince some bright programmers to come from Los Angeles to Berkeley with the promise of more fun at work and beyond.



Programming the Eniac

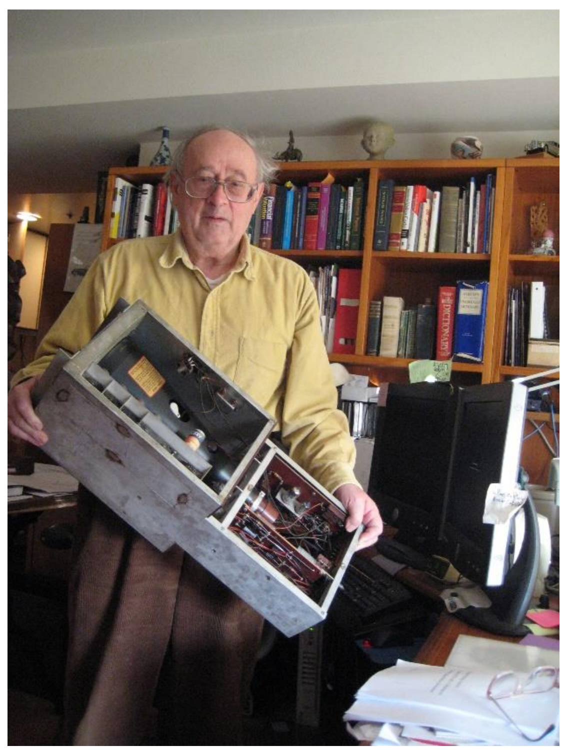
I came on board just as the previous director, a professor of mathematics, had been replaced by a faculty member from the business school. The thinking of UC's administration was likely that a business professor would be better able to manage the operation, and interactions with the many potential users. That notion did not work out either. A third director during my time at UC was David Evans, who had been brought into UC from industry by Professor Harry Huskey, a true computing pioneer.

Professor Harry Huskey

Harry Huskey had a longer history in computing than anyone I know of. Soon after obtaining his PhD in 1943 he taught mathematics at the University of Pennsylvania. In 1946 Harry Huskey obtained the clearance needed to work on the ENIAC, the first general purpose computer. It was designed by Presper Eckart and John Mauchly and had just been completed at the Moore school. ENIAC did not have instructions in the same memory as data, but instead was programmed using external plug-boards. One of Harry's contributions was to maintain a log of problems encountered, which allowed systematic improvements of the system.

Harry's lectures on using the ENIAC were attended by some UK scientists, some of whom had worked with Alan Turing on code-breaking during World War II. They invited him to spend time at their UK laboratories. He and his family left, by boat, in the fall of 1947. There Huskey encountered new technologies for program storage, supporting what is referred to as the von Neumann architecture, although the principle was already envisaged by Alan Turing. On their return to the United States in 1948 Harry Huskey worked on the design of the SEAC, the Standards Eastern Automatic Computer, sponsored by the National Bureau of Standards. The SEAC would have programs stored in memory, although because of the variety of alternatives being tested it took a long time to become sufficiently reliable.

With that experience, Harry Huskey took on the task of designing and building a computer for the Western division of the National Bureau of Standards, near UCLA. The result was the SWAC (Standards Western Automatic Computer), the first computer in California. To gain reliability, he did not stress the components to their highest capabilities.



256-bit Memory Tube from SWAC, now in the Stanford CS historic displays

The SWAC used 40 Williams tubes, each storing 256 bits on their display. I later was able to obtain one for the Stanford Computer Science Historic Displays. The SWAC was then widely used for numerical computation; among the users were George Forsythe and his wife Sandra. Later, in 1965, George started the Stanford Computer Science Department. In 1953, due to misguided congressional pressure during the McCarthy era, the Western division of the Bureau of Standards was closed and the SWAC was transferred to UCLA where it was used up until 1962 to support the new Western Data Processing Center (WDPC) at UCLA. WDPC had received in September 1958, following three years of negotiations, an IBM 709 computer from IBM with a full 32,768 words of memory – obviously sufficient to serve academic needs in all of Southern California, Arizona, and Nevada. The president of IBM, Thomas Watson jr., participated in the dedication. By the time WDPC closed in 1966, the UCLA campus and the Medical School had installed their own IBM 7090 systems and no longer relied on services provided by the computer at UC Berkeley.

Harry Huskey later designed the Bendix G-15, introduced in 1956. It sold for then a about $60,000, making it nearly a personal computer. As memory it used a magnetic drum, rewriting read bits in way similar to the design of his SWAC, but now holding 2,160 words of 29 bits each.

In 1964 Harry joined UC Berkeley's departments of Mathematics and Electrical Engineering where he also initiated several software projects. Later, both departments started offering education in Computer Science. One of his students was Niklaus Wirth, who joined the new Computer Science department at Stanford. After his return to Switzerland Nicklaus designed and implemented the popular Pascal language.

In 1963 Harry Huskey left foe a year to help establish electrical engineering and computer science at the newly established Indian Institute of Technology in India. The project was run by several Universities, including UC Berkeley. He asked me to succeed him there. In November 1964 I left for India. That led to significant changes in my life, presented below.

In 1967 Harry Huskey went on to start the Computer Science Department at UC Santa Cruz, then hiring some graduates from Stanford. I Extracted some pages from his autobiography for people interested in the history of IIT Kanpur. Harry died in Santa Cruz in 2017 at the age of 101.

At UC Berkeley had worked with several of Harry Huskey's students, as Bill Keese and Ralph Love.

Professor Edward Feigenbaum

At UC Berkeley I also met professor Feigenbaum, who later had significant roles in my life, in 1966 bringing me to Stanford as director of the ACME project, in 1976 on my PhD committee, and providing support in my academic career throughout. Now, retired in San Francisco, we mainly meet to go to classical music concerts.

Ed Feigenbaum was appointed to the UC Berkeley Business School shortly after completing his thesis at Carnegie Mellon University on EPAM (Elementary Perceiver and Memorizer). That program demonstrated verbal learning and concept formation and was written in a language, IPL-V, little known then and quite obscure now. Conceptually it might be seen as an assembly language for Artificial Intelligence (AI). I was willing to Install and maintain IPL-V on UC Berkeley's new computer system.

Teaching at Berkeley

Although not a member of the faculty, I taught short courses on programming and software, since those were not covered in any academic program at the time; there was no Computer Science department then. Computing was formally with the department of Mathematics, but Electrical Engineering and the Business School were interested as well. The languages I taught were FORTRAN and assembly language, still essential for demanding programs, since the computers were not that fast. For instance Gerald (Jerry) Johnson, working for professor Derek Lehmer, built a program to implement the Lehmer sieve, to compute prime numbers, which had been done previously by mechanical means. The 7094 implementation could check 100,000 numbers per second [Williams:02]. Jerry Johnson later succeeded me at IIT Kanpur.

Much later, in 1975, while I was working on my PhD at UC San Francisco, I taught some short database courses at as well. Those courses helped me develop the Database Design textbook I was working on.

Operating system concepts

Up to that time computers did not have software to manage the flow of different jobs, a task now accomplished by operating systems, that are now an essential component for all but toy computers.. Access to the machines was scheduled externally, and once gained, all of it was under ones control Given the small amount of memory available users would not want to give up anything resources. Many important programs were constructed to use all of the available memory. For charging a timeclock was placed near the console and a time card was punched when one started and left. That led to some waste of time and resources. For long jobs that was tolerable. In a university, where there were more users, and the jobs of student users often failed early due to an error the overhead was costly. Early solutions were to use a more economical or older machine prepare magnetic tapes containing the data and maybe programs from the submitted cards and print output from tapes generated by the previous job. That convention was so ingrained that Fortran had the default of using tape unit 5 for input, unit 6 for printed output, and unit 7 for punched output. Now the computer was free for the next user as soon as tapes from units 6 and 7 were removed and replaced by empty ones.

Having a computer with a second memory allowed addressing that issue much more effectively. One memory unit could handle the existing programs, at UC typically from the predecessor IBM 704 machines. The second memory was available to load the input for the next job and complete the printing of prior output. Soon after our Computer Center acquired a smaller computer, an IBM 1401, with a faster printer and a two-head IBM 1302 disk unit for sharing input and output, which was typically much more than the second memory could manage. While the concepts were simple, it was all quite novel programming. It required a modest but very competent staff. Berkeley and its student population provided a great resource. Together we were a fairly wild bunch, not always favorably viewed by university administrators.

Soon manufacturers started delivering operating systems with their computers. By 1965 time-sharing systems were being developed, allowing multiple users to share a single computer. In November 1964 Ken Thompson left the group; he later developed UNIX at Bell Labs. Several others joined me at Stanford, after my return from India, to build a real-time timesharing system for medical users there, using an IBM 360 computer, which had a much more suitable architecture for shared computing.

ForFor compiler

FORTAN was the primary programming language taught. It was the prime language used in industry at the time. The FORTRAN compiler delivered by IBM was focused in creating very efficient programs, no matter how large, but with the limited memory capacity had been designed to require (4 or 5) passes. The source program submitted by the users was kept on tape, and the successive passes would write their transforms onto other tapes. However that meant that even a minimal student program would take several minutes to compile into executable code.

One of our programmers, Gary Breitbard. took on the task of writing a compiler that would be fast, generate correct but not efficient code for modest-sized programs, and would be able to keep the users code in memory. My experience in with IBM's FORTAN and the problems it had, gained earlier at IBM, helped. Each statement was compiled into executable code, and no subsequent optimization was done.

At specific times during the day, the compiler was brought is, and all Student Fortran programs would be retrieved from disk, complied, and, if no syntactical error was found, executed. When failures in execution occurred, the error report could include the label of the source statement associated with the error. Existing system provided the memory location. If the error was not obvious, the location had to be found in a memory dump, often many pages, of octal code, to be matched to a source program instance.

By July 2020 FORTAN was eclipsed by many new languages, and had moved down to position 50 in the Tiobe index of programming languages. C and Java rank in top, with over 15% preference ratings. In terms, of history, Assembly language (rank 12) and Cobol (rank 28) rank much higher than FORTRAN.

An early Algol 60 compiler

A committee of prominent computer Scientists were defining a modern programming Language, In 1960 the product was Algol 60 . We supported a project to develop a compiler to conform with the specification, as did many others. For input and output, not specified in the original document, we used the code from the ForFor project. Niklaus Wirth, then a student of Harry Huskey in Electrical Engineering (no Computer Science there yet), participated. Niklaus Wirth remembers that we did not manage to implement recursion as specified in the report. His experience led him to define more effective languages, as Algol-W (1966) and Pascal (1970) that did implement recursion. Algol does not appear in the tiobe list, started in 1984..

I don't have any documentation at hand and would appreciate any to be shared.

PILOT

Another project that we support was at UC San Francisco, where a UC Medical School is located. A project initiated around 1962 by Prof. John Starkweather, in Psychology, was to provide computer-aided interviews in topics that are hard to deal with in person or difficult to schedule. As UCSF obtained their own computer and some Berkey staff moved there that project evolved into a computer language with just 11 1-letter commands: Programmed Instruction, Learning, or Teaching, PILOT (1968). By 1991 it had an IEEE Standard definition. Being simple to install and use it was transferred to mini-computers when they became available in several places. In 1974 Prof. Starkweather become my PhD adviser.

Concordances

It was important that computing be recognized as being applicable to all areas of university research. An opportunity to stress FORTRAN's character-processing capability was creating a concordance program. for Professor Bertrand Augst in the French department. Professor Augst and Joseph Duggan applied it to a classic manuscript. The result, showing all word instances with context and source line number was published as a tool for linguists interested in that period. The program was updated when computers switched to using 8-bit character coding, which allowed lower-case characters as well. It also distributed through SHARE.

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 en remeint guaste. / Mult ad grant  doel  Carlemagnes li reis, / quant  Naimun veit  345
dist li reis: "Seignurs, vengez voz  doels, / si esclargiez voz talenz e voz coers,   362
." / Respont li quens: " Deus le me  doinst venger!" / Sun cheval brochet des esperu  154
 France ad mis en exill. / Si grant  dol ai que ne voldreie vivre, / de ma maisnee,   293
/  Franceis murrunt,  Carles en ert  dolent. /  Tere  Majur vos metrum en present.    95
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." / E cil respunt "Tant sy jo plus  dolent. / Ne pois a vos tenir lung parlement:   283
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cevalchet par irur / e li  Franceis  dolenz e curucus: / n'i ad celoi ki durement ne  181
/ plurent e crient, demeinent grant  dolor, / pleignent lur deus,  Tervagan e  Mahum  269
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Snapshot of A Concordance of the Chanson de Roland [.J.J. Duggan, 1969]

NSE

A fascinating project was a computer language in which everything entered would be valid and translated into code. I forgot the name of the project, so I will refer to it here as NSE (no Syntax Errors). I believe Bill Keese was working on it. It seemed like a wonderful idea, but it turned out that nobody could ever write a non-trivial program in it. A simple typo would generate amazing code and mystifying output if it ever completed.

The nearest similar language was the Iverson language, implemented as APL in <IBM calculation>, designed in part as a reaction to overly wordy languages, such as COBOL [Example of an array sum in both languages]. It is now clear that a reasonable amount of redundancy in language is essential. I leave it to others to decide what the balance would be.

Student projects at UC Berkeley

Some other students at Berkely were working on the The Huskey Language, designed to avoid the problems seen in the implementation of Algol. Some of its concepts can be seen in Klaus Wirth'd Pascal language. I took the manual to India, but at the time there were no graduate students that could continue the work.

Trip to Columbia

An interesting colleague was Claudio Naranjo, a researcher from Chile interested in Psychotherapy. In July 1963 I accompanied him to Columbia, across the Andes by bus to Puerto Assis, a boom town due to the discovery of oil deposits. The expedition was supported by Richard Evans Schultes of the Harvard Museum of Natural History.

Puerto Assis looked like a scene from movies about the gold rush. The hotel we stayed in was just a space partitioned into rooms with bunkbeds. Most other buildings were false-fronted bars or girlie clubs. We left as soon as we could make arrangement to move on, continuing on dugout canoes down the Putomayo river, a tributary of the Amazon, to collect and preserve specimens of psychotropic plants, as yage.

In 2005 I participated in a lecture he gave in San Francisco. I showed a number of the pictures I had from that trip. I am still trying to locate them.

Second Marriage (skip)

While attending an early Artificial Intelligence (AI) course at UC Berkeley I had met an attractive and sophisticated girl there. (I will omit her name in this biography.) She came to visit me with her son a few times in New Almaden, driving her sporty MG, and we all enjoyed each other's company. When I decided to leave IBM she arranged that I would meet the recently appointed director of the new UC Computing Center, professor Austin Hoggatt. As described in the prior section, UC was just acquiring a large IBM computer and I was offered the technical management job there. I rented a house in a fairly dinky neighborhood in West Berkeley, next to a railroad track – used once most nights. She and her son moved in and we were married on a small boat in San Francisco by a friend who had gotten a certificate to be a pastor of the Universal Life Church, a popular organization in the hippie world of that day.

Being now a family man I also purchased a nice Buick Century station wagon (mine was blue), which allowed us all to go on trips to the coast or mountains together, often with the son. While we had some good times, over time it seemed that my lifestyle and ambitions did not satisfy her.

She had been married previously to a UC finance student, who divorced her and became a professor in Oregon. I now think that separation engendered much insecurity. While I could support the family there was not that much extra left in my budget.

Within a year or so she took her earnings and bought a nice house in Berkeley. While I would continue for some time to visit her there, it was not seen as a home for us together. After one visit, as I was driving the Buick to campus, I was broadsided by huge red Mercury, driven by a lady who told the police that she stepped on the gas by mistake when she noticed the stop sign. My car was pushed over the curb and the force bent the heavy car like a sausage. I was taken to the hospital and examined. While I had no significant injuries due to the crash, they found a benign but extensive bone tumor in my left leg. It was removed, but my left leg remained longer. An aggressive visit by her, blaming me for I don't remember what, upset me and I got the hospital to remove her name from a list of approved visitors. That pretty much ended our relationship.

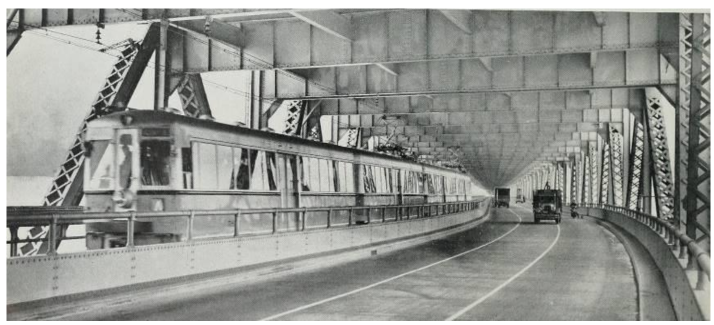
Later it turned out that we had gotten married before the one-year waiting period of my New York divorce [ref] had passed, so that my 2nd marriage could be annulled in early 1966.

A bachelor again

A long-time friend, Goodwin Sammel from my days at IBM/SBC in New York, was giving up computing to switch to just playing and teaching piano. He considered moving to Berkeley and contacted me. We rented a large house, adequate for several pianos, on Channing Way near Shattuck Avenue, much nearer to the University, sharing the $150 monthly rent. I moved out of West street and away from what remained of my second marriage. I did apply then for US citizenship, but they received a note that I had abandoned my American wife by moving out. The experience with the immigration service officials was quite unpleasant. Since there is no recourse to complain when one is not a citizen, I gave up. Having a chance to go for India provided final closure. The contract covered most expenses incurred in India, and as such allowed me to rebuild my savings; I had previously sold the modest amount of IBM retirement stock I had accumulated to cover debts incurred during the marriage.

As a bachelor again, had a few dates, mainly with women working at UC Berkeley, but nothing that became very serious. However, I did meet Voy during a job interview, who several years later became my wife. At that time she was determined to marry a Chinese boy, so I was off limits.

Without a family car, I started driving the Armstrong Siddeley car again that I had bought while at IBM. One night in 1964, returning from San Francisco, I had an accident returning alone from the city. I was using a shortcut, Adeline street, that went diagonally from the San Francisco Bay Bridge to downtown Berkeley. That right-of-way was originally used for the Southern Pacific suburban railway that went from San Francisco's East Bay Transit Center, now the Salesforce tower, on the lower deck of the Bay Bridge to north East Bay locations. Later the SP lines merged into the Key System that went to Oakland. Today, suburban BART trains run under part of Adeline street and freeways take cars from the bridge.



The trains had stopped running around 1958, but in 1964 the rails were still there, making it a rough and unpopular route, but a shortcut for me. Unbeknownst to me, crews had started removing the rails. I hit a concrete block with my left fender, crumpling it. I managed to drive the car home, parked it under the house, and ordered replacement parts from England. The parts arrived within a month or so at the San Francisco docks, but there was no time to fix the car, since I was about to go to India. While out of the country I could store up to 5000 lbs of household goods, so I stored 4800 lbs of Armstrong Siddeley until I returned, and had it delivered later to my new place on King's Mountain.

Friends in Berkeley

Being at the University I encountered many interesting people, Furthermore, through Goodwin Sammel there were also many musicians and mathematicians around. Goodwin had worked as a mathematician in Chicago, but much work had moved to the West coast. A good friend of Goodwin was Verena Dyson. She had separated from Freeman Dyson, then leading the Institute for Advanced Physics (IAS) at Princeton, and moved two Berkeley with her three children, Katarina, George, and Esther. George Dyson later became well-known for building modern versions of North-West Indian canoes, Badarkas and as author of books on the origins of computing and space exploration plans, drawing on work of his father. Esther Dyson is now a consultant and a prolific journalist of the modern computing scene. Many well-known mathematicians met at our house while I lived there. While I never was able to contribute to their discussions, I did absorb notions and concepts that certainly influenced me.

5. India November 1964-November 1965

My initial period of work in the US actually ended with spending a year in India, on a contract that UC Berkeley had with USAID, the US Government organization administering foreign aid. The American government had sequestered the Indian Rupee payments from sales of food aid it provided since 1954 under PL.480[2]. Giving the food away, letting people not pay for food, would have damaged Indian farmers. One means of spending the collected funds, amounting to about $1.2B in 1964, without disturbing other segments of the Indian economy, was to establish a new Institute of Technology, a school that could be a model for modern education. An earlier Indian Institute of Technology (IIT) had been established in Khragpur by the United Nations. The success of Khragpur motivated other countries to assist. The UK set up an IIT in Delhi, the USSR in Bombay (now Mumbai), and Germany in Madras (now Chennai). For the Kanpur effort MIT provided a model and leadership. Eight schools, including the University of California, as well as the California Institute of Technology, Carnegie-Mellon University, Case Western Reserve University, The Ohio State University, Princeton University, Purdue University and The University of Michigan, joined to support the Kanpur Indo-America Program (KIAP).

Prof. Harry Huskey decided to participate in the establishment of IIT Kanpur (IITK) and went to Kanpur in 1963. To support computing -– then still within Electrical Engineering -- Huskey solicited Foreman Acton and Irving Rabinowitz from Princeton's Computing Center. Harry Huskey described his stay in his autobiography [Harry D. Huskey, *His Story*, Book Surge Publishing, 2004]. I put the individual scanned pages dealing with KIAP p.77, p.78, p.79, p.80, p.81, p.82, p.83, and p.84 from his book on my web pages.

Irv Rabinowitz from Princeton took on the computer operations. The computer shipped to Kanpur was a 30K character (60K digits) IBM 1620 that Harry Huskey and KIAP officials were able to acquire and install in August 1963. Input and output was by cards, not ideal when the monsoons came. There were 20 IBM model 26 keypunches to prepare input. Printing was done by feeding cards into an IBM 407 accounting machine.

Irv Rabinowitz at the IITKanpur 1620

I had interacted with Irv before, and in 1964 Huskey suggested that I could succeed Irv at the Kanpur Indo-America Program (KIAP). In addition to teaching the computing courses a major task was to bring more capable equipment to Kanpur. Preliminary negotiations had selected the 32,768-word IBM 7044. It was a modern, somewhat less costly computer following the same architecture as the machines installed at UC Berkeley and many other U.S. universities. We did not know it then, but the architecture would soon be superseded by IBM's 360 and similar architectures, all based on 8-bit bytes and capable of flexible memory allocation, enabled by fast transfers to and from magnetic disks.

I accepted the offer with enthusiasm. It enabled a definite break with the remnant of my second marriage.

Getting a computer to India

A challenging assignment was to provide IIT Kanpur with a large, reliable computer. Negotiations were tedious. IBM was not anxious to provide its most up-to-date equipment. For instance, I insisted on, and got, the latest high-density tape drives which used error correcting codes. The older models only had error checking and in effect a much worse failure rate in dusty surroundings.

Frequent meetings with Indian government officials, other computing centers in India, and IBM offices in Bombay were part of the job. I learned much in these interactions with experts with a wide range of competencies. My work in India prepared me well for subsequent engagements in India and China.

However, I could not stay to see the actual installation of the computer in Kanpur. Gerald (Jerry) Johnson from UC Berkeley's Computer Center completed the job. He stayed there for three years.

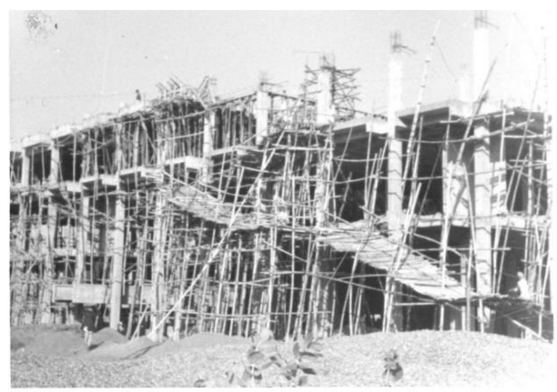
Teaching and living in India

I enjoyed teaching at IIT Kanpur. The students were very smart and motivated. The curriculum and class syllabi had been set up by MIT. To my surprise I had to cover analog computing as well.

In addition to teaching classes for students, KIAP also offered short courses for participants from industry and government. Much of the spread of computing capabilities in India was due to those participants, documented in a book by E.C. Subbarao: *An Eye for Excellence*; Harpers 2008.

To arrange the contracts and delivery of the computer I often had to go to New Delhi. The capital of India, and Bombay (now Mumbai), where IBM was based. Once settled I travelled quite a bit.

Living in India.



Parts of the IIT campus, about 10 km west of Kanpur, were still being built; an example is the library – as shown here. Bamboo scaffolds and walkways allowed mainly female workers to carry sand, cement, and water to higher floors. The final buildings are modern and straight.

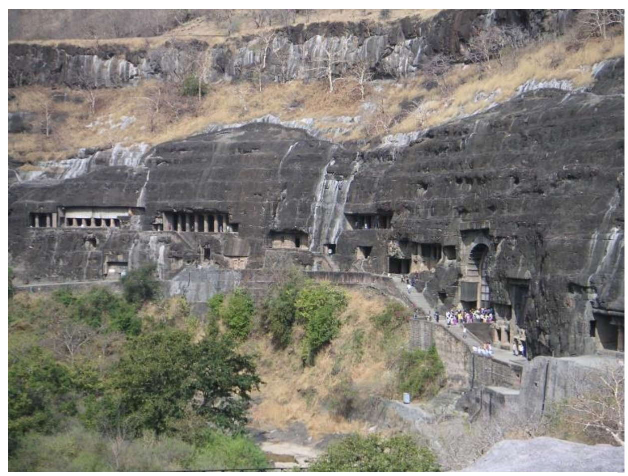
For housing, families had priority for housing on campus. I was assigned a house in Vishnupuri, a relatively modern area north-west of town, not far from the Ganges river. The house had actually been occupied my predecessor, Professor Irving Rabinowitz. I also inherited the servants that came with the house, but I kept only two: Daniel, who had worked also for Prof. Huskey, and an outside sweeper. A KIAP jeep would pick me up daily and drop me back, driving a segment of the busy Great Trunk Road that connects Calcutta with Delhi.

I interacted with many of the KIAP faculty, but of course mainly with the bachelors. Several were lodged at the *Kanpur club*, a remnant of the British days, which was located on the other side of town, where the British military had their quarters and parade ground. It was then known as the Cawnpore Club. Here, as in many places, including San Francisco, land formerly allocated to the military now provides open spaces that would otherwise have been overrun by growing populations.

Living in town allowed me to meet some local families, and I became good friends with the hospitable Khory family. The father, Navrooz, managed a textile factory. Being Parsis, that is, descendants of Zoroastrians who fled Persia during the Muslim invasion, they were more outgoing than many of their neighbors. Two of the children would end up in America, and we still maintain contact. Their daughter Purveen later married a banker and spent much time in the Near East. They retired to Pune, and she was able to come and meet Voy and me in Mumbai when we visited India in 2016. Later they also moved to Canada.

Travel in India

Getting to Bombay, a distance of about 850 miles (1400km) was complex when it had to be done without weeks of advance planning. Without a communication network Indian Airlines (the only option then) tickets had to be bought at the originating airport. The closest commercial airport to IIT was Lucknow (60 miles or 100 km north). A KIAP employee would have to go there for a ticket, but could not purchase a return flight at the same time. And flights and seats were scarce. But I learned that Indian Airlines used its planes at night to transfer mail and packages. Each plane would fly from its base to Nagpur, relatively central in India. The goods would be transferred and the plane would return to its base. No tickets were sold in advance, but for my unscheduled travel it worked well, as long as I was willing to spend a few hours after midnight in the not very hospitable airport in Nagpur.


The Ajanta Caves, abt 400km North-East of Mumbai

I had one occasion to drive back to Kanpur from Bombay. Professor Charles Elliott, on leave from the University of Michigan, had ordered an American Motors Ambassador, which was delivered in Bombay. He was not willing to risk driving it back, but I was willing to do that and drive through scenery rarely seen. A small detour allowed me to visit the amazing caves at Ajanta, about a third of the way to Kanpur. Seeing the Buddhist paintings in the dark caves meant getting a guide, who would drag lights along and plug them in at various points. The caves have now become a tourist destination, although, without a convenient airport, they remain hard to reach. The roads were rough. At one point the front bumper dropped down due to a bolt falling off. Luckily the road forced me to drive slowly so I could stop quickly. I was able to remove a similar bolt from the rear bumper, reattach the front bumper, and continue.


Gio's green VW beetle at the Khory home

Going to Delhi could be done by an overnight train or driving. Soon I was able to buy a VW Beetle from Professor Peter Fay of Caltech, when he upgraded to a VW bus because his family was growing. He and his wife, Marietta had gotten to know many local families. I also got to know their children. Both of them wound up at Stanford, and in 2018 a grandson enrolled as well. The Volkswagen, imported under a diplomatic exemption, had to be brought back to the US and became a rescue dune-buggy in the Sierra Madre foothills above Pasadena.

Professor Peter Fay

While teaching history at IIT Kanpur, Professor Fay wrote a book documenting the Indian National Army, a World War II effort supported by the Japanese to fight the British in India. After the war, participants in the Indian National Army were considered traitors and the leaders were imprisoned. When India became independent some entered politics. I met some that lived in Kanpur, but I was too naïve at the time to appreciate their complex history.

Having my own car provided flexibility. I no longer depended on KIAP jeeps and their drivers to take me from my place to campus. Driving in India requires care. Some evenings elephants would be returning from work on a farm. Coming upon a grey elephant on a dusty grey road can be quite a surprise. Buffalo carts often had kerosene lanterns in the rear, elephants never.

I could also take some daughters from liberal families to approved places, but never just one girl. Chaperoning was expected. There was one movie house in Kanpur, as well as a hole-in-the wall Chinese restaurant. At the movie house were several street people who'd offer to watch your car. It was all very civil: once you had dealt with one, he counted on you the next time and the others would not compete. Mine was referred to as the spider-man because his deformity.

More proper was the Kanpur Club on the other side of town, left over from colonial times, where several bachelor IIT faculty members lived.

I could pick up US supplies and food staples for myself and other faculty families at the embassy commissary in New Delhi, about 300 miles northeast on the Great Trunk road. That distance could be driven in a long day. A day or so in Delhi would be pleasant. There were restaurants, art markets, and museums. The Moti Mahal restaurant, in Old Delhi, had great tandoori chicken. Officially the area was dry – no alcohol could be served. But the waiters were willing to get beer and serve it discretely in a teapot. Delhi did get hot as summer approached. The Volga restaurant was the coolest eating place since it catered to Russian staff and expatriates. The Museum of Modern Art was good for cooling off, since they were protecting their paintings from damage.

On the way back I'd sometimes stop half-way at Agra, and see the famous monuments there. And again, there were decent restaurants, something that Kanpur lacked. I did get stuck once in the narrow streets there and had to back out for what seemed more than a mile, but was probably less.

A summer tour

In the spring I received a telegram from Patricia Vielehr, the wife of Jerry Vielehr, the original manager of the KIAP program. Pat and Jerry had returned to New Jersey the year before, but they realized that Jerry had been too busy to see much of India. Would I be willing to tour South India with him during the summer break? I agreed of course. I soon received a confirmation and bill-of-lading for a car to picked up at the docks in Bombay.

When I showed up the car turned out to be a Cadillac convertible. Pat had ordered it to be modified so would run on the low-octane gasoline available in India. It also had a refrigerator installed in the trunk, since we'd be driving through dry states and Jerry would need his cold beer no matter what. The car also had what was then a new feature: a limited-slip differential, which later allowed us to proceed on muddy roadsides where Jeeps were getting stuck.

While waiting I could drive the Cadillac around Bombay and impress some of my friends there. While impressive, it wasn't much more so than any full-size convertible would have been. Once Jerry arrived we filled the car with provisions and set off for the South. Instead of listing all sights and temples I have annotated a map.

There were few hotels in Southern India suitable for tourism then, but, through Jerry's contacts, we were able to stay at government rest-houses originally built for British Government officials at the major tourist destinations. The roads typically had only one paved lane and were mainly used by trucks. Private cars were too valuable to be risked for driving much beyond town. Because the Cadillac was a bit shorter and less wide than the ubiquitous Tata trucks we could go nearly anywhere. A problem was the absence of roadside rest stops. As soon as we would get out of the car we'd be surrounded by scores of interested folk, affording us little privacy.

Bangalore was the first major stop. A beautiful town, with an important Advanced Science Institute, wide boulevards, and a relaxing atmosphere. Voy and I stayed there again in 2002, with Professor Tom Binford and his wife. After his retirement from Stanford they decided to develop software for handwriting recognition. By then Bangalore had become a hotbed of computing activity. The US multinationals operating there created much employment for the new generation of trained computer professionals. Their business model managed to avoid paying local taxes. Local businesses followed their model. As a result Bangalore is now quite crowded and has a strained infrastructure.

Jerry's Cadillac in Mysore

In the entrance of the Lalitha Mahal palace in Mysore the car could be shown off appropriately. Further into South India many more of the original ornate Hindu monuments and statues remain, since the area was not conquered by the Muslims, who tried to efface all depictions of idols and replace them with elegant Moorish structures.

A high point was Cochin – now Kochi. It is a major port, Cochin had been occupied in the past by the Portuguese and the Dutch, who used it as a provisioning stop on the way to the East Indies. The hotel De Boer, on the inlet to the harbor, was an elegant remnant of those days. We visited the former Dutch residency on a nearby island and took the obligatory boat ride through its canals. Cochin also had a Jewish settlement, likely initiated during the diaspora, around the year 100. Two synagogues there are documented back to the year 1200; one was for Indian converts to Judaism. Most settlers with a European background had emigrated to Israel. When Voy and I visited Cochin in 2016 the synagogue had become a busy tourist attraction and the hotel was used by the Indian military.

Jerry's willingness to be engaged was infectious. When driving further south, through Trivandrum in Kerala, we encountered a large communist procession. Kerala, in part due its Christian population which emphasizes taking care of the poor, is a State in which Marxist parties have a major role. Instead of just following the throng, Jerry directed me to maneuver into the head of the parade. We were cheered by participants and bystanders. I have to assume that we were seen as representatives of the USSR; Jerry might have been Bulganin himself.

The next page shows a map of South India, a region still relatively unfamiliar to American tourists. I underlined the major places we visited.

Jerry Vielehr, posing

Map of India, with places visited the summer of 1965

The food became spicier and spicier as we traveled south. Luckily, it was mango season. I think I only ate mangoes as we continued further south.

Finally we reached the southernmost point of India, Cape Comorin, now Kanyakumari, just 8^{o} North (480 nautical or 550 statue miles) of the equator. Then we went back along the East coast of India.

The temples got even bigger, and their carts, pulled out for processions, overshadowed the Cadillac.

It was July 14th when we drove through Pondichery, which had been a French colony until 1962. We were surprised by all the French flags and street festivities, and learned that Bastille Day was still being celebrated there. We actually stayed a few days in the nearby Sri Aurobindo Ashram, a very welcoming place and relaxing after all the driving. An American who was staying there joined us for the continuing trip north.

The next major stop was Hyderabad, the center of a Muslim area that remained in India after partition. The buildings in town had a very different character, reminding us that we had now left the Hindu dominated area, and the inscriptions were now in Arabic.

In front of the hill-top hotel was a prewar Auburn, with a pre-selector transmission. It made me recall the Armstrong Siddeley, still waiting in Berkeley for its repair. Jerry dissuaded me from trying to bring the Auburn back home.

The monsoon rains were starting, making driving more difficult, but the car did well. Going on, we had to cross, I think the Pili Nadi river, using a small ferry. The Cadillac slipped off the boards laid to drive from the beach onto the ferry. It required dozens of people and huge beams to get it back onto the ferry. A Volkswagen would have been much easier.

Near Bhopal we stayed with a friend of Jerry's. The friend had a sugar cane plantation. Elephants were hauling in the crop and fed on the leftover stalks. A great example of sustainable agriculture. Jerry planned to go on to New Delhi, so I decided to take the 9-hour train ride to Kanpur and get back to work. He came back through Kanpur later. The Cadillac, having been brought in under diplomatic privileges, could not be sold in India, but wound up with the Maharadja of Bhutan. I hope he enjoyed it as much as we did.

I stayed in occasional contact with Jerry. He took on various executive position at US companies until he retired. Jerry Vielehr died in a car crash in Wisconsin in 2017.

UNDP

I had become known to Indian Government officials. By 1970 an Electronics Commission was established, headed by N. Sehagiri, to asses computing needs for India. A National Centre was established at the Tata Institute for Fundamental Research (TIFR), then in Bombay- now renamed as Mumbai. TIFR was headed by Prof. R Narasimhan, a mathematician, who had attracted some of the best Computer Scientists in India to that institution. When an independent consultant was needed for programs supported by the United Nations Development Program they suggested me. Hardware and software to enable complex design was acquired from DEC and graphics companies, and eventually spun off as the National Centre for Software Development and Computing Techniques (NCSDCT). I made several trips to Bombay's TIFR, meeting again experts I had known from Kanpur, directly or indirectly, as Prof. Kesav Nori. Mathai Josef, and C. N. Mahabala. A spinoff, ECIL, was the established at Poona, where a new microcomputers, the Trombay Digital Computer models TDC 12, 312 and 316 were designed and built, approximately matching the DEC PDP computers of that period. Given India's economy, most wound being used in government agencies.

When they proposed a project to the United Nations Development Program to better support the planning of the Indian economy. A National Data Centre in New Delhi, using large CDC computers was being planned. I was asked to join the project, managed by a Berkeley consulting company, Teknekron. Two valuable colleagues were Tom Follette and Tom Buckholtz. We are still in contact with Tom B. Being the independent academic, I was the formal technical representative for UNDP.

In total I made six work trips to India between 1970-1982. Some were long, some quite short, but always limited by my teaching obligations at Stanford. I mainly used PanAm 2, Pan-American airlines' westbound around-the-world route. That meant if I was out of the US say 9 days, I would only have experience 8 diurnal cycles, and have no jet lag. I often stopped on the way to India in Japan, to meet with academic colleagues there. Flying back I was able to see my father in Europe. On the last short trip I was able to take our son, John with me, using PanAm's two-for-one program. We arrived at the wild Holi holiday, a scary experience for him. The next day, a staff member took John to the see the Taj Mahal, while I completed some formalities. We left the next day. A few years later India started exporting software and software services.

These interactions were also a great learning experience. Understanding the problems encountered in large-scale, multi-party settings and devising feasible compromises is not easily obtained in limited and academic settings.

Effects of IIT Kanpur

I only spent a year in India. Not being a US citizen, staying longer out of the US could compromise my residency status, but, equally important, the field was moving rapidly. Being able to place multiple transistors on a chip, first tens, now millions, reduced assembly costs and size, and increased the capabilities of computers drastically.

The Computer Science building in Kanpur 2010

The work started at IIT spread rapidly. In 1972 IIT Kanpur started offering MS and PhD studies, followed in 1978 by the first undergraduate Computer Science program in India. It has been well documented [E.C. Subbarao: *An Eye for Excellence*; Harper-

Collins, 2008]. The generation from my days is now retiring, but all over India computing enterprises contribute much to India's economy.

Some students went on to study in the US and several became faculty in the US, as for example Rajeev Motwani (a 1983 IITK graduate) at Stanford. Rajeev helped develop the original page-rank algorithm that extracts relevance parameters from prior Internet usage. It became the basis for Google. Rajiv died in an accident at home in 2009 and now has a building at IIT Kanpur named after him.

Silicon Valley now has an active association of ITT graduates, with meetings attended by over 1000 professionals. In 2021 a student magazine, The Spark, was reborn, focusing on IIT Kanpur's history.

When I returned from India in 1965 I did not return to the University of California, but accepted an offer to join Stanford University. That move started a new and prime chapter in my professional history. At the same time I started a new personal life with Voy that is still ongoing. She should write her own history, but I will describe some events that intertwine with this biography now.

Voy and I visited India a number of times, initially as part of my consulting for UNDP Later, in 2010, we also went to ITT Kanpur as part of its 50th anniversary. In 2017 we went to Mumbai, Delhi, and Koichi, and met friends from Kanpur days, including Purveen Khory.

Voy

An essential part of my life was and remains my life with Voy. In terms of significance it would require an entire book to describe our interactions and life, so here I'll just summarize some events.

I had met Voy during a job interview at UC Berkeley. She was working as a programmer at Esso in New Jersey and was considering moving to California. She actually already had a job offer at UC Berkeley in Biostatistics. She moved to Berkeley a few months later. We encountered each other in the Campbell Hall basement when she took coding sheets to the keypunch room run by Penny Gee, took the cards with her programs for running on the computer there, or looked for help from the Computer Center programmers during their office hours. I learned that she had actually been using the same computer at Esso that I was using at night under the time-purchase arrangement made by IBM.

We were always very comfortable with each other. She had told me early on, out of the blue, that she would not marry a Caucasian. However, when she decided to move to Los Angeles to be closer to a potential Chinese spouse she was willing to have dinner with me and obtain names for people around UCLA where she might apply for a job. We spent more time than expected together, talking and watching the bay from my car. She received several jobs offers at UCLA and then she also accepted my suggestion to drive her, in her rather marginal large car, to Los Angeles. As chief programmer <ref> I could easily justify going to Los Angeles without making it a romantic event {ref WDPC]. The trip was very enjoyable and we lingered so much that her boyfriend gave up waiting for her. I arrived late at WDPC but that did not matter.

Voy did come up for my departure party in Berkeley. She insisted on me picking her up at the Oakland airport, which was not that easy because my daily driver car had been destroyed [ref] and my fancy car was not yet reassembled, so I had to resort to my MG, which had only one regular seat at the time. At the party she was annoyed that I did not devote myself to her. But, after all, we not supposed to have any mutual romantic interests, and we both had other friends around. Still, something triggered and she was the only person I wrote to regularly during my stint in India[ref].

When I returned and started at Stanford I contacted her. Again, I had occasions to go to Los Angeles to learn from the many related computing developments there – not there was no Silicon Valley activity around Stanford then. Soon we would meet just for personal reasons, sometimes justified by delivering thesis drafts to a professor at UCSF from his UCLA student. No Faxing and Internet then. Then Voy came up to inspect the house I had bought with my savings from the stay in India and to help me get organized there.

Eventually I asked her to live with me. For her that meant getting married. We got married on 30 July 1966 in the Westwood Methodist Church near UCLA, and moved into the house I had bought that spring off Skyline Boulevard, in the King's Mountain [map) area between Woodside and the Pacific Ocean.

We established a rather conventional life, with me working and Voy taking care of the household, but Voy had too much energy to be satisfied with that lifestyle. While being extremely supportive she is not at all subservient. Her speaking up when something does not suit her has helped my behavior and our marriage for now over 50 years.

Voy soon started helping with the testing of the ACME system I was developing. She wrote the user manual for the system – making its use more understandable than the nerdy documents that are commonly provided for guidance. As soon as the system was available Voy starting teaching the medical staff at Stanford, and as such contributed much to Stanford, and through her students to the spread of computing in medicine.

Voy continued to work part time when we had children. When they were young we were able to get some local babysitting help when she was teaching, and later Tante Annetje was able to help as well. We had found a job for her second husband, Tex, at a local estate, the Flood mansion. That ended when they decided to move to Gooding, Idaho, where houses were cheap. Later, Voy's schedule allowed her to see the children off to school and be back home when they returned.

I had observed that children would demand and often get all possible attention from their mothers. We made it a habit that we'd take off at least once a year without the children, sometimes on our own, sometimes in combination with a meeting I was scheduled for. Often my mother was available to cover for us. While marriage in many ways is an institution to protect and raise children, the marriage itself also requires attention.

Our marriage has been unusually close. Except for a consulting stint in India we have never been apart for more than a week. I estimate that we enjoyed more than 90% of our meals together. Creating and experiencing life's events together creates bonds and communication that are essential. I believe we established a great balance.

6. Life and work at Stanford (1965)

Going to India was a significant break in my career. I moved to Stanford University afterwards. While I am still associated with Stanford after more than 50 years, the flexible academic setting has allowed me to move among interests within Stanford.

While in India I had requests to join several projects in the US upon my return. At the same time, bureaucrats at UC Berkeley were concerned that I had overstayed some time-limit applicable to California State Employment for non-US citizens. That likely could have been resolved, since I was a legal immigrant, but the alternatives were more exciting, so I moved 50 miles south.

Ed Feigenbaum, who knew me from Berkeley, had joined the new Computer Science department at Stanford. He had also become the director of its Computation Center. I had received a telegram from him while in India -– manually transcribed at the Kanpur telegraph office onto about 4 pages – asking me to consider joining him at Stanford. I replied with a brief note saying that I'd be there on December 3rd 1966. There was no followup, but I came. Ed was surprised to actually see me. After some discussion it appeared that the ACME project would be the most relevant for me and I became its director. I also joined the Computer Science department as an instructor.

ACME

In the fall of 1966 Professor Joshua Lederberg of the Stanford Medical School obtained an IBM System/360 model 50 in an unusual configuration for development of a dedicated support system for medical laboratories. Ed Feigenbaum, a whiz with words, had given the project is name: Advanced Computer for MEdical Research, ACME. Its development and operation were funded by NIH and NLM <specify more precisely> to provide medical researchers with access to computing. An important sub-goal was to provide computer control of scientific instruments, complementing Prof. Lederberg's and Elliott Levinthal's research in planetary, more specifically lunar, data collection. The ACME project provided both computing services to terminal users and, for some, real-time data acquisition and control capabilities for their research laboratories.

Lederberg. I learned more working for Professor Joshua Lederberg than in any other situation my life. Lederberg had won a Nobel prize early in his career, 1953, and was able to broaden the scope of his work beyond reproduction oof bacteria to early genomic insights, planetary missions, and the protections mankind needed to shield as from extraterrestrial and earthbound invaders. I was able to join his weekly scientific staff meetings going over a wide variety of issues, from principles to management. Unsubstantiated opinions were not tolerated. Lederberg also helped establish the Federal effort to surveil possible Pandemics by establishing the Office of Human Services Emergency Preparedness and Response, reporting to an Assistant Secretary for External Affairs, which was reduced in scope, reporting level, and authority in August 2020, shortly before the threat of COVID become clear. Some funds went to help build a physical border wall. I recommend strongly that anyone worrying about mankind read the very straightforward 2-page publication of a PBS Frontline lecture he presented in 1989. The most salient quotes for me are.

> *Abundant sources of genetic variation exist for viruses to learn new tricks, not necessarily confined to what happens routinely or even frequently. The survival of the human species is not a preordained evolutionary program. I would also question whether human society could survive on beach with only a few percent of survivors.*

Back to work. We were not the only project investigating applications of computers to problems faced in medicine. Efforts at CalTech focused on instrumentation, at the University of Utah on hospital systems, at UCLA on building a statistical library, and many more. I visited and learned from them.

A huge computer.

The computer itself was an IBM System/360-50 system with 256K (262,144) bytes of memory. For laboratory support the system had an attached IBM 1800 computer for data acquisition and distribution, an IBM 2701 for interfaces for various laboratory computers, and a home-built network for terminals in the laboratories. An unusual component was the IBM 2361, a one-mega (1,048,576) byte ancillary slow core memory. It weighed about one ton. That unit was delivered from the IBM factory in Poughkeepsie on special truck using a soft suspension. The driver would call me every evening to report how far he had gotten. We later upgraded the memory to two megabytes. Obtaining that much memory was considered radical, costing about $500,000; such units had previously been used primarily for NASA's space programs. It used 2-wire technology – omitting the sense-wire, limiting its access speed to 8μ-seconds per 32-bit word of 4x8 bytes. For storage we also had an IBM 2321 Data cell drive, which used strips of magnetic tape, extracted from cartridges and wound around a small drum for access.

IBM advertised the megabyte memory as having

> almost 20 million ferrite cores -- tiny doughnut-shaped objects, each about the size of a pinhead -- were strung in two-wire networks and packaged, with associated circuitry, into a cabinet only five by 2 ½ feet and less than six feet tall.

Having that much memory provided the buffer space for real-time data acquisition, and also allowed us to have up to 24 simultaneous users, time-sharing the computational resources. The ACME web pages at Stanford provide details, with clips extracted from an old film movie showing participants.

I was able to use the contacts I had made at UC Berkeley to assemble a great team, complementing it with researchers already associated with Stanford. Central were Gary Breitbard (compilers), Jerry - now Joaquin - Miller (file system), Bill Sanders (OS interfaces), David Cummins (scheduler), Lee Hundley (from Washington Univ. in St. Louis - real-time data services), and Mabel Moore with Jane Wilson (statistical library). Voy wrote the manual for the system in a clear and simple style. In 1968 Steve Weyl joined to help develop a column-based file system. Today such a system is called a vertical database. David Feinberg helped around 1970 with some of the clinical interfaces. Throughout the research in Levinthal's lab provided good contacts, such as Larry Tesler, Richard Moore, etc.; researchers that later went on to play important roles in Silicon Valley.

Creating a system both friendly and sufficiently powerful to be useful to medical researchers was the challenge. Rather than inventing a new language, we chose PL/1, a language recently defined by IBM and external experts, intended to combine numerical and commercial processing. We implemented a subset, omitting some features that, while cute from a Computer Science standpoint, were likely to lead to problems. One specific issue was that the PL/1 specification allowed automatic type conversion within a statement. I consider that converting data from, say text to numerics should be an explicit decision, since textual data will be lost, and if converted to integers, fractional parts will be lost as well. This creates one of those situations where smart computers could frustrate users. The PL/ACME implementation required explicit functions for conversion. Novel was that ACME could acquire data from research instruments, which were then just being equipped with analog outputs for plotters or CRT screens. To the language we added a `On OVERRUN' statement to allow programmers deal with situations where real-time data arrived faster than the 360-50 and its associated equipment could handle it, even though the system gave such tasks priority.

Earlier experiences, as when visiting project MAC at MIT, had shown me how frustrating it was when users were typing into a computer that was not listening. We added lights to the typewriter terminal to inform the users of the system state. ACME sent a signal every couple of seconds, without it the ACME-Is-On light would go off. Typed text would only be processed when entering the carriage return. Up to then the Waiting-For-You light would be on. The You-Are-On light blinked during one's computation, important when sharing a computer. A Special-Run-On light would be on during real-time priority data acquisition.

Safe programming

My experience had shown that miscomputing subscripts, or indices to arrays was one of the major causes of errors in programming, and often hard to locate. In ACME we retained the size of the array in the generated code, and checked the index value used to access an array element against the array size, reporting an error when it was out of bounds. While that slowed the computation, it made the system much more pleasant to use. The fetching of the array size data would occur only once for that reference instance, so that the test would not incur excessive overhead when subsequently needed.

Programming languages currently used avoid such checking, trading speed for safety. A prime example is the C-language and its many derivatives. Index values in C can be awkward to compute. It is the major implementation language for the infrastructure code of current systems. Misuse of an index value allows accessing, destroying, or altering cells anywhere in the active memory of a system. It has become the major tools for destructive hackers [reference]. Once access to the program code is gained alternate instructions can be placed in memory, to be exploited then or later, when legitimate users invokes the program and data they have the right to access

Databases

Once data acquisition and medical records applications being served by ACME were coming along, it became clear that a basic file system would be inadequate. The principal difference between a file system and a database is having an interpretable schema, so that access to the data is mediated by information about the data, allowing data records to be added, changed, and reorganized without each program that uses the data having to be altered. I consider the inventor of that concept to be Bill McGee, working at IBM [McGee:59]. He did not use the word schema yet.

While we were working at ACME, papers by Ted Codd were appearing, describing relational database approaches defining operations over files having schemas [Codd:59]. We started implementing the concept, but physically quite differently from other efforts that tended to equate file records with tuples. For statistical searches, with functions such as *SUM* or *AVERAGE* over a variable, all tuples, but only a subset of the many variables that make up a person's medical record, would be accessed. The ACME database stored, as a single, compressed record, a single variable from all tuples. That also allowed for effective compression, since many of a patient's specific data only change infrequently (as for example weight or height) and some not at all (such as date-of-birth). Classes for physicians and medical researchers on its use were given by Voy Wiederhold. Some pictures from ACME are being displayed in the Stanford Computer Science Historical Displays. An IBM advertising movie for Real-Time

Computing (takes many minutes to load), featuring ACME is accessible there as well. Formal records have been deposited with NLM by Prof. Joshua Lederberg.

The principal investigator associated with ACME was Joshua Lederberg, Nobel Laureate for his early work in genetics. I learned most of what I understand now about the scientific process from the weekly group meetings and some occasional private interactions. I am sure that Lederbergs's recommendation for entering a PhD program at UCSF were given much weight. I also interacted with William Shockley, the inventor of the transistor, also a Nobel laureate, then a professor of Electrical Engineering and an avid sailor. But the public statements he made relating to genetics, and public confusion it engendered meant I had to refuse invitations to go sailing with Shockley.

In 1977 I started teaching the first regular database courses at Stanford.

Charging for computer use

When I had to purchase computer access around 1960, usage was charged by the time used, typically $1200 per hour. The entire computer would be turned over: tapes would be mounted, cards loaded, and work could begin. When systems allowed multiple people to share time on the computer, time charging was automated, so that all the many slices allocated could be aggregated and charged.

At ACME we wanted to minimize that accounting overhead. Since memory was actually our most valuable resource, and allocated less frequently than processing time, we charged by time, although most of the bills were symbolic, and only a few users outside of the medical school, mainly in the Aero-and-Astro department, actually paid anything.

Today, when computing cycles are well nigh free, we find that charging for computing is commonly just by cloud storage costs and Internet access. Many companies have a business model that encourages users to consume as much storage as they wish with photos and video--storage that then can be charged for.

After several years the developmental work on the ACME system had been completed. Research funding was now redirected to new projects of interest, and the use of the system was to become part of regular Stanford Computing Services. I continued as an internal consultant, actually focusing on a new smaller computer system that Stanford Hospital had obtained for accounting and billing purposes. While it provided insights into the complexities and difficulties of billing fairly for medical services, it soon became less interesting. At ACME, supporting quality research services also became difficult without specific funding, acceptable billing systems and the like. I found some outside opportunities.

Teaching

My initial position at Stanford, while primarily focused on the development of medical computing, also involved being a lecturer. That involved maintaining contact with the small number of faculty then in Computer Science, participating in exams and thesis reviews, and at times bringing my experience into other classes.

Non-numerical methods Alan Kay was at the time a principal scientist at Xerox Parc. He and I found that the Stanford CS curriculum, just like early use of computers, focused on numerical computation. A fairly intense course, CS125? Numerical Methods, was required for all students. In 1969 we decided to start a counter course, CS135 Non-Numerical Methods, covering the handling of text language translation, parsing language in documents, and applications such as text indexing and search. As vehicles we used Snobol and other languages. While we had fun bringing new concepts and techniques to the classroom, the course never gained focus and we gave up after a couple of years and moved on to our specific interests.

A lesson I took away is never to use ***Non-***something to describe something. The world is infinite, and by just excluding some segment, say, numerical methods or SQL, that still leaves an infinite world of choices and opportunities. Always say what you want to do. That was already stated in a political context by Sir William Gladstone: *To be engaged in opposing wrong affords but a slender guarantee of being* right.

I participated in a number of other courses but teaching only became a prime task when I joined Stanford as a faculty member.

Work in industry

When the ACME project came to an end I had the freedom to engage in commercial activities. Having initiated a project that involved novel tasks, including real-time data acquisition and file and database technology, provided many opportunities. Some of it was consulting, but I joined two enterprises as well.

Index (1969-1970)

Ray Edwards, a former manager at IBM involved in their data acquisition initiatives, asked me to join a startup in commercializing the technology that then existed. It was funded by a New York company, Reeves Telecom, an organization providing services to New York television studios and modeling agencies.

Before starting the California division, we spend a few weeks in Tuxedo Park, a walled community North of New York, where Ray and owners of the company lived. The town is also known for Alfred Lee Loomis, a Wall-street tycoon and scientist, where he hosted many international scientists. Out of the work came effective radars leading to the MIT Rad Lab, Loran for over-ocean navigation. The antennas used then were still visible. I don't know if Reeves, outside of the local club, had any business relations with Loomis.

We returned to California, rented office space in Belmont, and hired staff, including several earlier associates. Index designed some database search services for models and actors to be accessible over phone lines. The technological capabilities at the time were modest and frustrating. Modem speeds were at most 300 bits per second. We acquired a novel portable modem, which allowed the phone to be inserted after dialing, is now on display at Stanford [Livermore modem picture]. Long-distance phone calls of any length were prohibitively expensive: about $2.00/minute (equivalent to $13/minute today). At night the rate became $0.70, still too much, so we synched our New York and Los Angeles databases by flying a tape across the country every week. We had fun trying out novel stuff and approaches, but could not make remote information access into a viable business. With an Internet we could have focused on the customer's needs.

Mascor (1970)

The principal architect at Mascor was Cesare Galtieri, who had been with IBM's new computing project, at times referred to as machine X, or later machine Y [John Sauter], conveniently located on Sand Hill Road, where the Stanford Linear Accelerator Center (SLAC) was planning to install the largest computers that IBM offered. Similar research laboratories, such as Livermore, were using the large CDC computers. IBM decided to discontinue the project – I assume IBM's marketing staff felt more comfortable pushing the well-accepted IBM 360 and derivative technology, still the mainstay of IBM's mainframe business.

Another impetus for Mascor came from Tymshare corporation. Tymshare had started around 1965 offering remote computing services using dial-up lines to a pair of SDS 940 computers. By 1970 they had moved to DEC PDP-10 computers and Interdata mini-computers for access switching. Dave Schmidt, Tymshare's president, saw a need for much bigger computers that also avoided the difficult coding that sharing computers among competing users entailed.

Mascor was primarily funded by EMC, not Dell EMC, planning to exploit the promise of rapidly increasing memory and disk storage. Hardware technologies were inspired by IBM's efforts. A feature of the design was a well-nigh unlimited persistent address space. Real memory chunks actually being used were mapped into that space, but conceptually memory had never to be reused. Address translation is of course needed, just as on today's virtual memory systems. But translating from <72? bits> is not that much harder than from a, say 24-bit address. Not reusing addresses for distinct programs and purposes provides an extraordinary level of security and privacy.

At the end of the year though there was a general economic downturn and EMC management and Mascor decided just to close its doors, since there were plenty of opportunities for competent computer folk. All cash on hand was spent on a great New Year's Eve Party and we all went our way. Most of the hardware folk joined Amdahl, a company funded by Fujitsu in order to produce computers within the IBM architecture that were cheaper and faster. Tymshare went on to develop their own operating system, TYMCOM, with database capabilities derived from UC Berkeley's INGRES. Cesare returned to IBM, and I was free. I was able to do some consulting and help the Stanford Hospital with their computer system, as well as presenting, as a lecturer, some CS courses.

Having free time after having worked intensely for many years provided an opportunity that was unlikely to recur once I started working again. We took a vacation from March to June of 1971, starting in Luxembourg with some consulting there, picked up a car in Paris and drove through France, Italy, Germany and Holland: giving a few talks, visiting some professional colleagues, seeing family, and doing sightseeing. Europe on $10/day was our guide book. Our son John was able to sleep in the back of the Simca we had leased-purchased.

In December a second son arrived. We liked the name Randy, but in case he wanted to become more formal, he was registered as Bertrand Yat, combining a mathematical guru and Voy's middle name.

Getting a PhD (1973-1976)

Jim Warren, a Stanford Master's student who had been in one of my lecture classes, and had become interested in the emerging personal computers, advised me that the University of California had just started a PhD program in Medical Information Science. He suggested that it would be ideal for me. I applied, enrolling for the Spring semester, 1973. Jim went on to start the West Coast Computer Faire in 1977.

Voy and I switched to student couple mode. We were able to live cheaply, being well-settled by that time. Voy's cooking was tasty and healthy. Voy also took care of our son, Johnny, so I could focus on my new task. A new freeway, I-280, had just been completed from San Francisco to Highway CA 92, the road that provides access from the North to our house in Woodside. The construction of the southern continuation was delayed due to a routing dispute with the San Francisco Water District, concerned about runoff into Crystal Springs Reservoir. In the end I-280 was routed through the hills further east, but at that time I often had a 2x4-lane highway to myself.

Prof. John Amsden Starkweather, of the Psychology department became my principal adviser, with Profs. Marsden S. Blois and Ronald R. Henley. Later Drs. John V. Dervin and Jonathan E. Rodnick joined the committee; their clinic, in Santa Rosa, provided the experimental setting. Ed Feigenbaum was the external advisor. Through Professor Starkweather I joined a lengthy academic tree, all the way back to

Gallileo. Professor Blois, the chairman and founder of the Medical Informatics department at UCSF was specialist in melanoma, and also one for the founders of the American College of Medical Informatics. Prof. Henley was also an active consultant in hospital computing

I needed little technical direction. I had decided to focus on databases for long-term, ambulatory care, an application where retention and sharing data among the many and rotating care-givers would be especially important. Many technical papers were appearing in the physical design of databases and organizational concepts. The relational model had just been published. I had considered earlier writing a book that would put it all together. Being in a PhD program provide an ideal setting.

My work in the developing and applying the ACME system provided a broad basis. It had also led to having had contacts with many innovators in medical computing. Before anything can be studied and taught it has to exist. Inspecting and analyzing existing system is crucial. A major appendix to my PhD thesis was a survey of 16 systems that addressed ambulatory care, funded by the National Library of Medicine (NLM).

A side trip to Grenoble inn 1971 during the trip we took before starting on my PhD provided additional input to my understanding of database concepts. I met at the University there a pioneer in that new discipline, Jean-Raymond Abrial, who had developed the SOCRATE system. Those notions were reinforced by attending the first IFIP database meeting in March 1974 in Corsica. I believe that Jean-Raymond's career was sidelined because databases were then not being considered a proper Computer Science topic. Luckily there was more flexibility in the U.S.

My thesis itself was only 137 pages, but it had three appendices, two of over 1000 pages each. The precursor study and the final experimental work involved multiple people, and although I managed the projects, I could not claim them as my sole work. The analytical section, central to the work, was written in textbook style, to allow subsequent publication, and hence did not follow thesis rules. The validation involved the creation of a system, The Family System, created via contract to Lovelace Computing of Coulterville, California in 1975 at the Family Practice Center of Community Hospital in Santa Rosa. Prof. Henley was the sponsor and Joaquin Miller (at that time Gerald F. Miller) was the manager and report author. The economic analysis was performed by Ingeborg Kuhn.

Having a textbook on a novel topic right then helped me in getting an academic position right after I graduated, in August of 1976. When I published my book in 1977, *Database* was not yet an accepted concept. I had a long fight with the McGraw-Hill editors, who wanted me to use `data base' as two words, which would also mean that the book title would have to be hyphenated: "Data-Base Design".

I won. The book sold well since it also covered also the practicalities of the file engineering support that the emerging databases required. Now those issues are only relevant to programmers deep in the system innards, since file- and disk-access is hidden from database users. Fast and reliable access is now a matter of competitive performance of large companies. The income from the book allowed us to buy a house in Palo Alto so that our kids could go to high school there.

Chris Date, who published his book on relational databases at the same time, did not fight about the name. His Prentice-Hall book came out initially as "Data Base Systems", but the title was changed in a subsequent printing. At the time of writing, Chris lived near us, in a community of less than 300 people. If database authors would be uniformly distributed one would expect 2 million database books to appear in the US at that time.

Stanford Computer Science

After obtaining my PhD at UC San Francisco I did not want to continue as a researcher, depending on funding and direction from senior faculty or a company. Having both experience and a PhD I applied to and received tentative offers from several universities, even though, at 40, I was older than typical applicants and my degree was in a new area. In the end I joined the Stanford CS faculty.

I applied to Stanford late. I had not responded to Stanford's advertisement for a systems faculty position that had been published in the ACM Communications. That advertisement seemed to favor a renowned professor I was familiar with, then at USC. I checked with a faculty friend at Stanford, wording my inquiry very delicately. He laughed, and I decided not to apply. In the end the candidate from USC was not offered a position at Stanford. Stanford then needed teaching faculty badly. In addition to regular turnover, Vint Cerf had just decided to quit to take a very responsible position to drive Internet growth at (MCI). Harold Stone, who had been teaching introductory CS and EE courses as well also had left. Ed Feigenbaum, who had discussed a research position with me at his Knowledge Systems laboratory at Stanford, let me know, and I applied then. By then many Stanford faculty had written letters to support my applications at the other schools that were interested in me; they could now reuse their recommendation letters. It all moved fast then and I was able to negotiate a regular tenure-line assistant professor position, although I was just the second graduate from a new PhD program.

At that time the topic ”Database” was not yet a recognized academic field. I was hired as a professor of distributed systems. That had the effect that my first PhD student to graduate, Hector Garcia-Molina, did his thesis in distributed databases. My experience in writing compilers enabled me to get immediate research funding from the US Navy for software to support the Livermore-based S-1 Supercomputer project. For further funding it made sense to combine my database expertise with ongoing research at Stanford. I was the principal advisor or co-advisor for 36 PhD graduates.

Teaching Databases

In 1977, a year after I rejoined Stanford as a faculty member, I was able to start teaching a regular course on covering databases. It had become an acceptable topic in Computer Science. In 1976 the ACM had started a journal, *Database Systems*. Then, and also in my book, the focus was how do build software to effectively handle large amounts of data, a prerequisite to the focus today, which is how to exploit the massive amount of data that has become available on the Internet.

We also started a weekly seminar on the topic. Most speakers and many attendees came from industry, as the topic continued to grow in scope and depth.

Grading

For me, the hardest part of teaching was grading. I require all my students to do original project work, and that means their work has to be read several times a quarter. That approach also means I have to keep up. Keeping up means it is easier to write proposals to obtain funding since I learn about unresolved problems. I was of course lucky to be in an area where growth is rapid and relevance is easy to establish. I switched to emerging topics quite a number of times. That does not make one famous though.

Knowledge-based systems

When I rejoined, Stanford was a hotbed of artificial intelligence (AI). A new AI lab (SAIL), led by Professor John McCarthy and run by Les Earnest, was attracting young researchers from many places. While McCarthy's research focused on formal logic, researchers at SAIL explored a wide variety of directions, including speech understanding (Raj Reddy), data structure concepts as triplets (Jerry Feldman), and a time-shared system (WAITS) to use of the large computers they obtained there. John Sauter was the first System Programmer at the Stanford AI project when it moved to the DC Powers Lab, in the Hills above campus. He told me that - in a casual remark - that John McCarthy was surprised that the researchers were able to do their work under the time-sharing system. John Sauter, who I did not know then, but has helped me a lot with this biography, told me that he was secretly proud of that computer-sharing technology. It was more general, but also more demanding of resources than the one I had developed at ACME.

Professor Ed Feigenbaum and his Knowledge Systems Lab (KSL) was exploring the extrapolations of rule-based approaches demonstrated in Ted Shortliffe's thesis MYCIN, which could give advice on antibiotics selection. There were some subsequent spinoffs, such as Teknowledge and Doug Lenat's Cycorp in Austin. They had a hard time surviving as free-standing businesses. In 1983 Ed and Pamela Tellefsen (then McCorduck), published a book on Japan's fifth generation project, showing how Japan was ready to apply AI and revolutionize the world.

Mobi robot

At SRI, the former Stanford Research Institute, Stanford graduates Earl Sacerdoti, Daniel Sagalowicz and many others were applying AI to industrial problems. Scaling the technologies was not easy. Earl founded a company, Symantec, that went through several transformations and is now a major supplier of security software. There was also research on autonomous robots at SRI, but their environment had to be well structured. Similar research was done by several faculty at Stanford, as the MobiRobot, devised by Tom Binford, showing here as displayed at Stanford, with its many sensors.

That setting made it natural to combine these technologies with databases. With help from Earl and Daniel from SRI we submitted a white paper to ARPA how using AI to exploit the data in database – "let's call them Knowledge Bases" proposing that such an approach would be an exciting venture. The argument was that AI technology as it existed then, when applied to digested and organized information, would have a higher chance of success than when faced with an unstructured real world. I was funded, as were other researchers ready to explore the intersection.

Our KBMS project provided a fertile ground for research and enabled my PhD students to work with many inspiring faculty and researchers in related disciplines and in that way broadened my own insights. Sharing students and their brains does not scale well but is much more effective than organized multi-disciplinary efforts.

Our knowledge-based research just used data in existing databases as the ground truth. The World-wide Web was not available in 1977, so the scale of those resources was modest, and origins and biases could be identified. By the 1990ties substantial data sets were becoming available, motivating others.

Top: A bearded Hector Garcia-Molina, Sheldon Finkelstein, Jim Davidson, Arthur Keller, Norm Haas; standing: Hank Korth, Jerrold Kaplan, Jonathan King; ??, Gio Wiederhold, Tom Rogers; kneeling: David Shaw, Ramez ElMasri, Barbara Grosz.

An interdisciplinary PhD student of mine, Robert Blum, M.D., used textbook knowledge in rheumatology as a basis and a high-quality time-oriented database, developed by Dr.Jim Fries, initially within the ACME project, ARAMIS, that focused on patients in his Stanford's Lupus clinic. For Bob's RX Project, iterative improvement of statistical factors was achieved. The critical concept was time precedence. We all know that correlation points to, but cannot guarantee causality; having timestamp of events can overcome that problem. If, in each individual, a correlating event *A* consistently occurs before event *B*, then *B* certainly does not cause *A*. Bob was able to iteratively close the loop in his model and find a cause-and-effect result that was not commonly known. Later he could find a paper that had indicated such a relationship, but was not included in the initial textbook data base.

A problem with generalizing Bob Blum's work that at the time (1980) quality temporal clinical databases at the level of detail needed were rare. Now much information is available on the Internet, although concerns about privacy and a focus on reimbursement rather than clinical detail still stifle progress in that area.

Being the only faculty member in the database area made it hard to grow the area. It is easier for three AI professors to argue that they need a fourth AI expert than for one database nerd to convince the department chair that more resources are needed in that discipline. To overcome that deficit I would get outside professors, such as Stefano Ceri from Italy and Witold Litwin from France, to cover related topics. So, until 1991, when I left for a stint at ARPA, and Jeff Ullman moved from formal languages to Data- and Knowledge-bases, and my former student Hector Garcia-Molina came back from Princeton, I remained the lone flag bearer for data- and knowledge bases at Stanford.

My work at Stanford paralleled the emergence of the Internet. By 1977 I had access to the ARPAnet and By 1980 I had access to the ARPAnet for remote computer access and file transfer. Soon after had a node I named Earth, thinking it was cute that I could be addressed simply as Gio@earth. In 1983 the multi-level naming was introduced and I became gio@earth.stanford.edu. The number of sites that could be accessed in August 1981 was 213; ten years later, by July 1991 it had grown to 531,000 hosts.

Growth of Artificial Intelligence

I retired from full-time academia in 2001. By then AI activities at Stanford were exploding, although many of the innovators later left for industry. Daphne Koller, an innovator in probabilistic learning, moved on to found Coursera, a business to exploit the Internet to serve educational institutions, and later became active in startups exploiting AI. Andrew Ng went there as well and went on to become the founder of Google Brain. Sebastian Thrun, having won an ARPA challenge with a self-driving vehicle founded Udacity, another business serving education. Chris Ré was a prime initiator of Big Data analysis developing the DeepDive engine, subsequently founded SambaNova and Lattice.io, now part of Apple. Jure Lescovec, having greatly improved the performance of the technologies enabling processing those massive data founded Kumo.AI to apply them in practice. After providing the infrastructure for analysis of images, Fei-Fei Li became the lead scientist for ImageNet, but returned and is now the director of Stanford's Human AI (HAI) center.

As I expected, work in Artificial Intelligence moved from dealing with abstractions to dealing with recorded data. in my world view the abstractions or concepts employed are in the end always defined by the real-world items they cover. Having items described in databases provides an effective linkage between abstractions that are essential for reasoning about the world and the tangible world. There are now many thousands of such databases, allowing researchers to find facts supporting their abstract concepts. In databases sets of those facts will be labelled, so they can be found, using schemas or metadata. I have some notions about the collaboration of AI technologies within complex systems. The dependency of AI on databases also has some risks.

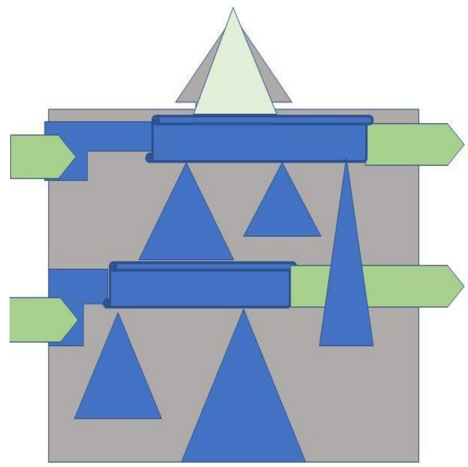
Big Data and Artificial Intelligence

The immense amount of data that can now be found on the Internet has provided impetus for many analyses using broad and deep computation. An underlying assumption is that the data is a fair representation of the real world. That is often not true. I will cite two sample areas where the data that are available for public mining are likely unbalanced. In those areas, conclusions drawn from even very large data collections will be biased and imbalanced. Policies based on such conclusion will mis-allocate efforts and resources.

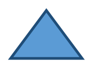
1. Clinical information. Data on potentially embarrassing cases is often under-reported or suppressed. Specifically, psychiatric findings and cases related to sexual behavior such as HIV, unwanted pregnancies and abortions are poorly reported. Broad-based analyses for allocation of health-care resources will under-emphasize such topics. Not all incidence data include the ages of the affected patients, and even fewer include such information in their analysis. For instance, while deaths from Alzheimer's may equal opioid overdose deaths, the effects on society of the latter are much greater. Problems due to gender and race imbalances are being recognized now. Careful studies take that factor into account and attempt to correct to baseline information. However, when arguments for resource allocation are being made, simplistic reasoning is common. Often, decision makers will use simplistic reasoning to conceal their real reason for making a decision because they don't want their biases challenged. The situation becomes worse for situations where no baseline are available, as the case for many studies.

2. Business economics. There is a strong tradition of public reporting by corporations of financial investments, ownership, and exploitation of tangible resources, such as machinery, transport capabilities, factory buildings and the like. However, intangible resources, such as patents held, design methods and documents, software developed and exploited, and business methods, and the know-how of the creative staff that can exploit them, is barely reported and never quantified. Analysis of business activities then focuses on traditional means of profit and growth. That was still appropriate for most of the 20th century. Today, much more profit and growth is generated by industries relying on intellectual capital. Using data from publicly available reports, collected in think tanks, and analyzed by highly capable, but traditional, economists is bound to lead to imbalanced advice. An example is the focus on the US Federal interest rate, which is important to investments in traditional local industries but nearly irrelevant to enterprises that share intellectual property globally and ship their products invisibly over the Internet.

Systems using artificial intelligence



Most research and analysis of AI capabilities focuses on the specific AI technologies, that I classify as

Logic  , Rules , Learning from data 

To apply these technologies they are inserted into systems. Many of these systems use multiple AI technologies. Those technologies may also use differing principles. I am concerned that these systems are built less carefully than their components and may not recognize the limitations of those components. I presented in 2022 a paper recommending research into that issue.

Medical Informatics

When I started at Stanford I wanted to continue in that direction as well, but there was no academic department. However, at Stanford an interdisciplinary PhD (IDP) program can be established if a student can convince several faculty members that a topic covering multiple disciplines is worthwhile. I was the principal advisor on 3 theses that combined medical science with computing. In 1982 another IDP graduate, Ted Shortliffe, founded a Medical Information Sciences training program at Stanford. I joined it in 1984 as a fractional Professor of Research within General Internal Medicine. I was then able to widen my research formally and advised several PhD students in its context.

A Medical Informatics textbook was written as well. I regret that later editions omit the topic of Hospital Information systems. While perhaps academically not that fascinating, hospitals perform a major segment of medical care and the use of computers in hospitals is now widespread, but often less effective than it could be.

The medical system in the US

Unfortunately, the delivery system for medical care in the US is broken. Clinically there is an emphasis on diagnosis, not on follow-on care. The commercial aspects are in worse shape, hospitals and clinics are competing for paying patients, while being burdened with patients that are unable to pay because of lack of insurance. Pharmaceutical companies profit from selling medication that must be taken daily, while the production of curative and preventive medications, as vaccines, requires government support.

I withdrew largely from the field. I had participated in a number of studies sponsored by US government agencies to improve health care by employing computers. My frustration arises from the complex and ineffective structure of health care delivery in the United States. Using computers to make a bad system more efficient creates new problems. For instance, while medical systems could reduce duplicate tests, a physician cannot afford to rely on data provided outside of one's organization. If something goes wrong the responsibility is born fully by the provider. Protection is provided by redoing tests and reentry of data. Furthermore, the companies that provide the software do not accept any responsibility for their products. Of course, the liabilities for injury and death due to failures are high, and many lawyers are eager to pounce on cases to make victims whole.

Computers for Teaching at Stanford

When in 1976 I joined Stanford as a faculty member, I became dependent on the computers that Stanford was using for teaching. Stories about early computers at Stanford have been recorded by John Sauter. Many were obtained as favorable deals by manufacturers that wanted to be in contact with Stanford. After having been in control of computing the setting was frustrating.

Microcomputers

I was assigned to teach annually for one quarter CS 182: Introduction to Computer Architecture. It was a standard course, obligatory for all students. The title sounded great, computer architecture had been a topic of work and interest to me for a long time, but the course curriculum and its teaching tools were fixed. I also had little experience in dealing with large classes and the mix of student interests. Assembly language was used to write a set of programs for the HP 21MX computer [information retrieved by Davia J. Lu]. I did not think highly of its architecture, but never had a chance to discuss and compare it to the many other designs that were coming on the market. Nearly all of the students' efforts were devoted to debugging the assembly language programs and fighting computer quirks. Today, assembles of chips containing microcomputers have taken over all computing, as well as control of all the many electronic devices we use. I did not follow that trend. When my book came out, I could move to databases and teach what I then considered significant, but required very different computer support then.

Databases

The medical database that we had developed at ACME was no longer available. There was also no commercial database software available at Stanford. An earlier hierarchical database system, SPIRES, originally developed for physics preprints as a thesis by an early advisee, Tom Martin, was available and was being used for Stanford administrative work. Since storage was a valuable commodity, the Stanford University Computer Center charged substantially for storage. Working with colleagues Daniel Sagalowicz and Earl Sacerdoti gave us access to the computers at SRI. It was there that we kept data for experimental research. But the focus was not on exploiting databases, rather than om improving database systems. Databases had entered the commercial work, and industry had many more resources to develop and market them. Many of my students joined that industry.

Xerox Alto and Smalltalk

At the Xerox labs, within the Stanford Industrial Park, a modern breed of personal computers evolved, exemplified by the Xerox Alto. Some of my students had positions at Xerox and used Xerox' systems for their thesis research. One of our PhD students, Alan Borning (later at the University of Washington), used the elegant object-oriented language Smalltalk-76 for his 1978 thesis, and it impressed me so much that I stated working with other faculty to get Xerox to donate some of those machines so that our CS students would be able to use them. It took some time, but Xerox in the end provided, I think, a dozen Altos each, to MIT, CMU, and Stanford. But, at the last minute, a Xerox lawyer decided we could not have the Smalltalk software - it being valuable Xerox IP. Without the ability to program them effectively the machines we got were mainly used for beautiful text editing. I turned my back on them.

The text editing technology first seen on the Alto did initiate a change in academia, and later the world. While at the time documents had already been produced on computers. An impressive early example was David Gries' book on Compilers. Some systems, such as IBM's SGML, supported markups with formatting directives and the results would be sent to typesetting machines. It provided an important capability to create their manuals. (SGML became the base for HTML, now widely used for the Internet.) The text preparation software, Bravo, that came with the Xerox machines, allowed our students to create documents in-house of a quality that met the standards that Stanford imposed for a thesis. At least one large bit-map high-resolution printer, a Dover, based on xerographic technology, was also provided. Students now typed their own theses, where previously they had to hire secretaries – or convince friends and spouses - to type and update their thesis drafts. By now that transformation of duties has happened throughout the working world. We see many fewer secretaries now, and the ones that remain do administrative work. I would have benefited greatly from learning how to type properly; I am still a two-finger typist. At Delft the expectation certainly was that engineers would have secretarial help.

The early Xerox personal computers became the model for the Apple Macintosh and many modern systems, but the wonderful object-oriented Smalltalk software and language stayed hidden. I believe that if Xerox had released that software then, it would have inspired students at these schools, and spread the word about object-oriented programming. Its derivatives would have become the basis for much future work in systems development. Instead, starting 1979, classes were added at Bell labs to C-language, becoming (C++) by 1985. The software to support C was initially proprietary, but in 1979 UC-Berkely released a public BSD version, and Bell Labs Lawyers were no longer involved. While C and its derivatives allow generation of very efficient code, they also have features that easily exploited by hackers, as lack of array boundary protection. In 1986 (Digitalk) and 1988 (ParcPlace Systems) Smalltalk was made available for commercial use, but the opportunity for broad impact was lost. It was used in some businesses, but I think it was never taught in any university or college. By 1999 those independent businesses disappeared, although versions of the software remain available.

China 1983

in 1983 I was nominated to be the leader of a State Department sponsored P2P delegation. I assume it came about due to my prior UNDP consulting. I had to provide a list of candidate participants, who would have to pay their own fares. It seems that being able to visit China at all was seen as a great opportunity and we had over 50 participants. With that number I was able to support two more leaders, Voy – who wound up doing most of the organizing, and a former student, Prof. Toshimi Minoura from Oregon State. We travelled 2 weeks through China, from North to South, given lectures in about 10 places. There were no tourist hotels then. In Beijing we were put up in dormitory building that had been used by Russian advisors.

I had informed the participants what type of power plugs would be needed in China, but when we arrived had to improvise to use the European standard sockets used by the prior occupants.

Our hosts were very accommodating, although the leader assigned by the Chinese government would only converse with use through an interpreter. Banquets were frequent, and require mini speeches, using notes quickly scribbled as the hosts were talking. One of our participants wase Paul? Marx from SRI, so at the May 1 banquet I was able to let him be the chair together with our Marxist's hosts. Changes in arrangements required patience, but always worked out. We were monitored; one of the younger participants who became interested in a local student had to leave early.

Being the leader meant I had less time to be tourist. I had expected that and negotiated that when the tour was finished, Voy and I could return from Hong-Kong back into China, to visit Guilin, a place I had always wanted to visit, and at that time only open Chinese and Japanese tourists. We stayed at an elegant government guesthouse. For the trip down the Li river we could take a barge towed by tug way ahead so we would not be disturbed by engine noises.

China has changed a lot since then. I had to do some negotiations later there for UNDP. The folk I dealt with were very smart, slow, patient, and thorough.

Handling trade issues with China remains a complicated and ever-changing issue. Both China and the US are evolving, but China's is certainly more rapid. Our last trip to China was in 2011 - amazing differences.

An assignment to ARPA/DARPA 1991-1994

A major source for innovation in computer science was ARPA, the Advanced Projects Research Agency of the US Defense Department, currently operating as DARPA. My 1958 work on Solid Rocket Fuel Analysis had been funded by them. Later ARPA leaders could be convinced that communication and computing were as important as weapons. In 1966 they transferred funding from ballistic missile defense to initiate the ARPAnet, which was the predecessor of the Internet. My KBMS research was funded by ARPA starting in 1977 and I had maintained contact with them throughout. It is a relatively small organization and depends heavily on the efforts of a few dozen program managers, the majority of whom rotate to and from research organizations. While several aspects of computing were well supported, the information systems area had lagged behind. When I complained, Barry Boehm, then the director of SISTO, ARPA'a Software and Information Systems Technology Office, suggested that I join them. I spent a year or so preparing and in September 1991, was lent by Stanford to DARPA for up to three years.

ARPA does not fund curiosity-inspired research, nor applied research, but rather problem-motivated research, also called use-inspired research. The common term, basic research covers both problem and curiosity-driven research.

Avoiding Bureaucracy ARPA's relies mainly on limited time appointments of experts from academia and industry. That approach contributed much to its success. I had been wary already of bureaucratic management of research. While there many great people in such governmental roles, in time it leads to risk avoidance. For a bureaucrat, if their decision causes problems or loss, the person blamed for the decision maker may lose their position or even their job. On the other hand, if it goes well, there is no or little benefit for the risk taker. ARPA's structure tried to avoid such stasis. In industry, learning what does not work is valuable, and should be remembered.

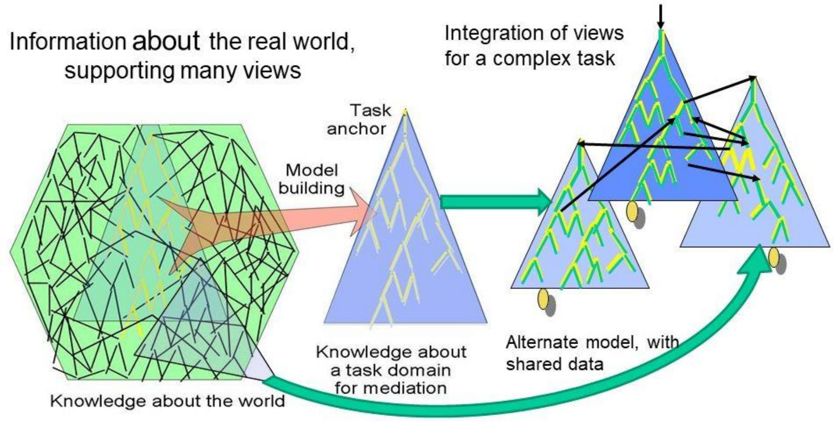
In my case, my stay was a leave from Stanford, and I received my salary from Stanford, plus reimbursement for costs in incurred in moving and living in Washington DC. However, all my pat research was interrupted, and because of conflict-of-interest rules, I had to start new research directions when I was done.

Even the directors are rotated. I had a discussion with Tony Tether, who directed DARPA from 2001-2009. He observed that the rotation, while beneficial, causes a loss of corporate memory, although it forces new staff to be innovative. Many political positions have term limits and hence are also subject to losing historical insights. A question arises, what to do after one's term. While U.S. presidents are fairly well provided for and can attract paying audiences for lectures and books, that is not true for most bureaucrats and politicians. For those that can, there are temptations to provide a comfortable situation when their term ends, easily leading to corruption. Laws controlling conflict-of-interest only provide restriction. Something positive is also needed when term-limits are imposed.

Intelligent Integration of Information *(I3)* I had learned about the problems that military and intelligence officers had in obtaining comprehensive views of information available in the variety of extant settings. I obtained substantial funding for a new program: Intelligent Integration of Information (I3). The I3 program funded a variety of existing academic and industrial research efforts, trying to bring their technologies together. Since ARPA's staff resources are small, the I3 program subcontracted the academically-oriented I3 aspects of I3 research to NSF jointly with ARPA's Computer Systems Technology Office (CSTO) program of Brian Boesch. Larry Rosenthal and Maria Zemankova had floated earlier the notion of a Digital Library, providing easy access to documents residing in hundreds of distinct repositories, in many forms with differing access rules. NSF had not been able to assemble the funding to get it off the ground, but with major ARPA funding, and some further funding we negotiated with Barry Leiner from NASA, NSF was able to solicit Digital Library proposals from academia. We selected several dozen and a few led to significant outcomes. The most visible result was generated via Stanford, where two students. Jeffrey Brin and Larry Page, working with Hector Garcia-Molina, Jeffrey Ullman, and Terry Winograd developed the page-rank algorithm and left to found Google in 1998. Terry's principles meant that he never accepted direct support from ARPA. Today little civil or military research goes on the world that does not intersect with Google at some point.

Mediators

An important concept arising out of my work is that recorded knowledge about data at an Internet site will be topic-specific. Their structure can be formalized as an ontology. Many ontologies are feasible covering the same data, as when there are producers of say mechanical parts from base materials and supplies versus purchasers that assemble those parts to make products for sale.



Extracting and then combing relevant structured data

The effect is that the aggregated data have a network structure, as the sketch here indicates. I experimented and published some papers on a concept that I called mediation. Multiple mediators would provide intermediate services, typically using AI, that allow data organized in differing structures and ontologies to be combined, and then provide results from their combination.

Several students, as Ramez El-Masri, later at UT Arlington, Jan Janninck – later a founder of the imeem music service, and Prasenjit Mitra, now at Penn State worked on the underlying algebra. Others, at Stanford and beyond implemented related concepts.

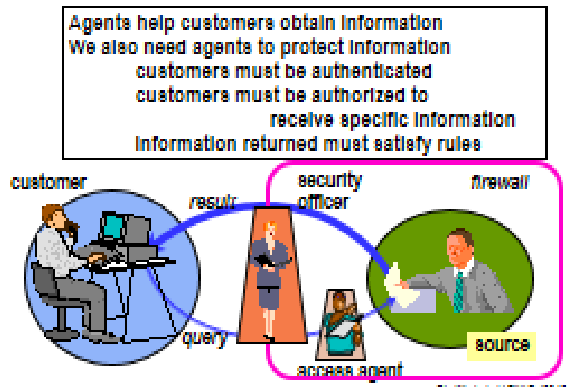
Nearly all follow-up work on ontologies for data interpretation focused on single, directly-relevant ontologies. That is understandable, because most people are experts in their own subject model - and that is where they have data for validation. Getting people to work on more than one and their intersection is well-nigh impossible, unless they are specifically supported for that. I tried to do that with some DARPA grants, but in the end they all became narrow again. It was also hard for my students to follow up in that line.

I see many efforts to convince others that their ontology is right. There is now an excess of “standards” to enable interoperability. I consider that foolish. Effective interoperation requires letting others do their work in a fashion that suits them.

Security and Large-Scale Software Engineering

After returning from DARPA in 1995, having funded through DARPA's I3 program the digital library and much related database work, I could not work in the area because of Conflict-of-Interest rules, so I moved to Security and Large-Scale Software engineering.

I was able to patent a method [US Patent 6226745], focusing on preventing data that should be kept private from being transmitted to the outside world. Having a security officer checking what is removed from a facility is common in business, but not in computing. We demonstrated use of that concept for a variety of data. The approach complements the many technologies in use to keep hackers from gaining access. But still, we see many instances where access control failed, and large amounts of data were transmitted to the outside.



Protecting release of results

To commercialize the invention, I set up a company, Symmetric Security Technologies, jointly with Maggie Johnson, Michel Billelo, Jerry Cain, Ione Binford, and Voy. We obtained the Internet URL 2ST.com for it. The name of the company was based on the concept that both access and extraction of private data should be protected. We demonstrated the software at in number of places and had one sale to a company handling genomics data.

Being small and having a different approach requires much convincing. Larger companies in the arena were focusing on protecting access, and since our approach implied that their methods could not be perfect created a major hurdle. In the end, with all of us just being committed part time, the sales efforts were not productive. The company was dissolved and the remaining working capital spit among us.

Later I saw some similar approaches being used by others, but engaging in litigation would have been painful. I was contacted by some businesses that wanted to obtain the patent. Since I knew they would just use the patent to sue possible violators, and not wanting to aid in patent trolling I kept the patent until it expired. In 2021 the 2ST website is used for the 2nd Stage Theater in NY.

Privacy

My attitude about protecting, in particular, my privacy is not typical. I have no need to keep my personal data private. Much of what I do is paid for by public funds, directly or indirectly. Already in my 1977 textbook I posited that trying to keep personal data private keeps useful information from friends, while, if it's worthwhile, one's enemies will always be able to obtain the facts and insinuations. They may well use them selectively without fear of being challenged, because nice people can't get to these data.

Today, in the setting of the Internet, I am well aware that in order to get free email and free searches from Google I give up some of my privacy. But I have nothing to hide. I am not looking for explosives or anything else that might be threatening. Yes, I am annoyed by unsolicited advertisements, but that is also true when I watch free TV. Going to a movie (and arriving just before the feature) avoids that annoyance, but costs me $10. Complaints that one's life is not private after using free mail on the cloud and sharing one's life on Facebook are only fuel for promises by politicians that won't be fulfilled.

Similarly I know of nothing in my medical history that needs to be kept private. In fact, I object to privacy rules that make it harder for my physician to get a full picture of the state of my health. There is one exception - my genetic profile, which I will not create, since I share that with other family members who may not be as easygoing as I am. Some medical data do warrant protection because they are easily misused. In 1967, I did not allow Stanford psychiatric data to be kept on the ACME system we built; I could not assure my colleagues that such data could never be accessed.

My tax return is kept very private by the IRS, but again there is nothing in it that I am ashamed of. I might be embarrassed if everyone knew that my book did not sell well or that I made an excessive profit on a house I sold. But a determined investigator can find that out anyhow, if it really matters to someone.

The current concern about keeping ones's social security number private is laughable. It was never intended to be private, it has no secure encoding, and in fact was published on all researchers' grant applications for many years. I view it mainly as an excuse for insufficient security provisions by banks, on-line stores, and similar institutions, that now can blame their customers for losses due to break-ins enabled by poor software and worse software maintenance. Hackers do not need to know social security numbers to accomplish break-ins. Again, because I respect the concerns of others, I won't reveal data of others that I have been entrusted with.

At this time I see privacy being used to withhold information from us, and disable informed decision-making. Invented threats to your privacy are easily exploited by politicians. Especially the need for corporate privacy should be questioned. Public corporations can fail and shareholders and communities will bear the burden, but the public cannot know what went on, and who might have profited.

The argument that we used to have privacy before the Internet is also questionable. Privacy emerged when people moved to cities. In the small villages of yore people knew what their neighbors were doing and buying. Bad types had to leave their home village.

Without having privacy we may all be encouraged to lead better lives, and be more willing to forgive mutual trespasses.

Data Engineering

A number of colleagues and I observed around 1983 that there was not an effective venue to publish papers that dealt with the systems and engineering aspects of organizing and exploiting data. The existing ACM conferences focused on models and theory. Dick Shuey from General Electric and Mas Tuchiya from TRW and I petitioned the IEEE to sponsor a complementary conference, inventing the term Data Engineering. Nobody quite knew what that meant. Now the term is in common use.

The First Data Engineering Conference was held in April, in Los Angeles, near the airport, allowing easy access for the many engineers working on relevant topics. After a few years the sponsors felt that more international participation was needed, and that required including academics from other countries. The name became the IEEE International Conference on Data Engineering (ICDE) and continues. Given my distaste of committee work I reduced my participation greatly. I did give some talks at later conference, including a review of its founding at the 32nd meeting, held in Helsinki, Finland, May 2016.

Historic Displays for the Computer Science department

Around 1993 the department had outgrown the offices it had used since xxx in Margaret Jacks Hall in the Central Quad of Stanford University. Getting a new building, to be paid for mainly by external donors, is a major effort, and faculty are solicited to use their contacts for substantial donations. It had been involved in earlier fund-raising efforts and did not want to do another around. I suggested that I would collect exhibits that could make a new building attractive and relatable to the field of computer Science. I had been doing that at a smaller scale already in Marguerite jacks hall, mainly by displaying relevant posters. That suggestion was accepted and Voy and I started the effort.

We received some items from local computer companies and IBM. A major source was The Computer Museum (TCM), organized by Gordon and Gwen Bell, when during 1996/1997 moved most of its collection was moved from Boston to The Ames Field in Mountain View. There was limited opportunity for display there. A major funder for the building was Bill Gates from Microsoft, so the building is now called the Gates Computer Science Building, completed in 1996. In November 1997, with the assistance of Gwen Bell and her staff November 1997, displays on all floors were opened with a big party. The displays on the first floor focused on Stanford, the second floor on the 1950's, the 3rd on the 1960's and the fourth floor on the 1970's with early Apple, TRS-80, and PET computers; the basement cabinets contained smaller artifacts.

As the Computer History Museum (now CHM) obtained its own building in Mountain View some items were returned, and in 2020, when the Gates building was closed for a major renovation all the remaining CHM items were taken back, mainly to their secure storage facility. CHM now operates like a regular museum, and preservation of computer artifacts has become a major objective. We were able to obtain replacements for some important artifacts, as the Williams tube and another IBM 360 front-panel actually from the original FAA light control computer.

Committees

I had observed throughout my working life the enormous amount of time taken up by committees and periodic meetings. Whenever there is not clear leadership that can resolve issues, establishing a committee is the escapist solution. All members get the warm feeling being considered relevant.

At Stanford I stated that I would not attend any third meeting of a committee that had not produced a result, or, if not measurable, at least a written document. My experience is that without such a basis the third meeting just revisits the topics and ideas presented in the prior meetings. My constraint saved me a lot of time.

Leading an effective committee is certainly a way to be visible and rise up in management. Heading up a committee also means one has to be fair. Since I tend to have strong opinions, that role was also not attractive for me.

Wimpy Writing

In any of the courses that I managed I always had the students write a lot. They would all do their individual projects, and I would have to read their work and provide feedback several times during the quarter. I believe it is a great way to interact with students. The approach was possible since the topics that I started: CS245 Database Design, CS247 Distributed Database Technology, and later CS73N Business on the Internet and CS207 Software Economics, all started small or had enrollment limits. Their course description have now disappeared from Stanford's on-line pages. The flexibility that Stanford allowed enabled a way of teaching that is hard to replicate in other settings.

Reading the students' projects, as well as editing TODS [ref] and other papers, has engendered in me a strong dislike of what I term wimpy writing, encountered so often in our public life. Examples are signs at supermarket that warn us that "The State of California has determined that (photo)" and news commentators that state "the alleged murderer was apprehended right after he had plunged the knife into the victim's chest (and emptied his gun into the victim's brain)". English, and certainly American English, is a language that allows straightforward expression and, having adopted terms from all over the world, has a rich choice of terms. Circumlocution for social correctness should be avoided.

Stanford University

Agassiz' statute, after the 1906 earthquake

As this section makes clear, Stanford has been the major influence in my life. I am often asked now what makes Stanford special. The obvious answers have much to do with technology and Stanford's interactions with Silicon Valley (a great collection of pictures) . However, there is also its history to consider.

Stanford was founded by an entrepreneur, *Leland Stanford* (1824-1893), who went from being a merchant selling goods to gold miners to participating in the building of the transcontinental railroad and becoming a Governor of California. Entrepreneurship is now an academic subject, but it is more of an attitude that includes risk-taking than a science.

At the time of Stanford's founding, German universities were highly admired. Stanford's Motto is "Die Luft der Freiheit weht" (The winds of freedom blow), by Ulrich von Hutten (1488–1523), a German Renaissance humanist and poet. *David Starr Jordan* (1851-1931), the first president of Stanford University (1891-1913) had been a student of Louis Agassiz (1807-1873). Agassiz had studied at Würzburg, Neuchatel, Paris and London before coming to Boston. He is also my academic ancestor. Agassiz' statue, one of four at the front of Stanford's main quadrangle, toppled in the 1906 earthquake, but was then restored. In 2020 it was removed, due his views on race and zealous social correctness.

Agassiz advisors were *Ignaz Döllinger* from Bamberg, *Carl von Martius* from Würzburg, *Alexander von Humboldt* from Berlin, and *Georges Cuvier* from Paris. Carl von Martius had explored Brazil, supporting the work of his advisor, Carl Linnaeus. The cold Humboldt Current keeps the Western coast cool and foggy. Ignaz Döllinger's son Johann was excommunicated from the catholic church for arguing against the Pope's infallibility.

These academic ancestors represent a much broader view than found at the older Anglophile Ivy league schools. Class distinctions on the continent were also less ingrained than in England.

I was able to publish regularly. Because information technology is applicable to so many endeavors, my research was applicable to many areas and the papers appeared in a variety of venues. Most of the papers had the contributing students as co-authors, often as primary authors. I was the primary advisor of 36 PhD students, but many master's students and some undergraduates contributed as well. Having projects with PhD and Master's students working together gave the PhD students some experience in working with others, an essential skill once they graduate into the outside world. At the same time, the Master's students had more interaction than I could provide myself.

I also had excellent secretarial and administrative help throughout. I want to thank here all the many people who enabled my productive life at Stanford. In the current ubiquitous presence of computers and fancy support applications much less help teds to be available. I have even never learned to type with more than two fingers, because it was expected that engineers would have secretarial help available.

Consulting

Solid Rocket Fuel

When I left IBM in 1961 they no longer had the staff to support use of the Rocket Fuel analysis program. The code was made available by placing it under the code T2 BC RCKT into the SHARE library, managed by users of IBM computers. IBM's business then was making and selling computers. Having people help or improve software supported their business objectives. For many years the software could be freely retrieved, but I hear that SHARE no longer has a library. When questions arose I would be called on to help, and to the extent that wouldn't conflict with my work at the University, I could earn some extra income. Thiokol, the builders of the Space Shuttle's Solid Rocket Boosters (SRBs), was one of the users I consulted for. The SRBs were huge, 150' (45m) long, and 12' (3.7m) in diameter, and tested horizontally. After use, the SRBs disconnect, and drop into the ocean, and may be recovered for possible reuse. I was very concerned when in 1986 an SRB failure caused the demise of the Challenger. I received questions about the program as late as 1989, 30 years after I started working on it. To my surprise the same boosters are used on the 2022 Artemis project. I am concerned that more modern, controlled reuse technology, is not being used.

Consulting Approach

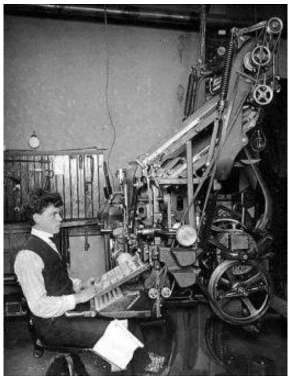
A substantial benefit of an academic position is being able to consult for industry. Academic intellectual capability can be freely shared. Conflicts with teaching have to be avoided. The common rule in the US is that a faculty member can spend one day per week on consulting. At Stanford that is formalized as a rule that 13 days per quarter can be so spent. Some faculty spend their day interacting weekly with a business with common interests. I instead used my days in bunches for short-term problem-solving and review tasks, spending typically about three days 3 times in a quarter. Having many colleagues and former students in industries that now were moving into using database technologies provided many opportunities. I did not need to market myself.

A typical 3-day consulting period allowed me to listen for day, ask questions based on what I had heard the next day, and spend the final day on discussing solutions. Sometimes a final, brief report was needed to support my insights to a broader audience. I am not sympathetic with what I call recipe-consultants, who enter the doors of a business already knowing what the solution should be. The local experts I interacted with had a variety of problems and would share their experiences.

I learned much in those consulting engagements. What were the problems that industry encountered? Sharing issues encountered in industry with students provided handles for future research. Fixes that worked in a specific situation provided background, but research will be needed for solutions to be generalized for broad applicability.

The variety of tasks I undertook was broad. Several were for the US Defense Department and its contractors. Commercial work I recall:

1. Optimizing allocation of rail cars using data from rail-side sensors.
2. Moving the annual legal publication of Shepard's Citations from linotype hot lead shuffling to computer-driven typesetting. Linotypes machines had been essential for publishing for over 100 years, and were considered the 8th wonder of the world



Linotype machine *[1904 from CreativePro.com]0*

3. Using corporate performance data to estimate the corporate risk factor (beta) used in discount computations.
4. Inversion of access matrices stored in column databases for rapid access, also used for ACME.
5. Data-oriented spreadsheet algorithms (Visicorp).

Today, database technology and supporting consulting is routinely provided by database companies, but those resources did not exist then.

VisiCorp (1983-1984)

In a break from Stanford, I took a consulting break that I will describe in more detail. I had kept in touch with the emerging microcomputer world and in the fall of 1983 Bill Coleman asked me to initiate a new project at VisiCorp. VisiCorp, the successor to the company that in 1979 developed the spreadsheet technology which made small computers relevant for business needs, was developing an integrated set of applications, similar to Microsoft Office, which had been promised but not yet released.

The base Visi On system had become operational, and two applications beyond Visicalc were in final development: Visi Word and Visi Graph.

I set out to develop a database system in that context, to become Visi Data. While largely following relational database principles it had some specific features for high interactivity. Visicorp management was focused on user-friendly behavior. I proposed and implemented some features that would make the product stand out. Since many database operations require sorting, the sort was organized so that portions selected for presentation on the screen would be sorted first, and while being viewed, the remainder would be sorted. Output was presented in true alphabetic order, not in the common ASCII code-based sequence, where all uppercase letters precede lowercase, with some odd characters in between. Some current systems have adopted the same convention.

The Visi On Systems required what was for the time a heavyweight PC with 512K bytes of memory and a hard disk (just introduced for the PC in 1982). Users also had to purchase a Visi Mouse for $250. Still, its performance was poor. The designers of the Vis ON Applications Manager infrastructure were not convinced that any specific PC design would dominate, and included an elegant interpretive layer, so that the Visi On software could be moved by recompiling to a variety of computers: the IBM PC, the Apple and the Amiga. The performance penalty was great. Microsoft, selected by IBM, had been more pragmatic. It focused its products just on the growing PC market and then maintained a separate development group for Apple products. That approach incurred some synchronization and consistency issues but allowed much better performance. Layering is an important concept and a muliti-layer model for software systems development was widely taught, but it is not wise to always implement it rigorously.

I had become knowledgeable about Unix, C, and Emacs by that time. These systems trade performance against user friendliness. I remember making one typo that converted all my working files to null characters, not changing the file sizes, but displaying nothing on the screen. Luckily Viscorp had a good backup system. I took the afternoon off and by morning all was repaired.

With the Macintosh and Windows announcements customers became uncertain about committing to any product line. Visicorp ran out of steam, and I rejoined Stanford full time in late 1984.

Intellectual Property assessment

After my retirement I had time for more consulting. With my prior record I soon had several engagements. Those also provide a great way to remain intellectually stimulated, while minimizing the need to draw on retirement savings.

It turned out that the issue of how to convert intellectual prowess to value in the business world was a major issue. After several engagements I accepted an offer from the U.S. Treasury department to help its Internal Revenue Service do such assessments, since assigning intellectual property (IP) to a foreign subsidiary at a low value and then sheltering the substantial derived income offshore is a major means for avoiding taxation. To broaden my competence I took a course in 2003 at the London School of Business. That choice was because in the U.K. corporate IP can be documented on their books, while in the USA the SEC does not accept IP. I learned there that while allowed, the computations made were vague, making the SEC position reasonable, although misleading for modern industry, where IP is such a large component of corporate value. Working for the IRS also requires a clearance. To avoid conflicts of interest I ceased all other commercial consulting.

After a dozen years I was able to aggregate the experience without naming any specific businesses into a book. After IRS review it was published by the Springer Verlag in 2013 with the title *Valuing Intellectual Capital, Multinationals and Taxhavens*. The reason for broadening the title to *Intellectual Capital* is that without people to crate, maintain, and explicit IP little measurable value is created. Sales were modest, maybe in part because the title term I used is not that common, although I received some royalties still in 2021.

Consulting insights

During my consulting I learned some rules to become effective. I will cite some here.

Listen to what is behind the story. When starting on consulting assignment listen carefully to what you are being told. Don't come in with a set of solutions before you have had time to reflect on what was presented. The problems that are presented are often surface issues relating to deeper issues; otherwise they likely would have been addressed already. Those deeper issues may be of a kind that are inherent in the structure of the organization. They may not be directly solvable, but if identified, workarounds may be possible.

Management levels. Starting with the rule that a person can deal with 7±2 items at a time[Miller's law] I consider that a manager can only understand the work of 5 to 9 employees in depth. When an issue I am faced with involves management – very often the case – I will compute *a management level expectation* $M = \sqrt[7]{\text{(number of employees)}}$; for 2 million employees that would be 7. If there are many more or many fewer levels of management there is an potential issue to be aware of.

Minimizing the problem. I often heard "It's really not that big a problem, we checked and were fine in 99.9% of the cases". That does not mean it's all good enough and negligible. If 0.1% of the products fail at customers' sites, then most customers that use the product in quantity experience failures. And the cost of a failure is easily 10-100 x the benefits of a success. Many customers will be unhappy. It gets worse in health care. The cost of one death cannot be compared with the benefit of hundreds of cured patients.

Sabbaticals

A pleasant aspect of working at a university is the ability to take sabbaticals. A sabbatical is a leave from the university every 7 years, typically at half salary, allowing one to develop a fresh take on the subject of ones's teaching. I did not take full advantage of the opportunity, in part because active research projects made taking off for a full year was infeasible. I had also taken a three-rear leave working at ARPA/DARPA.

I did take two external sabbaticals.

Stuttgart. The first one was in 1987 at IBM Stuttgart. While the original contact was with a university, the principal contact there had left, and I joined an innovative industrial research group of IBM there. Although everybody there was fluent in English, I had to greatly brush up my German language skills to interact effectively. Our youngest son, Randy, came with us. To spare him from the language issue we enrolled Randy in the school operated by the US military. The tuition was modest and Randy had a very good experience, especially with their sports activities. It forced us to drive many Saturdays to places where he had competitions, and those places then determined our Sunday sightseeing locations.

Lausanne. The second sabbatical was at the Technical University (EPFL) in Lausanne, just shortly before my retirement. By that time our kids were grown, but they could visit us.

Visitors

As mentioned earlier, I benefited from having some colleagues participate in teaching and research.

Stefano Ceri worked in distributed systems and is a professor at the Politcenico di Milano, Italy.

Oscar Firschein, a scientist from SRI that I worked with while at ARPA, helped in teaching and working with students interested in image analysis.

Witold Litwin, known for Linear Hashing is a professor in Paris, France. He presented and recorded summer courses on database distribution.

Rudi Studer is a professor at the University of Karlsruhe, Germany.

Peter Apers moved to the University Twente, in Enschede, The Netherlands during its founding, and became the chair of its Computer Science department.

Wolfgang Nejdl started the L3S research institute at the Leibnitz University in Hannover, Germany.

A brief visit Professor Herrmann Maurer from the University of Graz, Austria, contributed as well. We also visited the Moller factory in Davis, as described in his in his extensive biography. In my Freshman seminar we used his Science Fiction book: *The Parane*t, now available on the Internet, illustrating the risks of global network dependency.

Staff Assistance

I have had wonderful assistance from administrative staff throughout. I now just list their names, with my gratitude here: Martha MacMillan, Sharon Karpinski, Meredith Blue, Jean Plasman, Ginger Plasch, Ariadne Johnson, Mary Drake, Caroline Barsalou, and, for the longest part at Stanford, Marianne Siroker.

I should expand this section in a future draft. I could not have accomplished what I did without their efforts.

7. Retirement

For many people travel is one of the main objectives in retirement, but we had traveled a lot already, partially in combination with my consulting. Voy's work had allowed flexible scheduling. When needed, my mother would come and stay with the kids.

In 2001 I did retire formally, and so became a professor emeritus, still able to participate in most activities. The first item of importance was to make sure that the few PhD students that were still working with me would finish, and they all did.

I continued to participate in Stanford activities. While in 2015 I stopped teaching completely, I was still going Fridays to Stanford for the student presentation. Those ended in 2019 when the organizer, Hector Garcia-Molina – who was my first PhD student – died, much too early. That kept me au courant and sometimes my feedback with pre-Internet information was helpful to the attendees.

I also needed time to maintain the Computer Science historic displays in the Gates building.

We took time to make some family trips, and also participated in outings with the Armstrong Siddeley Clubs.

I now could spend more time with hobbies, reading, and consult with many fewer scheduling constraints. At age 86 (2022) I am trying to reduce my monthly consulting effort to less than 30 hours but have not been successful with that goal.

Taking care of parents

A major concern as children that live far away from home is how to take care of parents. Our experiences were relatively mild.

My parents divorced soon after the second World War. My mother started working for UNRRA, at a US Army base near Frankfurt.

My father was well taken care of by the son of his second wife, Klaus Dietze. He died at the house Klaus provided in Italy in 1988. His wife Ilse died in Cologne in 2000. We visited Klaus and his wife Inge most times when we came to Germany. He died in there in 2019

My mother, after her second husband died in 1962, moved to California in 1965. That allowed her to help with our children. Later she found jobs as a housemother in a boarding school there. She wound up taking a similar job at Sierra college, north of Sacramento, and we saw her less frequently. Around 1980, when our kids had become teenagers, she decided to retire to Gooding. Idaho, where her cousin, Tante Annetje, had moved with her 2nd husband. Being able to buy a small house there for $15,000 was a motivation. That it was remote from us and from substantial health-care services was not a concern then.

We were able to visit her a couple of times per year, sometimes in combination with work or by taking kids on a ski vacation in Idaho's ski resort. Such visits mainly required flying to Boise and Idaho Falls and a long drive. She also visited us, mainly driving, one or two long days often to take care of her grandchildren when Voy and I travelled. By 1995 health problems arose, and we had to make some urgent trips to Gooding. In the end we convinced her to sell the house and come to live again in Palo Alto. We had been able to buy a small house across the street in Palo Alto where we had moved so out kids could go to the good school in Palo Alto. That house was easy to split into two units, so that the rent from one unit could pay for most of the mortgage. After a fall in 1999 she could no longer live by herself

We found a small assisted-care home in Palo Alto where she could keep a dog. After a year or so they could no longer take care of my mother. In 2001 we moved her and her care-giver to an apartment in the house we just got for our son. The care-giver was a Chinese man who was happy to be responsible for one person 24/7 rather than for 7 oldies half-time, for the same price. We did deposit Social security for him which the care home `had forgotten', and we lived in other apartments in the same building. She was never sick, though her metabolism slowed down more and more. We got a doctor to stop by a couple of times per month on his way home from his hospital job so she did not have to be moved. She died in her sleep in 2002.

Voy's father had declared Voy dead to him after she married me. Her brothers took care of him and moved him to an apartment in New York's Chinatown after he sold his laundry in Jersey City. We tried to visit him a few times there. He died in 1883. After his death our relationship with Voy's brothers improved. They died relatively young. Her older brother, Naitan, also born in China in 1934, who came over to the United States with her, died in 2017. Her other two brothers were born in New Jersey. Both became ophthalmologists. Fred, born in 1945, had a practice in Saint Louis and died there also on 2017. Wing, born in 1947, established the eye bank in New York, but died there already in 2012. Wing also contributed their ancestry to the genealogy. We remain in contact with their children.

Move to San Francisco, Opera Plaza

By the time we were about to retire our kids were grown. John had graduated from UC Santa Cruz and gandy from The University of Oregon in Eugene. Both had steady girlfriends that they married later. John was working in software development and Randy as an architect, first for several firms. In due time Randy completed the formal requirements for an Architecture license and then, while also taking care of kids, worked independently.

We had bought in 1983 a junior 1-bedroom unit a new development, Opera Plaza, located in San Francisco's Civic Center. We wanted to have a pied-a-terre near the Opera and Symphony, so we would not be forced to have a strenuous hour's drive after attending a performance. To make the payments more feasible we'd rent it out for short periods to visitors and performers.

When we considered retirement we looked around in the same area, but found nothing as attractive. An alternative arose in 1991 when a neighboring studio become available. We were able to install a high door between the units, making long-term stays feasible. That unit we never rented out, so now we had a permanent base in San Francisco, important when we off in Washington DC. It is now my consulting office. In 1994 we were able to buy a third unit, on the other side of the studio. We again rented it out for some time, but for our retirement had an opening built between the units and that has become our main informal living space now.

The generous amount of space we now have in downtown San Francisco makes life very comfortable. It allows us to host guests. Many restaurants are in walking distance. And we have good access to public transportation. After 2019 it makes dealing with the isolation created by the Covid crisis much easier.

We were able to travel more flexibly after formal retirement, nearly annually to Europe, often in combination with consulting. In 2019 we spent over two months in Europe, starting with a birthday bash the 23rd of June at the Nizza restaurant on the Main river in Frankfurt, bringing together academics, Armstrong-Siddeley friends and family. We went on to Armstrong-Siddeley rallies in Europe and England, and afterwards took a narrow-boat trip in Birmingham there, with grandson Evan Wiederhold as the pilot. On July 26th we took a long, but fast train-ride to stay at Roberto and Christiana Zicari's apartment in Venice. Son John Wiederhold met us there and on August 8th Varese, where I was born 83 years earlier. Afterwards Voy and I returned for consulting in Germany and the Netherlands.

Our main house in Kings Mountain was fixed up for renting it out, but we can stay in the cottage that Randy designed and built with his friend on the property. The terrain is extremely steep there. We were able to buy unusable land there, so that we now have slightly over 4 acres there. That is also where work on the Armstrong Siddeley takes place.

Restoring the Armstrong Siddeley

As described earlier I had obtained a big British car in 1960, an Armstrong Siddeley 346 Sapphire. It broke down when moving it to California later that year, but it was shipped there, fixed and used there. After an accident in Berkeley in 1964, I ordered replacement parts.Those arrived shortly before I left for India. When I returned it was just stored in the garage in Kings Mountain, after putting oil into the cylinders to minimize corrosion. My MG I had was in front, blocking it. But after I retired I felt guilty leaving such a classic car just in the back of the old garage. Before leaving for ARPA we had added to the garage, and Voy had arranged that the contractor would put a pit in it. In 2006 we pulled the car out, washed it, and put it over the pit. After cleaning it, checking and reconditioning the brakes (a crucial task sometimes too long defered), I was able to turn the engine over with its crank. Repairs needed to get it running were only the fuel pump diaphragm and an ignition condenser. Next all of the deteriorated wiring connectors were replaced. Voy made a video of its first drive out of the garage. We cleaned up and returned it to the garage, for the remainder of the restoration work. I was lucky that a neighbor, Eric Sterger was an expert restorer ("panel beater"). We would get together most Thursday afternoons, and eventually the car was resprayed, matching the colors that had been protected under the wood trim, The wood trim was refinished by a guitar maker.

In the meantime I learned that there were some active Armstrong Siddeley clubs in Australia, the United Kingdom, and the Netherlands. I joined them all, and was able to obtain parts, remanufactured rubber seals, and advice.

Those clubs have annual outings, and we were able to join them in 2008 for an outback tour in Australia, in 2009 in England, in 2010 in Germany, and in 2016 both in and about the Netherlands and subsequently for an extended 50th anniversary tour from the north to central England.

8. Genealogy

After being settled in the United States Voy and I were able to visit my father several times. A stop at a trip in 1971 brought us the Hohentwiel castle, where an (indirect) Wiederhold ancestor, Konrad Wiederholt, had defended the area in during the 30-years' war, against catholic forces during the counter reformation.

My father, his grandson John, and me on a trip in 1971 to the Hohentwiel castle

We visited the castle several times since, including in 2013 with our entire family. It is a long climb to the base, and then even steeper to the fortifications on top. But we did it. The picture here was taken by Christine Lehto and shows all but one of us before the climb.

Randy, Eli, Anni, Evan, Zoë, Gio, Voy, and John Wiederhold.

An interest in genealogy was triggered in 1984 by a visitor form Germany, Alfred Wiederhold. I learned that he had spent much of his life creating a comprehensive genealogy of all the Wiederholds in the world, collecting and sharing that information. We invited him to stay in a motel close by our house in Palo Alto.


Six Wiederhold Males in 2013

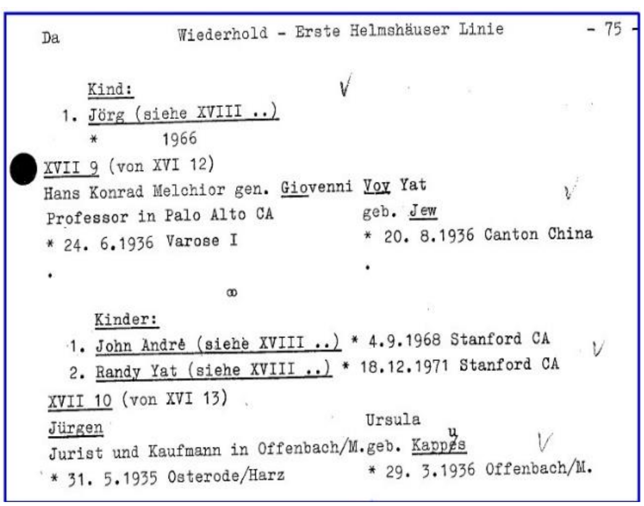
Alfred Wiederhold was able to link me into his ancestry, and we were duly placed into generation XVII and XVIII of his subsequent Felsberg branch books. Soon after, Alfred Wiederhold produced about a dozen copies of each the 10 books he created for sale using mimeograph technology. I purchased a set. Page 75 of Felsberg Volume 2 shows my family.

Looking up and looking down

I was able to get all 10 books scanned professionally, except for the extensive and complex charts. The charts I marked and scanned myself. I made the texts and scans available on a CD as searchable Adobe PDF documents and placed them on a dedicated website, which I was able to set up in 2019.

It appears that all Wiederholds have as ancestor a judge named Volland, appointed in 1229 in Westfalen, as their common ancestor, who named one of his sons Wedderold. The spelling of the name varies in the earlier books, since the scribes and preachers just transcribed what they heard, say at a baptism, but can still be matched. His descendants mainly lived around a small river, the Diemel, a tributary to the Weser, which separates the area of Westfalen and Hessen.

Many of the ancestors on my major branch were landowners in Hesse (in German Hessen), the province surrounding Frankfurt, and centered there around two small towns, Felsberg for my branch and Homberg Efze, about 10 miles away, for a parallel branch. During the 30-years (1618-1648) war there was much movement due to religious infighting, broadening the geographical scope of the family history, but also creating some uncertainties in the linkages.



Da Wiederhold - Erste Helmshäuser Linie - 75 -

Kind:
1. Jörg (siehe XVIII ..)
* 1966

XVII 9 (von XVI 12)
Hans Konrad Melchior gen. Giovenni Voy Yat
Professor in Palo Alto CA geb. Jew
* 24. 6.1936 Varose I * 20. 8.1936 Canton China

∞

Kinder:
1. John André (siehe XVIII ..) * 4.9.1968 Stanford CA
2. Randy Yat (siehe XVIII ..) * 18.12.1971 Stanford CA

XVII 10 (von XVI 13)
Jürgen Ursula
Jurist und Kaufmann in Offenbach/M. geb. Kappes
* 31. 5.1935 Osterode/Harz * 29. 3.1936 Offenbach/M.

← the page of the Alfred Wiederhold genealogy, that includes us and my cousin

Another large Wiederhold branch is located a bit east, in the Eichsfeld, a region that reverted to Catholicism in the 30-years war. Many U.S. immigrants came from that region.

Now, much of the source texts can be searched, although underlined names, umlauts, diereses, and hand-written insertions will not be found.

To avoid that this huge oeuvre would be lost I started transcribing the information into computer formats and have been making those trees available on the Internet. To complete and verify the work I subscribe to most genealogy Internet sources, and have also purchased some major collections, such as the 138 volumes of the `Deutsche Geschlechterbücher" on 18 CDs, the address books of the Dutch East Indies on 2 CDs, and several German church books in print or on CDs.

For my mother's Tuybens family I got a good start by merging the data from a cousin, Loes van Beuge-Davis, who had become a Mormon. On two vacations I also spent time at the Royal Dutch Archives (CBG) in The Hague. The records of the Dutch East India Company are detailed and well-preserved, but also quite difficult to read and search. The earliest entry I found is there was Andreas Tuybens, who in 1775 left the service of the VOC, the Dutch East India Trading Company. Later I learned from a Dutch genealogist that Andreas Tuybens was a name used while by the VOC, but he came as Andreas Teubes from Schleswig-Holstein and settled later in South Africa. The Tuybens branch he left behind in the Indies died out in the aftermath of World War II. Two survivors settled in Holland: my mother's stepbrother Wim and a nephew Otto, but neither had children.

Published Trees

After I had entered most of the information from Alfred's books that was related to branches of my tree, I published it in June 2015 on a site provided by My Heritage. I then continued to follow Alfred's intention to enter all the world's Wiederholds and their ancestors. That task is too ambitious, so in 2017 I limited myself to enter all known Wiederholds born before 1800, their known ancestors and those descendants leading to current families that are interested in their genealogy.

There are issues to be dealt with. Misspellings are common as well, most frequently Widerhold and Wiederholt. Although I believe that all Wiederholds are related not all relationships are documented. That means I have to create some hypothetical links; I will always state what my reasons are for a hypothetical linkage and will change relationships if more trustworthy alternatives appear. I tried in 2017 to maintain separate trees for my father's Wiederhold and my mother's Tuybens ancestors, but I found there were overlaps, so I plan to recombine them again in the future.

An interested genealogist in Switzerland, Ruud de Ruiter, used my working file as of 2016, with some transformations, and published it on Geneanet, a service which is easier to access, but because of that feature it appears to be somewhat less reliable. Ruud also did a thorough diagnostic pass, which I used both to correct and augment my current work. In order to gain consistency and focus my work I am using some rules. Other Wiederhold family members have been contributing information as well.

By 2020 I was able to make the large genealogy tree available to the public on the Wiederhold.org website that I obtained from another interested Wiederhold. In June 2021 I updated the tree there to include all known Wiederholds born prior to 1800, as well as many branches thar emigrated. I plan to continue to work on completing the tree towards current Wiederholds. By October 2022 I was able to cover all known Wiederholds I could find born before 1860. That extension covers the big wave of emigrants leaving Germany and France. Dealing with emigration requires matching names that were often spelled differently and is always subject to revision. Using the flexibility of the Internet, trying to be comprehensive and entering likely matches with notes enables making corrections, which was nearly impossible on paper publications.

As part of the research I compiled and published stories of some interesting ancestors. The full stories are available on my Genealogy website:

- The earliest direct ancestors found lived along the Diemel river that separates the provinces of Westfalen and Hesse in central Germany. The documented Wiederhold ancestry start with a Volland, a judge in 1229 in Marsberg, Westfalen, Germany, who gave the name Wedderold to one of his sons. To make the text easier to access it has been transcribed by Josephine and Gio Wiederhold and subsequently translated to English by Google and Gio Wiederhold.

- The Wiederhold families living in the central German region of Eichsfeld further east are ancestors of the majority of Wiederholds that settled in the Americas. This story is a draft to provide insights into their background.
- Konrad Wiederhold (1598-1687) is a mercenary officer who became famous as the defender of the Hohentwiel fortress during the thirty years' war. A copy of an 1839 story about Konrad was scanned by Alfred Wiederhold and attached to his 12 volumes.
- Georg Reinhardt Wiederhold (1599), went with his soldiers to Holland to fight the Spanish there. Some descendants are found all over Europe.
- Bernard Wiederhold, (1757-1810) an enterprising mercenary in the Napleonic wars, with descendants in Portugal, Scotland, Canada, Oregon, and California.
- Johannes Wiederhold (1578-1626), a promoter of Luther, drowned in the thirty years' war. His wife and children may have fled to Eichsfeld, a Catholic region. In that case he would be the ancestor of most Wiederholds in the USA.
- Henrich Reinhard Wiederhold (1631-1673) took on bookbinding in Frankfurt.
- Jean Caspar Wiederhold (1703-1768), started the French Wiederhold branch when he was sent out to an inherited area in southern Alsatia.
- Heinrich Wilhelm Wiederhold (1836-1930) and Christian Friedrich Klaus Wiederhold (1831-1856), went to Southern Chile. The town of Osorno has a large number of Wiederholds; I'd like to visit it sometime. Descendants founded San Carlos de Barriloche in Argentina.
- Hendrich Julius Wiederhold (1724-1788) went as a soldier for the Dutch East India Trading Company, the VOC, to the Indies and settled there. A branch became the Hedrich von Wiederholds. Some live now in the Netherlands and the USA. A comprehensive story is told by George Molenkamp in English and in Dutch.
- Gio Wiederhold's mother's family, Tuybens, also went to work for the VOC in the Netherlands East Indies, now Indonesia.
- A more recent Wiederhold ancestor is Franz Schmidt (1818-1853), a delegate to the 1848 first democratic assembly in Germany. He had to flee and wound up in St. Louis, Missouri, USA.
- The Wiederhold records show a line of Droz, including a Jean-Pierre Droz (1707?-1793), who emigrated to East-Prussia from La Chaux-de-Fonds in the Swiss Canton of Neuchâtel. There is certainly some relationship to one of the Droz families there, which include a famous maker of humanoid automatons, Pierre Jaquet-Droz (English) (more in German). There are also video clips in English and more in in French. A longer video shows technical details, in French on YouTube. I don't have a reliable family linkage yet to the Swiss Droz family, but we enjoy the possibility.
- The rulers of Hessen played an important role in the fortune of many Wiederholds and Wedderolds in earlier days. Count Hendrik II. of Brabant (1204-1308), assembled, with the help of his wealthy wife Sophie von Thüringen (1224-1275), many small counties in central Germany. As Heinrich I. of Hessen he became the first Landgraf of what is now the state of Hesse in Germany. An appendix in that story provides a summary of the titles used and their significance.

A current draft of this biography has been placed in that collection as well.

Insights gained from genealogical work.

Working on the genealogy provides many insights into the past. Many marriages in the past were arranged in order to retain or increase land ownership. Intermarriages among cousins to various degrees, aunts and uncles are common. Mathematically the effect is that at the n^{th} generation there are fewer than 2^n ancestors. Since many men left to become soldiers, there are quite a number of unwed mothers in the ancestry. Being rejected by society, many moved and some emigrated. Their children would take on the mother's family name, even if the father was known. There was no privacy in village life, and the pastors were also well-informed. If the father decided to marry the mother subsequently they may have had to pay a Kirchenbusse, a penalty fee to the church.

Conclusions.

A rolling stone gathers no moss

Moving around is fun, promotes growth, but is not a path to fame.

Planning is useful – it contributed to a pleasant retirement, but one should remain open to opportunities, as moving from aeronautical engineering to computing and then to economics.

Writing, motivated in part by having a poor memory, allows sharing experiences and ideas with many more people than talking, even talking in front of a classroom where many are distracted. Text also can be updated, now easy on the Internet, allowing corrections and expansions.

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I only cite here some uncommon references. Those are now in my library. The many links to Wikipedia articles can provide most of the background if a reader wants to follow up. Most of my own papers are on-line at Stanford, or if copyrighted, referenced there.

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