GENIUS WITHOUT GENIUS:

The Autobiography of John Franklin

Vol. 3: Working at Hewlett-Packard — the Divisions

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In A New Technical Publications Dept.

On July 7, 1970, after several tries, I finally got a job at Hewlett-Packard. Art Heller was traveling at the time, and so I had to tell him the news over the phone. He made a crack about my taking the easy way out, since everyone knew that at HP people had it easy: they just sat in open bays of cubicles, with no individuality, and practically had guaranteed lifetime jobs. Worst of all, they were treated decently by management.

I was hired to write the manual for the company's — and the world's, as far as I know — first commercial Fourier Analyzer, the 5450A/5452A, an instrument for analyzing wave forms by breaking them down into their constituent frequencies, and then allowing various mathematical analyses to be performed on these frequencies. The company had decided to exploit a new algorithm called the Cooley-Tukey Transform (named after the two mathematicians who had discovered it), which was much more efficient than any previous one. The Analyzer would be used by, among others, automobile manufacturers for analyzing the vibrations produced by their engines.

For a few weeks the Fourier group, which was part of the Frequency and Time Division, a name I always liked, was located in Palo Alto. Then it moved to the first floor of the Santa Clara plant. I had, in effect, two bosses: the head of the Publications Dept., Bruce Anderson, and the head of the Fourier programming group, Pete Roth.

Bruce Anderson

Bruce was a guy about my age who had next-to-no college education, but who was expert at rebuilding Porsches, and usually won several prizes at the annual Grande Concorde d' Elegance, a fair at which renovated classic cars were shown. Knowing what a precision and expensive machine a Porsche is, and always ashamed of my lack of any kind of mechanical ability, I asked him how he knew what to do in the rebuilding process: for example, how did he know how tight to tighten the various nuts? He said that he used a torque wrench, and that the proper torque wrench settings (the maximum turning force to be applied to each nut) were available in published literature from Porsche. I felt relieved to know that this level of rationality had invaded at least the upper levels of the automobile culture: even someone like me, then, could tighten the nuts properly. Similarly, years later, I was glad when circular saws and nail guns and other machinery came into common use in the carpentry field, because these too removed the craftsman from the picture.

Bruce always smelled of cigarette smoke (he was a chain smoker) and engine oil. His fingers showed traces of oil, though I got the impression he spent a lot of time washing his hands so they wouldn't. He was a friendly guy, easy-going, a little overweight, and seemed to have recognized from the start that the way to supervise me was to leave me alone and to maintain a good sense of humor. And so I did my best for him.

John Buck

Also in the department was a tall, blond guy named John Buck, who lived alone in a little house in Palo Alto, and had an oafish sense of humor. He enjoyed aphorisms, for example, "A job done on time is a job done twice", referring to the fact that, at least in publications, you might as well be late, or just barely make the deadline, because if you were early, they would make you rewrite the manual anyway. He got a kick out of my aphorism, "Standing still is a step forward. (And a step backward is standing still.)" I think he or Bruce was the first person I heard pro-

nounce "doughnut" as "duffnut" (as a joke), from the fact that "gh" in "enough" has an "ff" sound.[1] These were still the days before the spelling was changed to the current "donut".)

Employee Humor

I think it is fair to say that the average HP employee, like employees everywhere, was always on the lookout for a little humor to lighten the work day. I remember that there was a manager in the division who was known to have made a couple of major blunders, and as a result was regarded as something of a laughing stock. He eventually decided to leave the company and start his own business. The company dutifully made the announcement, using the words, " — has decided to strike out on his own," which was good for a laugh for several weeks, since everyone immediately saw the pun on the baseball expression. No one knew if the words had been deliberately chosen for that reason. Employees were not shy about kidding their managers either, if they felt they could get away with it. Bruce's boss was a tall, somewhat awkward, bearish guy with a good sense of humor, and so Bruce and others called him "Yogi", after the Saturday morning cartoon character, Yogi Bear (the name obviously derived from the name of the Yankee catcher, Yogi Berra). In the opening sequence of the cartoon, Yogi would be introduced, in an appropriate cartoon voice — somewhat reminiscent of the doofus voice of Norton[2], Ralph Kramden[3]'s upstairs neighbor in the immortal comedy series, *The Honeymooners* — would be introduced as "Smarter Than the Average Bear", and so Bruce would sometimes greet his boss, or refer to him in the boss's presence, as "Smarter Than the Average Bear" in the same voice. The joke eventually wore thin on his boss, and I remember him saying to Bruce, in public, that it had been funny for a while, but now it was not funny any more.

We technical writers were all painfully aware of how far down we were on the engineering prestige ladder, and how great it must be to have a PhD, and how unfair it was that we didn't. So I proposed that if anyone wanted to be called "Dr.", then he simply needed to say so to the others, for example, at a coffee break: "Excuse me, but I would like to be called 'Dr.' " And then everyone else would do just that. The writers, especially John, thought this rather amusing, though a perfectly good idea.

Sharon Johnson

Our secretary was Sharon Johnson, a gorgeous young blonde about whom I had countless sexual fantasies. She could have been in Penthouse magazine. I once asked one of the writers, a gray-haired ex-career-Army guy, how he'd like to have her for a girlfriend. He replied that he wouldn't because he'd never want a woman in his bed who could think.

Pete Roth

In the Fourier group I worked under a young Jewish engineer named Pete Roth. (However, my desk was downstairs with the other writers — not with the engineers.) He had a slightly pigeon-toed walk and, though he was still in his twenties, he was already on his way to acquiring a middle-aged potbelly. I car-pooled with him and another engineer, Webb McKinney, to be introduced below. Pete and his wife owned a nice house in Los Altos, but, since they were determined

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1. Bernard Shaw, a great student and critic of English spelling, once argued that the correct spelling of "fish" is "ghoti": "gh" pronounced as in "enough", "o" pronounced as in "women", and "ti" pronounced as in "nation".
2. Played by Art Carney
3. Played by Jackie Gleason

to have only the best furniture, they had almost none. The few chairs and tables they did have were ornate, old, and obviously cost a fortune. He was also proud of the compost heap at the side of the house and showed me how it had two separate bins, one for material in the first stage of decomposition — he had me feel how the interior was hot — one for material in the final stage.

He drove a Volvo. He said once that he could never buy a German car, for example, the then popular VW Bug, because of what the Germans had done to the Jews.

There was no question about his excellence as an engineer and his determination to do the best job possible in this opportunity that fate, and his own hard work, had given him at an early age. But outside of engineering, he pretty much made things up as he went along. For example, he once told me that an argument for the theory of evolution was that, just when man began to invent industrial machinery at the start of the eighteenth century, evolution began producing men with the inborn capability of operating those machines, and for designing new and better ones. Occasionally, he put his own spin on the pronunciation of technical words. The word "causality" he pronounced "causiality". I wasn't above getting words wrong myself, however, and the first edition of the manual contained a reference to something called an "asking code", which was my understanding of Pete's pronunciation of "ASCII code" (the initials being pronounced *ask*ee and standing for American Standard Code for Information Interchange). This was (and still is, at the time of this writing) a standard numerical representation of letters, digits, punctuation marks used in the computer industry. Thus, for example, 101 is the numerical representation for "A".

Dave Snyder

I don't know how many programmers I have personally known in my life — certainly more than 50. The vast majority, as far as I could tell, were merely competent, almost always spending their time on optimizing their programs for speed, whether or not there was the slightest rational basis, given the goals of the project, for that effort. They liked tricks, cleverness, knowing more than others, covering their tracks. Not one that I ever knew had any interest in ways of improving the efficiency of programming itself (not of programs, but of the programming process), or of measuring their own efficiency as programmers. I have known perhaps four programmers who seemed far above the rest, albeit for vastly different reasons. One worked on the Fourier project. His name was Dave Snyder, and his initial task was to speed up the Fourier algorithm by improving the microcode, that is, by improving the subordinate programs at so-called "machine level" that interpret the Assembly language instructions that the programmers wrote.

He had a strong preference for a certain type of donut, and would always keep an eye out for the donut cart to be sure he would be able to get his kind: large and covered with sugar granules. Having been raised properly, he knew that all that sugar was bad for you, and so he would tap the donut on the donut tray, which was covered with white paper, several times to at least knock some of the granules off. He drank a lot of coffee, and throughout the day, including when he was talking to you, he would routinely go over to the coffee urn, slosh the remains of the coffee in his paper cup into the drain beneath the spigot, and refill the cup, all the while continuing what he was saying.

He spoke very rapidly, and usually seemed to know exactly what you were going to say before you said it, though he was never impolite. He had one of those extraordinarily fast minds that immediately saw to the core of a problem. In discussions about technical problems which had the remotest chance of being amenable to solution by a computer program, he would say, in that rapid, dismissive way of his, "It's trivial, it's trivial," and then outline how a program could be used to solve the problem.

The run-of-the-mill programmer, given Dave's assignment, would have started by poring over the existing Assembly language programs, trying to figure out which parts could be changed to increase the overall speed. Instead, Dave made a loop of paper tape which he kept in the tape reader. Whenever the Analyzer was working, this tape would move forward regularly one byte at a time (a byte was a sequence of holes running across the width of the tape), and when a special byte had been reached, it would cause the program that was then running to be interrupted, and a little program of Dave's creation to be invoked. This program would record, in a table of addresses, the address of the instruction that was being executed at the time of the interruption. After a day or so, the table would be printed out in a form that showed the number of times each address had been recorded in the table, and by simply glancing at this printout, and then figuring out in which programs the addresses occurred, he could find out where, in fact, the programs were spending most of their time. Using this information, he was quickly able to increase the speed of the programs significantly.

He also devised a humorously clever way to defeat competitors' attempts to steal the programs or to study the program statements in order to figure out what some of the secrets were. He wrote a little program that would fill the entire memory with halt commands if anyone tried to print out the contents of memory. I saw a demonstration once: someone typed the command that caused a certain forbidden section of memory to be printed out: in an instant, everything came to a halt, and no matter how often you pressed the next-memory-location button, the same number always was displayed in the sequence of lights that showed the contents of the current memory cell: 10703: halt. As far as I know, throughout the life of the product, this little program did its job perfectly.

Webb McKinney

Another engineer on the Fourier project was Webb McKinney who, it turned out, lived only a few blocks from us in Los Altos, although their house on Van Buren was much bigger than ours (they added another room soon after they bought it — from a contractor named Pounder) and was situated on an acre of land. Webb, Pete Roth, and I carpooled to work (the plant was about 20 miles south of Los Altos, just off Route 280). The only thing I remember of all the conversations we had going to and from the plant for well over a year is that I once remarked that I felt that every educated person should know Kepler's three laws. Being well-trained engineers, they disagreed, saying that I couldn't expect that, especially as that kind of knowledge wasn't useful. Then, for some reason, Pete dropped out, after which Webb and I carpooled alone. Once he forgot to wait for me and drove straight home after work. When I called him, he replied cheerily, thinking (as he told me years later), "How nice of John to call, and I only saw him this morning!" Then, after a few moments, he asked where I was. "At work." Only then did he remember.

He was tall, good-looking, and had a sunny sense of humor. He always seemed to be just waiting for the next funny thing to come up in conversation. He got along well with people, yet at the same time was a thoroughly competent engineer. Both he and his wife, Chris, were from southern California (when he referred to Los Angeles, he often called it "Boss Angeleez), and they both, she in particular, had something of that aggressively carefree attitude toward life which, to me, was part of the personality of everyone who lived there. Chris's father was a well-known radio and TV announcer, Steve Dunn.

Webb and Chris had two little girls, both named after girls in Louisa May Alcott's *Little Women*. Megan was the older one, and I think Amy was the name of the younger. Webb's father had been a bomber pilot during World War II, and had been killed in a raid over Germany. His

mother idolized Webb and apparently let him know throughout his childhood that he could do no wrong. As a result, he grew up to be a confident, happy, man. He had an extraordinary memory for song lyrics — I think it is fair to say he knew all the lyrics to all the songs that Bob Dylan recorded in the sixties. In conversation, he would quote lines of Dylan the way some people quote Shakespeare. I remember, for example, him quoting the following lines from Dylan's "Desolation Row":

> Einstein, disguised as Robin Hood
> With his memories in a trunk
> Passed this way an hour ago
> With his friend, a jealous monk
> He looked so immaculately frightful
> As he bummed a cigarette
> Then he went off sniffing drainpipes
> And reciting the alphabet
> Now you would not think to look at him
> But he was famous long ago
> For playing the electric violin
> On Desolation Row

He and Chris played guitar, and together they often sang and played the song "Leaving On a Jet Plane":

> ... So kiss me and smile for me,
> Tell me that you'll wait for me,
> Hold me like you'll never let me go.
> 'Cause I'm leaving on a jet plane, I
> Don't know when I'll be back again,
> Oh, babe, I hate to go....

In my mind's ear I can still remember the, to me, strange emphasis on the word *on* in the line: "I'm leaving *on* a jet plane...". Webb could also recite Wordsworth's "The World is Too Much with Us", which, like me, he had had to memorize in high school.

He called me "Doctor" because I always seemed to be preoccupied with books (most of them having little to do with engineering or business).

He also had a certain gift for mimicry. Often, as we drove up Los Altos Ave. on the way to work in the morning, we would pass two old women who apparently went for a walk together at that hour, and he, having decided they were Italian, would suddenly break into whatever we were talking about and say, all the while gesticulating appropriately, "Èh, buon giorno, come stai, va bène, èh, ...", the words all run together. He also did a flawless Black Panther imitation: "I have had en*uff* of the white fascist social structure that oh-presses everywhere the black man in his struggle to gain *pow*uh and achieve the revolution that ..."

He called Wednesday "Hump Day" because it was the middle of the week: after it you went down toward the weekend.

Steve Cline

Another engineer associated with the Fourier project (I think he worked in Webb's group) was a tall, blond guy in his late twenties named Steve Cline. I kept wondering about what I considered the peculiar spelling of his last name: Was he Jewish and had his last name originally been Klein but he now was trying to conceal it by the rather odd spelling? Or was "Cline" just a Scandinavian name I was not familiar with?

He was always friendly, except once when, in the course of discussing an Assembly language program he had written, I referred to him as a programmer. "Don't call me a programmer!" he said, clearly insulted. Off and on over the years, I ran into a similar attitude among engineers. Programming was something an engineer occasionally had to do, or, better still, had done by somebody else, but it was not a fit activity for a person intelligent enough to have earned an engineering degree.

Steve was the first person I came across who used the vaguely academic phrase, "I claim", in discussions and arguments, for example, "OK, now if you write the program so that...and then you issue a call to the subroutine...then I claim that you will get the value of ..." I started using the phrase myself, because it seemed to soften assertions a little. Instead of saying that such-and-such would or would not happen, which could be regarded as confrontational by egotistical engineers, you could always stick this "I claim" in front of it, just as in conversations with non-technical types, you might say, "I believe", "I feel".

For all his status consciousness, he always gave the appearance at least of recognizing your presence in his world and seemed willing to listen to what you had to say. This may have come from his role as a Big Brother, which I gathered meant a lot to him.

Dave Goelz

One of the most amusing characters I ran into during the Fourier years was a guy named Dave Goelz. If you were a viewer of *Sesame Street* during the eighties and later you probably saw his name many times in the credits. But in those days he was just another engineer — an industrial engineer by education I think. Like certain other characters in this narrative, he didn't have his heart in his work. Or perhaps I should say: he couldn't take seriously the world of corporate enterprise in which he found himself because he kept noticing its absurdities. As a result, he sought escapes, and one of them was an ongoing search for what he called "shit stands", which were hole-in-the-wall little lunch counters in San Jose and elsewhere that served good falafels. He also couldn't resist a good challenge as long as it had comic dimensions. Thus, as Webb told me many years later, he conceived the project of seeing how long it was possible to keep a life insurance salesman in his house. Once, he apparently was able to keep one of these poor souls in a state of hopeful expectation until well into the evening hours. Then, when the salesman returned the next day to clinch the deal, Dave answered the door wearing only a hat — otherwise he was stark naked. The salesman retreated in shock and disbelief.

He once trained a dog to stop barking, by buying a whistle whose purpose was to get dogs to bark. But he kept blowing it continuously until the dog went hoarse and lost its bark.

Another time, he and his girlfriend dressed as mountain folk and went car shopping. They told each dealer that they were looking for a station wagon, but that it had to have a ramp instead of a rear door, so that their little beagles wouldn't dislocate their limbs from jumping out the back.

Eventually the company realized that the only way it could keep him actually doing work was by indulging his interest in muppets. So he was assigned to make training films for new employees. Some of the muppets he created were hilarious caricatures of well-known executives in the company. He was able to mimic all their speech peculiarites. One of these executives was a man

named Dexter Hartke, who spoke with a slight lisp and tended to water his s's and x's. So the films featured a character named Hexter Dartke who spoke the same way as Dexter did. Webb told me that Dave's imitation of Dexter's speech was so good that he once called an employee of Dexter's and in his voice said, "Come into my office immediately." When the employee arrived, out of breath, Dexter of course asked him why he was interrupting him when he was in an important meeting.

Dave made copies of the *Sesame Street* characters Bert and Ernie and sometimes went to local grammar schools to put on a performance for the kids. He told us once that he was always amused by the way the kids would initially spend as much time looking at his bare arm below the muppet sleeve, as they did at the muppet itself, but that gradually, as the performance continued, and he made the muppet character talk to them, their attention would eventually be exclusively on the face of the character, as though it were that of a real creature.[1]

One day he heard that Jim Henson, the creator of the muppets, was going to be passing through San Jose. Dave called the muppet studios and asked if Henson could spare a few minutes so that he could show him some of his creations. Henson said yes, they met, Dave gave a demonstration, and Henson hired him on the spot.[2] He worked for Henson for many years, creating the characters Gonzo, Dr. Bunsen Honeydew, Zoot (the saxophonist of *Dr. Teeth* and *The Electric Mayhem*), Beauregard the janitor and Tiny (the huge chicken in *The Adventures of Elmo in Grouchland*), among others.

The Manual

I had come into the project remembering next-to-nothing of the math I had struggled to learn in my 2½ years of electrical engineering courses some 15 years earlier. Apart from that, all I had studied in the way of mathematics since then was the formal logic in Manny Gordon's seminar. One of the main textbooks the project members used was Ronald N. Bracewell's *The Fourier Transform and Its Applications*. Bracewell was a Stanford professor, and had attempted to write a book for engineers, as opposed to mathematicians, and as a result had provided ample illustrations, but for me, with most of the calculus gone from my memory except for the meaning of a few basic symbols, it was desperately hard going. I went over and over some of the pages, and often felt as though my brain cells were scraping the dry, solid bone of the inside of my skull in their attempt to achieve an understanding.

The manual for the Fourier Analyzer was in the usual expository format, the tacit implication being that the prospective user would start at page 1 and *learn how the machine worked*, then apply what he or she had learned in order to accomplish his goals. (This was still several years before I developed the idea of the Environment format, in which the user didn't have to learn anything at all in advance *if* the manual were organized so that he or she could always look up the desired operating procedure quickly, for example, in less than 25 seconds.) Like the other writers, I prepared a succession of typewritten drafts each of which was reviewed (more or less) by Pete and perhaps one or two of his fellow engineers, and, maybe, briefly, by his boss, a friendly,

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1. The *Sesame Street* people knew full well the importance of keeping the parents interested in the show, and so, for example, they created a pink flamingo character named Placido Flamingo, the name not only making perfect sense to the kids, but also no doubt bringing a smile to the parents who enjoyed classical music and, in particular, the singing of the great tenor Placido Domingo. In the nineties, a story circulated that a youngster who happened to hear the tenor announced on a PBS concert program, piped up, "Look, Mommy, that man has the same name as Placido Flamingo!"

2. The story in the 9/24/10 Wikipedia article on Dave is somewhat different.

thoroughly capable engineer named Ago Kiss. Then the final draft was given to repro typists to type out on an IBM Selectric or equivalent in order to produce camera-ready copy for the printer.

A few words about Ago are important here. He was a man you felt comfortable around. At the time he was probably in his forties or early fifties, with thick hair that was thinning on top. He always had a ready smile, always seemed glad to have you drop by his office and discuss any aspect of the project. He had fled his native Hungary after the 1956 revolution. He led his team to deliver, on time, a major new product for the company, and thus was generally regarded as destined for promotion to the higher ranks of management, possibly to Division manager eventually. But I heard several years later that he was passed over on the grounds that he was too inclined to give credit to his employees, rather than taking it for himself.

I was well aware of the opportunity I had been given, so I worked hard to make the manual as worthy of respect as the new product it described. Because I was always unsure about what you actually had to do to make the machine work properly, I added pictures of the sequences of keys the user was supposed to press, which was something of a novelty, plus photographs of various waveforms as seen on the oscilloscope. I did my own illustrations to show how the waveforms were digitized and how the resulting bits (1's and 0's) were stored in memory. I heard no major criticisms of the manual afterward, and so I have always assumed it was a success.

Bruce, my supervisor, gave me all the freedom I could ask for. (Once he called me, with a wry smile, "the resident genius", which, I admit, made me feel quite good.) Perhaps to show his appreciation for my good work, he asked me if I would interview an applicant for a writer's job. The guy turned out to be a shy, soft, eager-to-please type. He said he was a poet, and I felt sorry for him (a poor bastard trying to survive in a world he was never meant to live in). Then he revealed he was a believer in Scientology. I was intrigued, having heard very little about the movement. I asked him about it, but the fact that a guy so weak was an enthusiastic member made me suspicious of what it was promising its members. (This was before the numerous scandals about it broke. The saying of the founder, Ron Hubbard, "If you want to get rich, start a religion", clinched the whole business for me.)

Our Neighbors

As in all suburbs, we knew very few of our neighbors. The Connors lived three doors down on W. Portola. We knew them because Jeff played with their two sons Scott and Ty. Two doors the other way lived Jane Wilson, whom we knew because Jeff played with her son John. Next door to us lived the Bradners, who had no children. We said hello to them when we saw them, but that was about it. Mr. Bradner ran a dancing school.

A few doors beyond the Connors lived the recently widowed wife of the poet Yvor Winters, who had died in 1968. On this rather dull suburban street, with a school ground on one side, here was a literary cottage, hidden away behind tall bushes and trees and an old gray wooden fence. We visited her once or twice. I remember lead-lined windows, greenery outside, blue and orange vases on the window sill, books everywhere, old, comfortable chairs. Clearly the home of a writer. Mrs. Winters herself was a thin, tall woman with gray hair, quite friendly. I was surprised that a well-known poet would have chosen to live on such an ordinary street. But it didn't much matter, since I hated him anyway because he had been a Stanford professor.

A Trip to England

In the early seventies, Marcia got the idea of our making a trip to England. I never quite understood why England and not some other country, but that is what she had decided. I'm sure she couched her initial proposal in language of the sort, "Let's take a trip!" or "I think it would be fun to go to England, don't you?" But the truth is that no matter how she couched it, I didn't want to travel anywhere. In effect, it meant having to give up what little self I had; it meant becoming an object that is defined by travel brochures, and what must be seen, and what must be memorized, with all my books and writing paper thousands of miles away. But she was determined and, resigning herself to my lack of enthusiasm, she planned everything. She decided — I suppose for practical reasons — that we should bring Jeffrey with us. He was then about three.

With the anguish that only those who have no self can imagine, I left our home, climbed into an airport van with my wife and child, and the three of us were driven to the airport (or maybe we took the car, I can't remember) and got on a plane for the 13-hour flight to Heathrow Airport. In the plane, trying to keep my fragmenting self together, I got through the successive moments by saying to myself, over and over, "Just live through this next minute, that's all you have to do, just the next minute." I thought about where we were and what we were doing: we were sitting inside an aluminum tube, hurtling through the air at hundreds of miles an hour. What would it be like to hit something at that speed? Would there be a fraction of a second in which I saw the crumpling front of the plane coming back at me, the passengers and stewardesses flying through the air — starting to fly through air — with an expression of combined horror and astonishment on their faces? It was almost unbearable to think of how fast we were going relative to a solid mountain or other plane directly in front of us. We were racing to our deaths.   I was riveted with anxiety about being able to get an erection in strange surroundings when I could no longer put off sex.

In London, we searched for a place to have lunch, our first meal in England. Somehow we decided on an Indian cafeteria, and I remember how bad the food was: it was the food of cooks who didn't care about cooking, who couldn't wait to get home, who didn't have enough time or money to spend on doing the job right. I remember cardboard bread and lukewarm coffee and some sort of brown mixture that might have been beans and curry. I told Marcia, almost with disbelief, "It's really true! English cooking is terrible!"

 If the food, at least initially, lived up to its reputation, so did the people live up to my prior image of them, only in this case it was the image I derived from seeing countless British films. In fact, I couldn't get over the impression that the whole country was like characters out of British films — in other words, that the films were the reality and the people mere imitations.

I may have been prepared for the food and the characteristics of the people, but the toilet paper was a complete surprise. Who would think of making toilet paper shiny, almost like wax paper — exactly the opposite of what you wanted for the job! Furthermore, it had virtually the same color as what it was intended to remove. You kept wiping and there was always more left to wipe, except that it had been smeared over a wider area. I thought it must be left over from World War II. Maybe they had manufactured too much of it, and still hadn't been able to get rid of it.

On the other hand, I loved the explicitness of the signs. Yes, this was the land of the greatest of all authors. For example not the boring, bureaucratic "Exit" but "Way Out", which always brought a smile because it was the expression we had used as jazz musicians to signify that a piece of music was not only outstanding, but pushing the very limits of the art form.

We rented a car and set out for Bath. We were to share the driving, with me going first. I thought it was suicidal for a man who had all his life driven on the right side of the road to set out driving a car on the wrong side, in a car in which the steering wheel was on the wrong side. With

your wife and child beside you, you had to drive on the wrong side of the road over narrow, winding roads with stone walls and hedgerows on both sides, and drivers who did this every day speeding by you. The only way I thought we had a chance of avoiding a headon collision was if every moment I sat at the wheel, I kept repeating to myself, "Drive on the left, drive on the left, drive on the left...", and constantly thinking about every action I took as driver, every shift of the gears, every turn. Strangely enough, Marcia was more confident than I, almost pooh-poohing my repeated expressions of fear.[1]

In Bath, she had booked us into a little bed-and-breakfast. Our room was in the attic, our narrow bed under the sloping roof, Jeff in a little bed in front of a dormer window. God knows how many times we had sex during the trip but I can assure you I took every opportunity to find an excuse not to be subjected to the ordeal. Suppose he wakes up? Suppose they hear us downstairs. How can I perform when all these other considerations have to be kept in mind? Surely, she can't expect me...

The owners were a middle-aged couple who had survived the Blitz. I was eager to hear their stories of what it had been like. As it turned out, they were pretty much what I had already heard and read: they spoke of the comraderie in the tube tunnels, the getting used to the alarms going off, and the rationing, and the prospect of their house being destroyed any night. They spoke of friends, relatives, who lost everything in a raid. They spoke of the time with a kind of fondness, as though to say, "We were a nation then, we showed our mettle then..."

We visited the Roman baths, and I couldn't get over how depressing they were: a dark, slimy pit in the basement of a shell of a building with dusty shafts of sunlight coming through arches high above. Pipes, signs of construction, as the baths were in the process of further excavation. Here and there a placard on a wall, and a faint mosaic. I thought, "If you think you are depressed, think about those times, when the height of the day was sitting in a pool of hot water."

We went to the Lake Country, and the single memory I have of the place is how small it was. All those poems, all those difficult words, all those hours of trying to understand Wordsworth's concept of Nature, and this is all he was writing about? A few ponds surrounded by a few hills? (I had imagined something equal to the scope of the Rocky Mountains.)

Similarly, when we visited Robert Burns' house in Dumfries, I was amazed at how small it was, how primitive. He was able to write all that poetry when this is what he had to squeeze himself into at the end of a hard day in the fields, and with no electric light, only a kerosene or oil lamp? It should have filled me with admiration, but it didn't. I felt I had been conned all those years. I had a similar reaction to Thomas Hardy's house in Dorset. A little cottage behind greenery at the fork of two little dirt roads... Such big literature out of such small places! Shakespeare's house in Stratford-on-Avon seemed all but unlivable: the beams upstairs, long hallway — it was more like a dorm than the home of the English-speaking world's greatest writer.

The last place we stayed was a Victorian mansion that had been converted into a small hotel. For some reason, it reminded me of Toad Hall in *The Wind in the Willows*. In the late afternoon, they had the equivalent of a cocktail hour, which I always looked forward to. We went into the bar (exactly as in *Fawlty Towers*, which had not yet been written), had a drink, or maybe just tea, and enjoyed feeling well-off. One time I got into a conversation with another guest, a guy probably in his thirties, with wavy blond hair, who looked exactly like one of the characters in the sixties British comedies. I was struck by his barely concealed eagerness to be sure that Marcella and

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1. "Another serious problem is stepping off the curb and looking the wrong way. I always found British drivers very aggressive, too, which surprised me, since the Brits are so diffident otherwise." J.S.

I knew he was a member of the upper class. In fact, so indirect were his references to the working class, that it took me some time to realize what all those euphemisms, grimaces, jerks of the head were referring to.

Jeff was sometimes a problem, but I remember no details. I don't see how we managed to take care of him and still do everything Marcella had scheduled. He has said several times that he has no memory of the trip except for "an overhead light in a hotel in London."

I of course was allowed to have a notepad and a few books. In England I bought Geoffrey Hunter's *Metalogic: An Introduction to the Metatheory of Standard First-Order Logic*, and found some relief from my daily depression in the challenge of trying to understand these wonderful, dry, rules about, not finite, but *infinite*, realms. On a hilly street in some medieval town, I remember trying to imagine how statues must have looked to the people of the middle ages and earlier, in a time when the only visual images most people saw were, in fact, the ones in the churches. And I came up with the idea that they must have seen a statue as a kind of frozen version of the actual person, or demon, or animal. That this *was* the person or creature, right there on the wall, he just happens not to be moving at the moment.

I sensed Marcia's impatience: "The trip is not turning out the way I wanted and he is the cause of it." We swept through her itinerary, I always pulling up the rear, psychologically if not always physically. And so it was inevitable that my anguish and misery would explode sooner or later. It happened in London, when we were returning the car to the rental agency. I no longer remember the cause, but I know that we faced off there in the waiting room and shouted at each other. I was convinced for a few moments that there was no more space left for me in the world, that it would be shameful if I went on living another day. I felt as though my guts were being ripped out, or that it had been decided to turn the remainder of my supply of air off. We may have talked about cancelling the rest of the trip, of going home separately. Somehow we decided to finish the trip together.

Two incidents made me aware of how different England and America really were. We had stopped in a little town, I think to get something to eat. When we came back to the car, a bobby was walking back and forth on the sidewalk, apparently trying to gather some information as to whom the car belonged. As we approached, he said, "Excuse me, but would this be your car, sir?" I was amazed at the politeness! "Yes, I said." "I assume you are visiting our country," he said. "Yes," I said. "We're Americans, here for a summer vacation." "Ah," he said. "Well, here in England, we do not park where the curb is marked ..." and he mentioned some identifying characteristics. "There will be no penalty this time, but in future, we would appreciate your observing this rule." And he gave a kind of brief forward lean (not a bow, certainly), turned and walked off, nightstick at his back. As so often happened in response to a gesture of kindness toward me, I was moved almost to tears. "The British are great!" I said to Marcella. "They're civilized!"

Another incident established this fact beyond a doubt. We had gone to Brighton for a day's trip, and visited several historical sights along the coast before returning, including a little chapel where the remains of an early queen or princess, I can't remember. We pulled up the driveway of our hotel, opened the doors to get out, Marcella looked behind the back seat for her handbag, didn't find it. We quickly searched the car, and realized that somewhere in the eight or more hours of the day's trip, she had left it behind. It contained all our money: some $800 worth of travelers' checks, plus cash, plus our passports, plus her identification and personal effects. We stood looking down at the driveway, and I said, "Well, there goes our vacation." We trooped inside the hotel, got to a phone, somehow found the police station that had some kind of central authority for the area we had been in. It was six in the evening, I remember. We both were con-

vinced that there wasn't a chance in a million that anyone would return the bag, considering its contents.

About 25 minutes later, the phone rang. It was the police station. The bag had been found. Marcella had left it on a quay not far from the chapel. The quaymaster had found it.

We were beside ourselves with gratitude. We asked the policeman on the phone for his name and phone number. He gave it to us. I called him, and practically with tears in my eyes and my voice choking, I thanked him and told him we wanted to drive down and give him a financial reward for what he had done. He declined our offer, and then said, in a voice that sounded like that of a character out of a British film — the stalwart, gray-haired captain of a ship that he had just brought safely into port despite storms, enemy fire — , "Knowing you have found it is reward enough." ("Rule, Britannia, Britannia rule the waves...!")

We drove to the police station, where the quaymaster had brought the bag or they had brought it after retrieving it from him. We asked if we could give them a token of our appreciation, some kind of reward. No, the stern, but friendly face behind the counter, said. "You saved our vacation!" I kept repeating. No, thank you, it's just our job. Finally, he agreed, reluctantly, to allow us to put some some money in the policeman's charity box — I forget what it was for: maybe the retirement fund.

These two incidents made me realize what it means for a country to be civilized. Imagine, a country in which people return things, including handbags containing money! Unthinkable in the U.S. A country in which the police are polite and respectful and actually seem to be proud of the fact that they are serving the public. After the trip, I had no doubt about the importance of courtesy and honesty in daily life, even though there are no Nobel prizes in common decency. No Hollywood films about ordinary people returning wallets and purses they find in the street or in bus stations or airport terminals. No acts of politeness reported in the evening news. And yet, ever since that trip, I have had no doubt that a country in which these things are lacking is a wasteland — or, to put it on more personal terms, a country in which these things are part of daily life is a country in which even the most despairing soul may find a reason to postpone suicide for one more day. I say that even while keeping in mind a story I heard about the comic author S. J. Perlman. Apparently he became fed up with the rough manners and crime in New York City, and so decided to move to England. But after two years he returned, and upon being asked why, he replied, "There is such a thing as too much couth." Not for me..

My Intellectual Development
Readings

During this time, the early seventies, I attempted to go through the whole of Heidegger's *Being and Time*. (I had started reading the book in the Frequency and Time Division at HP.) I tried it in German at first, but that was far too difficult, so I settled for the 589-page Macquarrie and Robinson translation. I carried the book around with me, even took it to the beach, and worried aloud to Marcella about someone stealing it: there could be roving bands of *Being and Time* thieves, I said, preying on absent-minded intellectuals at beaches and resorts! She: "If anyone is going to steal something from you, it's not going to be that book!" Even though I worked through the pages line by line, word by word, over and over, they were so difficult that at first I seriously considered the book might be a hoax, a kind of ultimate satire of impenetrable academic philosophic works. But I also had Walter Kaufmann's paperback, *Existentialism from Dostoevsky to Sartre*, which had a chapter on Heidegger, and I didn't think that Kaufmann would perpetuate a

hoax[1]. Eventually, I was driven to making an index of Heidegger's terms — "Being-in", "Being-in-itself", "Being-in-the-world", "existentiale", "existentiell"—with brief explanations of the meanings, and references to the pages where the term was used. I felt I had no other choice but to take Wittgenstein's dictum literally — "The meaning is the use". True, there was an index in the back of the book, but it didn't refer to every page where the term was used, and also didn't provide a brief definition of each term.

Two sentences in all those hundreds of pages struck me and made me believe that Heidegger really might possess the originality that he was reputed to possess: "Dasein [human self-conscious existence in the world] is an entity which in each case I myself am,"[2] and "When, for instance, a man wears a pair of spectacles which are so close to him distantly that they are 'sitting on his nose', they are environmentally more remote from him that the picture on the opposite wall."[3] The reader who knows anything about Heidegger's works will perhaps say, Well, yes, the first sentence expresses an idea of fundamental importance in the philosopher's thought, but the second defintely does not express in any way the second-most important idea in his thought! But these are what stayed in my mind, in addition to a vague understanding of the meaning of some of his numerous technical terms: "Being-in", "Being alongside", "Being-towards-death"", "ready-to-hand", "thrownness", "authentic", etc.

For many years I was convinced that the book contained an enormously deep, important truth, which I was prevented from understanding because I had not been able to study philosophy in Germany. At the same time I had a great deal of trouble believing that this book really described *all* of the human condition, despite the implicit claim that it did — that it described not only the experience of Germans and Europeans in the 20th century, but also that of primitive tribes past and present throughout the planet. (I had the same doubts when I read the other existentialist philosophers, and Hegel.) It seemed simply unbelievable that a German or French philosopher could come up with a theory of that scope, especially given the fact that he had no first-hand experience of these other cultures. Eventually I came to agree with the view of a group of philosophers, also German, who flourished in Vienna at about the time the book was written, that books like this are not *treatises*, they do not set forth *theories*, they are works of art, fundamentally no different than, for example, pieces of music. But that realization was still years in the future[4].

I am not sure, but I think it was around this time that the thought began going through my mind, "Things don't merely exist, they exist in a certain way." The thought was intriguing because it forced me to contemplate its opposite, namely, things that could exist in any way whatsoever — things whose only property was existence! — and what kind of things would they be?

Also around this time I discovered Sylvia Plath's poetry. Poems like "Ariel", with the lines

"...I
Am the arrow,

The dew that flies

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1. But in 2004, a woman who had studied philosophy at Princeton said Kaufmann had written pamphlets for the Rev. Sun Myung Moon's Unification Church ("the Moonies"). I don't know if this is true.
2. Heidegger, Martin, *Being and Time*, tr. Macquarrie, John and Robinson, Edward, Harper & Row, Publishers, N.Y.., 1962, p. 78.
3. ibid., p. 141.
4. The critique of Heidegger I eventually arrived at is contained in the essays, "The Object", and "Philosophy", in *Thoughts and Visions* on the web site www.thoughtsandvisions.com.

> Suicidal, at one with the drive
> Into the red
>
> Eye, the cauldron of morning"

and "Death & Co.", with the lines

> "I do not stir.
> The frost makes a flower,
> The dew makes a star,
> The dead bell,
> The dead bell
>
> Somebody's done for."

seemed to fit perfectly Emily Dickinson's definition of poetry ("...if it tears the top of your head off..."). She was famous at this time (although I never met anyone who quoted even a line of hers), largely because she had committed suicide at 31[1], and because of the female rage that was expressed in her poetry. When I first came across her book, *Ariel,* I knew nothing of critical opinion of her work, but there wasn't the slightest doubt in my mind that she was a great poet. I also read her novel, *The Bell Jar*, which I think Marcella said she had read in school.

Kepler's Bookstore

My main source of books was Kepler's in Menlo Park, which sold only new books. Mr. Kepler had a reputation as a staunch liberal who was opposed to the Vietnam War. (I remember sitting next to him once at a meeting to plan a protest demonstration.) As a result, in the early seventies, right wing groups threatened to attack his store, and in fact Neo-Nazis taped explosives to the store windows and set them off at night. I, along with many others of his regular customers, called the store and volunteered to stand guard outside it. But I was never called back.

One of the clerks was a man named Ira Sandperl, a well-known expert on Ghandian non-violence. He had the looks and manner of a Jewish rabbinical scholar, and was a strong influence on the young Joan Baez. I always had the impression that all that idealism was little more than the attempt of an old man to compensate for his passionate, unrequited love for that beautiful young woman. This is no doubt unfair to him, since as far as I know he was a Ghandian long before he met her. Nevertheless, I always felt that his idealism had a bad odor.

Ironically, Kepler's was the only bookstore I have ever patronized at which I was suspected of stealing books. I had been browsing, looking for a book I didn't find, stepped out of the front door, and was accosted by a young woman who followed me from inside the store. Smiling politely, she asked me to open my knapsack, which I did. I remarked that all the books were mine, she could check my markings of important passages. She smiled, looked through the books, and made clear that she doubted me. I was completely flustered, and, as in my childhood, started thinking — started *believing* — that I had in fact stolen a book and had suppressed the act in my mind. When she finally allowed me to go, I was ashamed and racked with guilt.

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1. In 1963.

Bell's Bookstore

The other bookstore I patronized was Bell's in Palo Alto, which sold used books. I considered it part of my self-discipline to be able to withstand the intimidation of old man Bell, who reminded me of an English professor (and then, later, of the tyrannical law professor Kingsfield in the 1973 film, *The Paper Chase*). At first, of course, I would just march in as I did at any other bookstore and ask if he had a certain book. He would stand and look at you over the tops of his Ben Franklin half-glasses, then draw air slowly into his lungs, never once taking his eyes off you, as though he were asking himself if it were really possible that the human race could continue to produce such dunces as the one currently standing before him. Then, half under his breath, as he turned away, he would say, "Upstairs in the rear on the left". And you would crawl up the ancient wooden steps, find your way to the location he had named among the ancient, creaking, brown-wood bookshelves, and only hope that the book was there, because very few human beings, much less intellectuals, could endure his response if you went back after he had already given you instructions as to where a book was, and said that... *you couldn't find it there!*

The task of not arousing his anger — or I should say, of not doing something that would bring his contempt for his customers to the surface — became a game with me. Even if you bought something, even if you were able to find what you wanted without having to go back and ask him for further instructions, he would always sigh, like old Mrs. Donovan in the candy store in Valhalla, as he figured out your bill. I would rack my brains trying to come up with the behavior of the ideal customer. Would the customer have a running tab, so that the old man would only have to send a bill at the end of the month? Would the customer just know that he should ask in order to begin such a charge account? Or did the customer know the sales tax by now, for God's sake, and simply compute the total price and place the money, in bills and change, on the counter, along with the book?

I always had the impression that here was a man who hated the world, hated life. Yet I couldn't help wondering why, if you could spend your days among books, you wouldn't be a little less unhappy. A woman worked with him who I assume was his wife. She was small, thin, nervous, and had long since been reduced to the role of the female who knows that her one purpose in life each day is to try to avoid making her husband angry at her while at the same time knowing that this is all but impossible.

Trying to Learn Languages

I had had German in high school and at Lehigh, but was always ashamed at how little of the language I understood, so over the years I would every once in a while buy a new or used text and attempt to go through it. The tedium of doing the exercises soon proved too much, and I would lapse into mere reading: everything from Goethe's *Faust*, Part I (and later Part II) to collections of short stories to Mann's *The Magic Mountain* (twice: the second time with the original German in one hand and an English translation in the other, thus saving the time and labor of turning dictionary pages) to Günther Grass's plays and novels to a German newspaper published in San Francisco (the *Deutsche Freie Presse*, to which I subscribed), to Georges Simenon novels in German translation. I also listened to a local German radio station .

In the early seventies, I decided I should learn Italian, so I bought the Berlitz book, with its illustrations of the little professor and its ad hoc English renditions of Italian pronunciation. Here I did all the exercises, one reason being that anyone who went through the book was offered a free lesson at a Berlitz school. When I finished, I called them, said I was ready for my free lesson. A time was set in the evening. I drove in to San Francisco, went up a flight of stairs, knocked, and

was ushered into a small room where there sat a smiling woman in her thirties who seemed glad to welcome such an ambitious student. We talked for an hour, mostly in Italian, and I felt I did rather well. There was a clear offer of further instruction, for a price. I said I would think about it. The fact was that the cost was way too high for me (something over $400, I think), and so instead I put an ad in the local paper, or saw an ad, and started weekly sessions with a Signora Accornera in Sunnyvale. She was a little old lady who lived with her husband and several relatives in a tract house. Unfortunately she was no teacher. She also didn't speak English. No sooner had I uttered, or tried to utter a few words, than she corrected me with a long-winded explanation that I didn't understand. I would try again, again be interrupted, again receive a long explanation. I stopped going to her after a few weeks, and, as with German, contented myself with reading an Italian newspaper and collections of short stories and listening to a local Italian radio station. Once or twice, I attended services at a Catholic church in San Jose in which at least part of the service was in Italian. I was surprised at how casually the members of the congregation dressed for these services. (Since Italian has no prestige in the intellectual world, in contrast to French and German and Latin and Greek, I was completely confident that I could learn it on my own, and indeed I always found the language much easier than those others. But the reason may be that it is, in fact, much easier for an English speaker who had had Latin in junior high school.) At some point, my stepfather, Emil, gave me his copy of the Langenscheidt's Home-Study Method for Italian[1], a book some three inches thick, in German Gothic print, with rigorous grammar and exercises and examples from Italian classic literature. He had gone through the entire thing.

Being an intellectual, I was always deeply ashamed of my paltry knowledge of Latin. So here, as with German, I made attempts over the years not to master the language, which I knew was hopeless, but at least to be able to understand the Latin quotations I came across in my reading. In the sixties I bought Frederic M. Wheelock's paperback *Latin: An Introductory Course Based on Ancient Authors* (Barnes & Noble, N.Y., 1960), and went through much of it, doing all the exercises. I memorized one of the epigrams of Martial that for some reason I liked immediately:

> Non amo te, Sabidi, nec possum dicere quare.
> Hoc tanto possum dicere: non amo te.[2]

> [I do not love thee, Sabidius, nor am I able to say why.
> This only am I able to say: I do not love thee.]

I was impressed by the fact that my stepfather had gone through the entire Langenscheidt's Home-Study Method for Latin also, a book, like the Italian Method, some three inches thick, with rigorous grammar and examples from ancient authors, and exercises at the end of each lesson. Neither of these huge labors did anything for his creativity, of which he had none, but they gave him a repertoire of memorized passages from which he could quote at any time.

Some time in the sixties or seventies, I came across, in a used bookstore, an interlinear translation of Caesar, specifically, *Caesar's Commentaries; With an Analytical and Interlinear Translation of the First Five Books for the Use of Schools and Private Learners*.[3] The book was

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1. *Original Methode Toussaint-Langenscheidt: Italienisch*
2. Wheelock, p. 30.
3. Hamilton, James, tr., David McKay, Publisher, Philadelphia, 1884.

hardbound and the price marked on the flyleaf was $1.85. I immediately thought: interlinear translation is the best way to present classics in their original language. At the very least, they save the enormous amount of time the student usually has to spend in turning dictionary pages and writing the meanings of words in the margins or between the printed lines. Furthermore, they enable the student to come fairly close to actually "reading" the original text, even if he has only a superficial knowledge of the language, because the English words are always directly underneath, like subtitles. I later bought another interlinear translation: *Select Orations of Cicero: Four Orations Against Catiline and Seven Remaining Orations*.[1] Only many years later did I learn that, in an interlinear translation, *the word order is changed from what it was in the original*! Ever since, I have felt that side-by-side Latin-English translations are the best.

As soon as I saw, in my early college years, how academics used French to enhance their prestige, I hated French. David R— had learned to speak the language fluently, and at a lunch one time in Sausalito, Calif., when he had come to the West Coast on a trip for his art school, he made sure I understood where that placed him in the intellectual hierarchy, and, in particular, in the hierarchy of art historians. That made me hate the language even more. And yet I had been in love with my aunt Jeanne on our trip to Switzerland in 1949, and had been spellbound by Paris during our two days there. I loved French films, read Sartre and Camus and, later, Montaigne[2], and still later, Proust (all in English, naturally). Finally, in the mid nineties, partly as a result of going to France with my son for several days, and partly as a result of my growing self-confidence, I allowed myself to start learning a little of the language. My procedure was the same as with other languages: try to force my way through various paperback grammars, and then, when that became too oppressive, escape into reading: mainly newspapers and, most valuable of all, Simenon novels.with my aunt Jeanne on our trip to Switzerland in 1949, and had been spellbound by Paris during our two days there. I loved French films, read Sartre and Camus and, later, Montaigne[3], and still later, Proust (all in English, naturally). Finally, in the mid nineties, partly as a result of going to France with my son for several days, and partly as a result of my growing self-confidence, I

Forbidden Territories

Intellectuals — at least mavericks like me — are supposed to be willing and able to tackle any subject. At the very least, they are supposed to be able to pursue any subject until they understand why they can't, or don't want to, pursue it any further. Yet there were subjects which quickly declared themselves to be out of bounds for me: "Don't bother to enter here. Don't even bother to try to find out why you *shouldn't* enter here. This is *not for you*!"

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1. Underwood, William; Clark, Thomas, trs., David McKay Company, Inc., N.Y., 1952.
2. The first book of his essays I bought was the Penguin Classics edition (1966). I still have it, though it is in battered condition, some of the pages loose, as a result of many readings. In this edition, English translations of all the Latin quotations are given, but there is no index. I never could understand why since Montaigne seldom stuck to one subject in an essay, and so it would be very helpful to be able to locate quickly all the passages in which he deals with, say, children, or conversation, or reading, or politics, or enduring physical pain. Then, later, I bought Donald Frame's *The Complete Works of Montaigne* (Stanford University Press, 1967). On the one hand, the book is a must for lovers of Montaigne. On the other, *only* English translations of the original Latin are given, and there is no index to content, only to proper names. And so ever since I bought the book, I have seen Frame as yet another arrogant, strutting academic, determined that there will be no making things *too* easy for students, not to mention the masses. If you index the content, well, then people will be able to quickly find out what Montaigne said on any given subject, and then, why, there will be no reason for them to sit through your classes!

Classical Greek is such a subject. I had Latin in high school and went through a few self-teaching books on the language in early middle age. I know what to do when I come across a Latin quotation or when I feel I should spend a little time with a classical Latin work. (Get an interlinear or side-by-side translation.) All very workmanlike and down-to-earth. But Greek is completely out of bounds. No use for me even to try to transliterate the letters. No use to try to understand a word or phrase. That is something that only a Heidegger can do, and, of course, the thinkers who lived in previous centuries. It has nothing to do with lack of talent, so there is no use my raging against it. I was born an American; therefore it is hopeless.

The same applies to Welsh. If someone with unquestionable authority were to tell me tomorrow that Welsh has no grammar, that the words are used in entirely different ways than they are in all other languages of the world, and that only those who were born with the gene for understanding Welsh can possibly hope to learn anything at all about the language, I would have no trouble believing them.

In my twenties, when I first began reading Schopenhauer, I resigned myself to never being a philosopher in any legitimate sense because I did not know intuitively what the title of Schopenhauer's doctoral thesis was derived from or referred to: *On the Four-fold Principle of Sufficient Reason*. To be able to use — to know how and when to use — words like "four-fold" and "sufficient reason" — well, that was one of the things that separated the greats from the rest of us. No use even to bother trying to find out what motivated the thesis with that title, or trying to find out what previous thinkers had said about the subject. This was closed to me. (Later on, when I began studying mathematical logic, I had no trouble learning what "necessary" and "sufficient" meant. It was a straightforward matter of reading and understanding.)

Another one of these forbidden territories, until my early thirties, was Boolean algebra. In high school, I somehow had picked up the idea that Boolean logic was logic invented by a tribe in Africa, possibly because of the lines in Vachel Lindsay's poem, "The Congo":

> "Tatooed cannibals danced in files;
>   Then I heard the boom of the blood-lust son
>   And a thigh-bone beating on a tin-pan gong...
>   Boomlay, boomlay, boomlay, BOOM!"

Boom, Boole — I couldn't get that connection out of my mind. Of course, there is nothing remotely African about Boolean logic: it is very Western logic named after its founder, the Englishman George Boole (1815-1864) (who was largely self-taught in mathematics). Possibly the connection occurred after I read that Picasso, a *modern* painter, had been strongly influenced

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3. The first book of his essays I bought was the Penguin Classics edition (1966). I still have it, though it is in battered condition, some of the pages loose, as a result of many readings. In this edition, English translations of all the Latin quotations are given, but there is no index. I never could understand why since Montaigne seldom stuck to one subject in an essay, and so it would be very helpful to be able to locate quickly all the passages in which he deals with, say, children, or conversation, or reading, or politics, or enduring physical pain. Then, later, I bought Donald Frame's *The Complete Works of Montaigne* (Stanford University Press, 1967). On the one hand, the book is a must for lovers of Montaigne. On the other, *only* English translations of the original Latin are given, and there is no index to content, only to proper names. And so ever since I bought the book, I have seen Frame as yet another arrogant, strutting academic, determined that there will be no making things *too* easy for students, not to mention the masses. If you index the content, well, then people will be able to quickly find out what Montaigne said on any given subject, and then, why, there will be no reason for them to sit through your classes!

by African art, and I had then read that computers, a *modern* invention, employed Boolean logic (which, therefore, must also be African in origin).

In college English courses, I had a mysterious block about learning the meaning of the archaic spelling of the word "diverse", namely, "divers", which I insisted on seeing as referring to people who venture underwater, even though no one in England was doing anything that could be called diving at the time. As with the other cases, it was obvious to me that I could never know the truth about the word. That was something that only English professors knew or *could* know.

Similarly with the meaning of the seventeenth century word "satyr", which was the spelling of "satire". I insisted on seeing it as having to do with satyrs, that is, lecherous half-man, half-goat creatures.

The big words in the rule in biology "Ontogeny recapitulates philogeny", I felt was a strong , in fact a final, argument that I had no business in that subject, even though I had the courage to ask what the words meant. I might even have allowed myself to believe that I might have been able to come up with the rule, but never using those words, and therefore...!

When I decided to teach myself mathematics, and was going through Marvin Bittinger's beautiful little book *Logic and Proof*[1], I believed that no proof could be correct if it did not have the "end of proof" symbol "●" and that only mathematicians were allowed to use that symbol. In other words, if a non-mathematician wrote down a perfectly correct proof, and followed it with the words "End of proof", the proof would, in some mysterious way, not be correct. My natural instinct was to use "QED", standing for the Latin "Quod Erat Demonstrandum" ("which was to be demonstrated"), just as we did at the end of high school geometry proofs. But I soon came to understand that was so old-fashioned that no math student, much less a math professor, would take you seriously if you put it at the end of your proofs.

And the title of Darwin's great book was *The Origin of Species*, not what it seemed to me it should have been, namely, *The Origin of* the *Species*. Why did he leave out the second "the"? Those who were meant to study biology, understood this. I didn't, and therefore... (I was in my sixties before I understood why the first title is the one that makes sense: "Species" is plural.) And, let me remark in passing, I was in my fifties before I realized that "radian" in mathematics simply meant "radius"! Thus, to say that an angle is so-and-so-many radians is to say that when you draw a circle with the vertex of the angle at the center, then the two sides of the angle will intersect the circle in such a way that the smaller of the two possible arcs defined by the intersection of the sides will be that many radii, or that fraction of a radius, of the circle. I wondered why no mathematics teacher in any math course I had ever taken, didn't explain this, instead of allowing a perfectly simple concept to be made strange and obscure by its name.

Self-Teaching

There are some things that you have to accept about yourself — about which you have to say, "That is the way I am and I can't change it." In my case, one of these things is that the only way I can really learn anything is by teaching myself. Having to sit in a classroom is for me a gross humiliation, an insult, an act of indescribable rudeness and presumption on the part of the teacher that is barely tolerable. If forced to justify this attitude of mine, I can do no better than the following quote:

"The things a man learns for himself he never forgets, and can adapt to many situations. The things a man does by himself, he does best." — Bannister, Roger, *The Four Minute Mile*, Dodd,

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1. Addison-Wesley Publishing Co., Menlo Park, Calif., 1970

Mean & Company, N.Y., 1955, p. 228.

God knows, I gave the Enemy a fair chance: I forced myself through 2½ years of electrical engineering courses, then another year and a half of English literature. In my late twenties, I had called the Stanford English Dept. and asked what I had to do to apply for admittance to course-work leading to a Master's degree in English. The woman on the other end of the line, who sounded like one of those insufferable middle-aged bitches that universities always seem to put in these jobs, asked me old I was. I said 28. She said she was sorry, but the University did not accept graduate students that old.

In the early sixties, programmed instruction was briefly popular in some circles, including the technical writers' professional organization, STC (Society for Technical Communications). (One member I recall was a tall guy with a dark brushcut who worked at HP, and who liked to pontificate, in a cultivated, sonorous, baritone voice, about "binary searches" as a technique for discovering the location of bugs in a piece of hardware or software. I was terribly impressed and intimidated. Anything with the word "binary" in it in those days was impressive. You would hear on the news, or in movies, "... utilizing a high-speed binary electronic computer...")

Articles on the subject of programmed instruction appeared in the organization's publications, and at least once an expert on teaching machines spoke at a monthly meeting. These machines were embodiments of the stimulus-response theory of learning promulgated by B. F. Skinner and others, and were supposedly going to replace human teachers. The technical writing profession would evolve into one that created programmed instructions on the use of products.

I thought I would try the new methodology on a subject that I had always disliked but needed to know far better than I did, namely, transistor theory. So I bought a new programmed instruction text and started going through it, writing out the answer to the question at the end of each little instruction cell, of which there were hundreds. I found it boring and unproductive. I could learn each little fact, but I had no global understanding of the subject. I tried several times to put myself in the state of mind that the author imagined that students would be in. It did little good. Fifteen years later, I understood what the problem was, namely, that this was a so-called "bottom-up" approach to learning, and that there is another one, the so-called "top-down" approach, which happens to be the one that is most natural for me.

I should mention in passing that around this time, or a few years later, another fad was briefly regarded as a major breakthrough in human communcation, namely, the practice of using several slide projectors *simultaneously* to project multiple images on the screen. One or more of the images could be changed while one or more others remained constant. I don't recall the words that were used to describe the great promise that was claimed for this simple innovation. It soon became part of the slide-projector culture, and is now used routinely.

But until well into my fifties, I was still subject to other people's superstitions about learning. For example, early in my career at HP I remarked to an engineer that I found it easier to learn certain electrical engineering concepts having to do with circuits if I thought about them in terms of flow of liquids or gases through pipes. He remarked, with visible contempt, that if you needed to think in terms of analogies, you probably had no business studying engineering. I was crushed, and from then on fought every temptation to look for analogies across different branches of engineering or physics. Then, at the age of 60, while reading Feynman's *Lectures on Physics*, I was amazed to see him *emphasize* the fact that, for example, the equations for the motion of a weight oscillating on a spring had the same equations as an oscillating current in an inductive circuit, and he even gave a little table to show the parallels between mass and inductance[1].

One superstition that I still have not been able to shake is that, after all is said in done, the knowledge you gain *in technical subjects* by self-teaching is simply inferior to the knowledge you gain in a classroom, particularly in a classroom in a very expensive school like Stanford. Even if you buy the textbook used in such a course, and do all the exercises, and memorize all the important theorems, and believe, in yourself, that you have obtained a grasp of the subject, this is all self-deception, all losers' consolation. And even though I could get an A in a psychology course with my analysis of why I believe this so strongly, it would change nothing. I will go to my grave believing that a classroom course in any technical subject, no matter how arrogant, cruel and incompetent a teacher the professor might be, is still infinitely better than my own efforts can possibly be at learning the same material.

Mathematics

Although I had taken 2½ years of engineering calculus by the time I was 21, and earned a master's degree in computer science when I was 40, I still consider myself essentially self-taught in mathematics. I never took a math or computer science course that I didn't have to re-teach myself as the course proceeded (or later), and I never met a professor of either subject who I felt had something to teach me that I couldn't learn for myself.

When I think about becoming a teacher myself, and thus helping to rectify the situation of bad math teaching which prevails, I find I cannot bring myself to do it, the reason being that I cannot believe that the classroom is the best venue for learning. I cannot believe that any good will ultimately come from my helping to perpetuate the myth, in the minds of students, that the best way to learn is to listen to a man talk while he stands at a blackboard. (If he is having a good day, and happens to give a good lecture, then the students learn. If not, well, then that part of the subject will always be a source of anxiety for them and they will do badly on the exams — all because one man happened not to be in the proper state of mind on one day of one course!) I cannot believe that the students wouldn't be *much* better off if they had instructional materials, with well-thought-out, skillfully rendered, illustrations, and the opportunity to ask someone (teacher, graduate student) questions. (The Environment idea to be introduced later developed from these considerations.)

In those early years of trying to teach myself mathematics, I studied whatever seemed accessible, which meant the various paperback popularizations, like James R. Newman's *The World of Mathematics*[1], and easy survey texts like Howard M. Nahikian's *Topics in Modern Mathematics*[2]. One of the ideas explained in the popularizations absolutely stopped me dead in my tracks, namely, Cantor's proofs about infinite sets: that there are just as many rational numbers (fractions), as there are integers (whole numbers), and that there are more real numbers (numbers with or without decimals) than there are fractions. Furthermore, there are not just these two different-sized infinities but an *infinite* number of different-sized infinities!

The basic idea underlying these proofs I thought absolutely ingenious.

"When he heard the Succession music, 'he did not notice what he was eating' for three months afterwards." — Waley, Arthur, *The Analects of Confucius*, Vintage Books, N.Y., 1938, p. 69.

1. Feynman, Richard, Leighton, Robert B., Sands, Matthew, *The Feynman Lectures on Physics*, Addison-Wesley Publishing Company, Reading, Massachusetts, 1977, Vol. I, p. 23-6.
1. Simon and Schuster, N.Y., 1956,
2. The Macmillan Company, N.Y., 1970

The idea is often illustrated in popularizations by the description of an (imaginary) primitive tribe that was unable to count beyond two, but that had a rule that the chief's daughter could only be married to the warrior who had the most cows. So how could the tribe manage this, if no one could count beyond two, and if warriors typically had many more than two cows?

The answer was that, when it was time to marry off the chief's daughter, a series of gates was set up side by side, one for each warrior candidate. I will assume there are only two candidates, for simplicity. Both warrior candidates, each with a cow, then approach the two gates and lead their cows through them. Then each goes back and gets his next cow, and each leads it through the gates. This continues until one warrior has a cow to lead through his gate, but the other hasn't. Thus that one warrior has more cows than the other, and wins the princess's hand. If neither warrior has a cow at this point, then they both had the same number of cows, and presumably the tribe had a way of dealing with that situation.

The key idea here — the absolutely stunning insight that is completely obvious after it is demonstrated — is that you don't have to be able to count in order to be able to tell which of two sets has more members!

One of Cantor's goals in studying infinity was to find out more about God. There was no doubt in my mind that he had succeeded. (His labors, plus the scorn of some of the most important mathematicians of his time, eventually drove him insane.) For me, these proofs were not only proofs about infinities but also proofs that there was far more to mathematics than the calculus — that other kinds of thinking than that required to evaluate integrals rapidly had an important place in the subject. And to this day, Cantor is the mathematician I most admire, even love, though I know that other mathematicians, for example, Gauss, rank higher in the pantheon. And to this day, whenever a discussion comes up about what in mathematics is beautiful, or what the attraction of the subject is, these proofs are always in my reply, even though they are over the heads of the liberal arts students and graduates whose indifference to, if not actual strong dislike of, mathematics I am trying to overcome.

But there was some hard going too. Around October, 1971, Webb showed me Hopcroft and Ullman's *Formal Languages and Their Relation to Automata*[1]*,* a textbook that was considered, by compiler[2] writers and those aspiring to be such, to be definitive. I seized on it and decided to go through it. It set forth, in an austere academic style, the basics of the Chomskyian formal grammars, of which there were four main classes, and it described their relationship to four main classes of Turing machine or "automaton", that is, classes of idealized computers consisting only of memory tapes with squares to hold symbols, and a tape head connected to the program. The program in turn consisted solely of instructions of the form, "if the symbol under the tape head is ... then replace it with the symbol ... and move the tape head one square to the left [or right]".

Like Bracewell's book that I tried to go through while writing the Fourier Analyzer manual in my first job at HP, this text was, for me — working alone and without the necessary background — extremely difficult. I still have my notes for the problems I attempted. The notes are full of my thinking out loud, under a section called "preparation", and the writing out of definitions of the terms in each problem, then my reasoning, and then checks when I felt I had the right answer.

1. Hopcroft, John E., and Ullman, Jeffrey D., *Formal Languages and Their Relation to Automata*, Addison-Wesley Publishing Company, Menlo Park, California, 1969.
2. A compiler is a program that converts the statements written in a high-level language like Fortran or Basic or C or any of the languages used in connection with web sites, into a low-level language like Assembly language that the computer can understand.

I also have a letter, dated July 24, 1972, from Hopcroft himself, whom I had written in frustration at not understanding a statement at the top of p. 42 — a statement that now, some 35 years later, is so obviously true that I can't believe I spent more than a minute or two trying to understand it. The statement is simply that the number of distinct mappings from a set containing s elements to a set containing $s + 1$ elements, is $(s + 1)^s$. (Readers with no mathematical background need not worry about understanding that statement.) Hopcroft's letter begins, "Thank you for your letter. The fundamental problem seems to be that you do not have the correct definition of a mapping." He then explains the definition via an example, and later in the letter says, "One of the difficulties encountered in self study is that it is virtually impossible to be assured that one has the the 'pre-requisites' for what one is studying. If you wish to study language theory, you should first have a firm grounding in mathematics, especially set theory and logic." So apparently, but not necessarily, this was before I went through Bittinger's *Logic and Proof* , which is described later in this chapter.

More than 40 years later — after I had developed a new, much more efficient, approach to presenting mathematics — I had occasion to refer to Hopcroft and Ullman's text again. I was appalled at the unnecessary difficulty, the all-too-academic hiding of the Big Picture ("Keep it difficult! Separate the Winners from the Losers! Above all, *impress*!"). To begin with, a much more honest title would have been, *Formal Languages and Their Relation to Turing Machines,* since all automata are Turing machines, and most prospective readers would know what a Turing machine is, though not necessarily what an automaton is in this context. The term automaton could have then been defined in the text as a type of Turing machine that recognizes strings in a formal language.

A clear, easy-to-understand Bitg Picture could have been given on the first page. For example,

A formal language is the set of strings of symbols generated by a formal grammar, which is a finite set of replacement rules (called *productions*) for such strings. Thus the production $A \rightarrow cBBdg$ means that the variable A in the grammar can be replaced by $cBBdg$, where c, d, g are constants, that is, strings that do not have replacements, whereas B, like A, is a variable, that is a string that does have replacements. The language consists of all strings composed of only constants.

There are four classes of formal languages, Type 3, Type 2, Type 1, and Type 0, in decreasing order of restrictions on what can be a string in the language. Associated with each class is a class of Turing machines called *automata* that can recognize strings in the language, that is, which return, for example, "String is in language" if given a string in the relevant language, but which (in the case of a Type 0 language) may compute without halting if the string is not in the language; in the other cases, the automata return, for example, "String is not in language".   The names of the automata classes are

Type 3 language — Finite-State machine
Type 2 language — Pushdownj automaton
Type 1 language -- Linear bounded automaton
Type 0 language -- Turing machine[1]

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1. A misleading term in this context, since all the automata are Turing machines

But the reader who is studying alone (and maybe even studying in a classroom course) will spend a lot of time and effort before he or she arrives at this simple viewof the subject.

I also wrote to two other authors of texts on formal languages and automata (David Gries and Martin Kain) about matters I couldn't understand, and received equally courteous replies. Which surprised me. I carefully worked through the first 200 pages of Kain's 300-page book, taking notes which I still have at the time of this writing. They contain questions about material in the text that I asked myself, followed by my answers. I also worked many of the exercises.

I particularly liked the idea of a formal grammar. You could enter a grammar into the computer, and then have it print out as many strings as you liked. I was very proud of my ability to do this, and one afternoon I remember calling Barb (my fellow programmer, introduced above) over to observe my latest creation. I can clearly remember the big, sunny office space on the second floor of the building in the Santa Clara Division, the desks all around, the teletype that I had appropriated for my demonstration. I can remember the smell of the ink from the ribbon, my typing in the command to initiate the printing of the strings, the clunking away of the machine, Barb leaning forward, scrutinizing the strings as they appeared. She had a big smile, was genuinely interested, and, I think, was pleased that I, a self-teacher, had been able to accomplish something important[1] and theoretical like this all on my own. She was generous in her praise. It was one of the best moments of my working life.

I was a man who could fairly be described as lacking self-confidence in just about everything he did or attempted, but there were two realms in which I had self-confidence from the very beginning, and these were music and ideas. Even in high school, I had no doubt about my taste in music; and later on, probably beginning with Manny Gordon's seminar on symbolic logic at Beckman Instruments, I realized that I likewise had no doubt about my ability to recognize good ideas. My reaction to Cantor's proofs was another example. I had a similar reaction later on, when I first came across the subject called "algorithmic information theory", which was discovered by Greg Chaitin, who, as far as I know, was largely self-taught in mathematics. His theory gave what is still the most general and rigorous definition of "randomness" in mathematics: a string of binary digits (1's and 0's) is random if the shortest computer program that can generate the string is roughly the same length as the string of digits; a string that can be generated by a very short program relative to its length is not random, but orderly — it possesses a pattern. Thus, for example, the string consisting of "10" repeated a billion times is a non-random string, because a very short program — "for i = 1 to a billion do Print '10' " — can generate the very long string. On the other hand, the string of 1's and 0's typically resulting from a long succession of flipping a coin, where 1 is, say, heads, and 0 is tails, is random: the shortest description of the string is simply... the string itself.

Later, when I first learned about Benoit Mandelbrot's discovery of fractal geometry, I knew immediately that it was a great idea, and I continued to believe it was even after I found out that many mathematicians viewed it with contempt. There are some things you just know, regardless what the experts say.

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1. Formal grammars — though far, far more complex than the one in my simple example — are the grammars that define all computer languages.

At this point, I want to reveal something that might provide encouragement to others who are interested in mathematics but who are not at all certain if this interest is justified. It is this: I have never had much interest in numbers. For me, numbers are just things to hang interesting structures on. And so, when I first read about Gauss's love for calculation, I thought it was useless for me to continue studying mathematics, because for me calculation — including the kind of "calculation" represented by substitution into formulas and then arriving at an answer, and represented by doing simple proofs — has always been boring. However, what gradually became undeniable to me was my attraction to *classification*. I found that I was far more interested in classifying mathematical knowledge — developing lists of all the types of functions, all the types of spaces, all the common tasks that are performed on a given entity in a mathematical subject, putting things in alphabetical order. That was a form of labor I could be happy doing for the rest of my life. At times it took an act of will to resist this urge. Once, in the famous and beloved Berkeley bookstore, Moe's, which had a vast selection of used books, I found that all the volumes in the German section were not in alphabetical order by author. I started reorganizing them on the spot — I couldn't help myself. Then it occurred to me that maybe I could make this labor both permitted and profitable, so I went down to the main desk and offered to put the entire section in alphabetical order if they would give me credit for one used book. They said no. In my house, if I suddenly find that I am unable to decide how to classify a collection of magazine and learned journal articles, I fall into a deeper depression than usual, and likewise if I can't decide where, in an Environment[1], a theorem I have been studying should go.

Humanities

I have never been able to understand how anyone could bring themselves to believe that they needed to go to college in order to understand any of the humanities. It's just reading and thinking, for God's sake! Literature is something you read when you should be reading other things — not something you *study*. If you want to know the Big Picture on a novel, buy Cliffs Notes. If you want commentary, go to the Literary Criticism section of any good bookstore.. In my 1-1/2 years of taking classes in English literature at Lehigh, I didn't once hear anything that I didn't think was obvious, or that I didn't think I could have dug out of the books themselves, or their introductions, or the Encyclopedia, or out of one of the reference works like the *Oxford Guide*s. If you can read, you can give yourself a liberal arts education.

Of course, I had no interest in reading academic writing about literature, which I regard with a natural, and, I think healthy, contempt.

I have always felt that, if I am going to allow myself to waste time reading literature, then I might as well waste it on quality. So I have always had an inclination to read hard books, good books, and ignore currently popular books.

In all the humanities, I have always had complete confidence that I knew how to proceed, that I could trust my instincts. (I was pleased to hear Eric Hoffer make a similar remark in one of TV interviews he granted to KQED's James Day in the sixties.) I am one of those few who realize what a privilege it is to be able to make up one's own mind about what one reads.

A few authors I knew almost immediately were going to be with me for the rest of my life. It

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1. A list, in alphabetical order, of all concepts, terms, symbols, in a subject, with brief explanations of each followed by references to textbook pages where more details are given. In the case of concepts ("entities"), a list of all the common operations on the entity is also given. Thus, for example, if the entity is "equation" then some of the common operations are: put the equation into a standard form, move terms from one side to the other, multiple/divide through by a term, solve the equation...

wasn't that I read an especially convincing argument of their importance. This is another of those things you simply know. These authors are (in chronological order of my first reading them) Montaigne, Nietzsche[1], Moliêre, Borges, and Proust. For me, they are beyond criticism insofar as criticism means questioning their fundamental importance or value.

As I have said earlier, Shakespeare always was and always will be a closed book for me. Although I can certainly appreciate the greatness of some of the oft-quoted lines, the plays to me have too many words, too many boring, all-too-predictable sentiments. Everything to excess. I have never been able to get it out of my mind — even though I know it is not true — that Shakespeare wrote first and foremost for English professors, and second for upper class ladies who want to feel cultured.

Many years later, I found that I was not alone in my opinion.

"I remember, the Players have often mentioned it as an honor to Shakespeare, that in his writing, (whatsoever he penn'd) he never blotted out a line. My answer hath been, would he had blotted a thousand." — Ben Jonson

Voltaire was not entirely admiring of the Bard. And Nietzsche commented on "the revolting vapors and closeness of the English rabble in which Shakespearean art and taste has its being..." — *Beyond Good and Evil*, section 224.

Moliêre was entirely different. Here was a comrade, here was a man I could admire as an equal, a man who didn't spend his life extolling the virtues of royalty and nobility, but who saw what I saw, namely, hypocrisy and vanity and absurdity everywhere. It was years before I saw one of his plays performed: *Tartuffe*, by an amateur group in Palo Alto, Calif., with Victor Buono (best known for his role as the Boston Strangler in the 1964 film, *Strangler*) brought in to play the lead. As of my late sixties, I have probably seen no more than half a dozen performances of the plays. (I remember taking a day off from work at Hewlett-Packard to see an afternoon performance, in French, of one his plays at a university in San Francisco.) My impression is that Americans don't know how to present his plays.

In the eighties, when Ariane Mnoushkine's beautiful film *Moliêre* was played on PBS, I felt that the movie was about me — perhaps only because his early years, when he took his little theatrical group on long treks through the countryside to perform in provincial villages, reminded me so much of the Music Days.

Working on Puzzles

Already by the time I started at HP, I had decided that, if I was to have any hope of being allowed — by the mathematicians of the world — to study math, then I would have to overcome my lifelong fear and dislike of puzzles. So I began trying to work every puzzle I came across. I still have the two thick 3-hole binders containing the record of my efforts. In each case, not only did I save the puzzle statement, but also notes on my efforts to solve it, what went wrong, how long the effort took, the date, what I needed in order to improve in my puzzle-solving skills. I got no pleasure out of this new regimen — each attempt was an exercise in facing my mental slowness and mathematical ignorance — but I was convinced that, no matter how much I hated doing puzzles, I had to take these tests because my performance would determine if I had any right to continue studying mathematics.

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1. My opinion of him as a philosopher has greatly diminished, mainly for his arrogant assumption that psychological analysis is the way to truth in philosophy.

The Goat Problem

One of the technical writers, a young guy named Jim Hardin, having heard about, or observed, my puzzle-solving activities, said he had a puzzle I should try.

Problem: A farmer ties a goat to a stake with a 10-foot rope. The goat eats all the grass within the length of the rope. Then the farmer moves the stake to the edge of the circle of eaten grass and wants to know how long the rope must be so that the area of the *additional* grass the goat eats will equal the area of the original circle.

I decided this was meant to be the ultimate test of my future as a student of mathematics. I hadn't looked at a trigonometry problem in some 15 years, but nevertheless I was convinced that I should be able to solve this one. I will never admit to anyone how long I worked on it. Unquestionably, my absorption in the problem encouraged Marcella's belief that she was married to a man who cared about some things far more than he did her or the family. But I couldn't give up on it — the shame would have been intolerable, and it would have meant the end of my allowing myself to study math.

Here are slightly edited excerpts from my notes on the attempt. I have omitted the diagram I worked from.

"Turned away after [a while], unable to find area of a pie-shape. In doing so, realized how to do it. Then [amount of time] spent trying to solve for x; always with a θ [symbol for a certain angle] in the solution. A guy at work said, 'You've got two unknowns, you need two equations.' (Thought possibly I might cheat that.) So then a period of putting together two different equations. ...nervousness and this-or-else prevented me from making the simple observation that if A − something = B, then another equation with a different something there adds nothing to the story, since all we're saying is that the two somethings are equal, which we knew by inspection (namely, that the area to be subtracted = the area to be subtracted). The two unknowns business was solved by discovering that everything could be expressed in terms of θ (via x, the rope length being sought). Much time wasted on that something business, guessing, hoping, that this would click.

"Final break came when, solving for θ, came up with the answer that proved to be correct, then, thinking that $\theta = \tan(\theta) − \pi$ is no solution, went on another tack, came up with the same answer. Felt this expression at least was valid. (Still hunting for another one.) Then, thought I'd found one ($\tan(\theta) = \sin(\theta)$), went to library to look up these, found it no good. About to give up, figuring that trig had beat me, when doodling with the trig tables on that previous answer, saw that indeed an answer might be possible. Did a few of the $\tan(\theta) − \pi$ subtractions, zeroed in, found that things crossed from less-than to greater-than at 77+°.

"That of course seemed right by the drawing. Calculated x, knew I had it."

I was so fearful that Hardin, who I assumed knew the correct answer, would take one look at mine and shake his head that I then sat down and wrote a computer program in Basic (I assume I had managed to teach myself enough of the language for this purpose) that did all the calculations and then printed out the message,

"Y IS 314.191. Y IS THE AREA OF THE ADDITIONAL GRASS THE GOAT EATS. THE AREA OF THE ORIGINAL CIRCLE WAS 100 PI, OR 314.12. IF Y IS CLOSE TO THIS, THE ANSWER IS CORRECT."

I wrote up the solution in the clearest longhand I was capable of and showed it to Hardin. He immediately nodded in agreement. I sensed that he was impressed. He remarked that some math

teachers he had known had had difficulty with the problem. I felt that once again I had demonstrated to myself that, even though I had no talent and only mediocre intelligence, I could make up for some of these inadequacies by my ability to endure frustration and humiliation and self-contempt to a far greater extent than most other people. But this problem almost broke me.

I should mention in passing that Hardin had little use for creative writing. I remember him once saying that a teacher asked a class he was in to write an essay on the question, "How far is up?" He said that he wrote on his paper, "Up is a direction, not a place. Therefore the question makes no sense." I don't recall what grade he said he received.

Toastmasters

Still believing I had great things ahead of me, and always painfully embarrassed at my fear of public speaking, I joined one of the Palo Alto chapters of Toastmasters. You couldn't have asked for a kinder, more welcoming group. I was able to overcome my extreme nervousness sufficiently to participate in Table Topics, in which each member was called on spontaneously and asked to give a short talk on some topic in the day's news. Then, every few weeks or so, you had to give a fifteen-minute prepared talk. I did one on Marshall McLuhan's ideas, which were then receiving a lot of attention. Because I was very interested in the subject matter, I spoke at machine-gun rate, and lapsed into my New York accent, which I tended to do whenever I was excited. In the kindest possible way, the group remarked afterward that although it was an interesting talk, I should slow down my rate of delivery a bit. I won some sort of prize for the talk, and took it home proudly to show Marcella.

I remember only one of the other members of the group, a young guy who was clearly on his way up in the ranks of management. For some reason, he felt he needed to know Robert's *Rules of Order*, and so, for one of his talks, he had us pretend to be the unruly attendees at a meeting, interrupting constantly, asking questions and making requests at all the wrong times. I was very impressed at his skill at handling the situation. He clearly had memorized the little book backwards and forwards, and managed to keep us all in line.

After a few months I left the group, largely because the routine of the meetings had become all too predictable, and because we had all become friendly enough with each other that the meetings no longer served to help people like me deal with the problem that brought us there in the first place, namely, fear of speaking publicly to people we didn't know.

Within a year or two, I had forgotten all I had learned, and so to this day, I am totally inept at, and petrified of, public speaking.

A Therapy Marathon

The search for an Answer continued. I was now not in any group, had no therapist, and was not writing in a journal.   Someone (who can remember who tells us these things?) got me the name of a guy named Hsain Chung who was conducting marathons. These were one of the latest things in therapy circles. You had to stay in a room for 48 hours, being allowed to leave only to go to the bathroom. As exhaustion set in, defenses broke down — that was the theory.   I felt this was my last chance, so I was prepared to try anything.

We met in a house in Menlo Park one Friday evening. Hsain looked like a Viet Cong guerrilla: he was a short, good-looking Asian, with a bandana around his head. He had one or two young women with him whose purpose in life seemed to be to tend to his needs.

We sat on the living room floor. Hsain knew the parents of one or two of the teenage girls in the group, and he would refer to the girl's father. "You telling me that your father wouldn't want you to ..." He used role playing, except that I had never heard of it before, and so when a teenage girl was on the hotseat, and he asked me and a woman to play the role of her parents, I thought I was supposed to be exactly the opposite of the person she had been describing. I was nervous, embarrassed, unsure of myself, and after a few seconds the girl stopped it, saying, "No, no, this isn't working." I was ashamed for the rest of the weekend over the stupid blunder.

When it was my turn to be in the hotseat, I started talking about something I had never really considered over the years, namely, that I was angry at my father for his not having said goodbye to me when he was dying. Hsain had one of the other guys play the role of my father. Hsain encouraged me to express my rage. So I hit the guy. We wrestled on the floor. At one point he had me down flat on my back, holding my wrists, while I screamed at him.

 Then Hsain was shouting at me, *but did you go to your father? Could you have gone to him?* I had never thought of it that way. It had seemed to me my father's obligation to come to me.

Later on, I heard that, during our fight on the floor, I had broken one of the other guy's ribs.

And so it went. Hsain had an extraordinary psychological intuition. After a long interchange with one person, in the silence that followed, he would suddenly point over his shoulder and say, "What's going on with you?" and the person would burst into tears. He had sensed that she was right at the edge as a result of what had been said in the interchange. He was well aware of his ability. He said at one point that if he had his own radio program, "I could have the whole Peninsula in the palm of my hand if I wanted to".

We continued until Sunday afteroon. Then it was over, and everyone was invited to swim in the pool before leaving. I walked out to the poolside and saw several of the young women stark naked. I don't remember if I had the courage to take all my clothes off. But by the time I left I had the feeling that my feet were fastened to the earth, that I was walking in Indian moccasins. We each gave Hsain a hug before leaving, and hugged each other.

Unfortunately, the feeling only lasted a day or two.

Months later, while riding up a ski lift at Lake Tahoe, I happened to get into a conversation with the guy sitting next to me. He turned out to be a psychiatrist connected with Stanford. When I mentioned Hsain, he shook his head, said he knew about him, felt that his approach had some merits, but didn't like the fact that he never followed up afterward, especially since, after each of his marathons, there were usually several cases of people walking into hospital emergency rooms after suffering psychotic episodes.

The Free U.
A Marxist Cell

In the early seventies, something came in the mail about a new kind of university being established in Palo Alto. It was called the "Free University" and its motto was, "Let the Free U. free you!" It offered courses in everything from baking bread to fixing cars to left-wing gardening to writing poetry to Marxism. Given the mood of the times, I was feeling guilty about working for a large corporation, earning a good salary, and not being particularly interested in overthrowing the government. I was also only too aware of my ignorance of Marxism — for example, I still didn't

understand what "the dictatorship of the proletariat" meant: Did it mean "the dictatorship *over* the proletariat" or did it mean "the dictatorship *by* the proletariat"? I assumed that the meaning was obvious to all Marxists. In any case, I felt it was time I did something about my ignorance.

So I signed up for a course in Marxism. The class met on Saturday mornings in Palo Alto in the apartment of one of the students. The teacher, if the term can be applied to the first-among-equals of such an egalitarian learning experience, was Peter Ober, a young professor of German at Stanford. He wore dark-horn-rimmed glasses and reminded me of my sixth-grade teacher, Ken Allard. The text was Baran and Sweezy's *Monopoly Capital*. We had weekly assignments, then discussed the reading, along with events of the day. I was surprised to learn that Baran, until his death in 1964, had been a Stanford professor, and that Sweezy was a professor at Harvard. Rebellion became clean and acceptable when it was presented by such prestigious figures.

There were about six regular members of the class, most of them students. The class had the feeling of a small brotherhood, a real communist cell, in the literal meaning of the words. The members did their best to practice what they believed. Each class meeting had a leader, but the leadership changed each week. I remember remarking to Peter how dedicated another student, a slim, rather quiet guy in his early twenties, seemed to be; how he seemed to be trying to live the life of a dedicated communist in its purest sense: thinking of others, in particular, of the working class, behaving as unselfishly as possible. Peter said yes, a hundred years ago this guy would unquestionably have been a divinity student.

At the time there was a plan to build a large office complex at one end of downtown Palo Alto. I think it was called the "Superblock". The area leftists were against it on several grounds, including the threat of increased traffic and the intrusion of more capitalism into the then-genteel city. Our class participated in marches and demonstrations. One Saturday we went from door to door at apartments and houses in the city, trying to get people to vote against the plan in the upcoming election. I knocked at a door in an apartment building and heard in response the voice of an obviously nervous woman. I explained what I was representing; she said she couldn't hear me through the closed door, would I talk a little louder. I did. She asked further questions, and soon we were engaged in a political discussion about the benefits and disadvantages of urban development— I shouting in the echoing, empty corridor, she shouting from behind the locked door, the two of us never actually seeing each other .

Ideas from Eastern philosophy were in the air in those years, and one of the ideas was that consensus is the only proper way for groups to reach decisions. Not tyrants, not leaders, not even the mere majority of participants should make decisions: only the group as a whole. Discussion on each issue should continue until all participants (every one of them) agreed on a solution. I attended one meeting at a house in Palo Alto — I forget what the political issue was — in which the attempt was being made to adhere to the consensus model. The young people, mostly Stanford undergraduates, I think, sat on the floor, Indian fashion, talking, weighing what the others said, talking.... It was all very calm and enlightened and New Age. I remember at one point one young woman stuck her hand up and said: "Let's have a poll taken to show..." The sweet young thing took it for granted that polls are simply ways for points of view to be given an official, objective, cachet. You go through the rigamarole of asking people's opinions, but you do so in a way that will guarantee that your poll results are exactly what you wanted them to be. I think I endured an hour-and-a-half of the attempt to arrive at a consensus — on just one point — and then I left, having not the slightest doubt that the work of the world will never get done this way.

In conversations with Peter, I found out that his father had been (or still was) a banker in Boston. I thought (knowing something about Lenin's life): here is another case of the radical left hav-

ing its roots in the upper middle class. He had the calm, patient, manner of the intelligent proselytizer. I told him that I didn't mind marching and protesting, but somehow I couldn't get used to the idea of throwing bricks through windows, which had been done at several recent demonstrations. He said he could understand that, he had been the same way, it was due to our capitalist upbringing, but you have to overcome that, and after you break one window, you will find it a little easier to break the next, and soon you'll have no trouble doing it.

At the time, Bruce Franklin was teaching at Stanford. He was a professor of English literature, specializing in science fiction. Because of his radical activities, the university had suspended him, and this had become a cause célèbre among the left. His teenage sons came to one of our meetings. They sat with arms spread out on our chairs, gave us their obnoxious pronouncements on the local scene, and behaved pretty much like the sons of the local Mafia boss.

I was growing more and more disenchanted with the radical left. I didn't like the arrogance. More important, I felt that everyone in the movement was entirely too naive about economic realities, including economic realities as humble as running a business, whether capitalist or communist. Not to mention scientific realities. One Monday morning a few years later (late '70s, early '80s), after I had moved to HP Labs in Palo Alto, everyone was talking about a bomb that had gone off behind our building (Building 25 on Deer Creek Road) over the weekend. No one had been hurt, and the engineers were having a real laugh over the incident because it revealed the extent of the scientific ignorance of these radicals (members of the the Red Liberation Front, I think) who were proposing to take over the running of the country. They had placed the bomb under a gas storage tank, with the aim of causing the gas inside to explode and do major damage to the building. Unfortunately, they had had their noses in revolutionary tracts when they should have been paying more attention to their chemistry lessons, and, as a result, instead of putting the bomb under the oxygen tank, they had put it under the one containing nitrogen, which, as every high school chemistry student knows, is not flammable. The damage was slight, but the company decided that to repair it, and to prevent future similar occurrences, namely, by installing a secure fence around the building, they would have to use the money that had been earmarked for putting solar water heaters on the roof of one of the Mountain View buildings. So the environment lost as well.

At one of our meetings, we listened to a tape-recording of a two-hour speech by Huey P. Newton, head of the Black Panthers. The others listened with wrapt attention, clearly believing that they were being presented with a depth of insight about American life and culture that had never been expressed before. I did my best to join in their enthusiasm but by the end of the first hour I knew it was hopeless: no matter how much I tried, I couldn't get over the feeling that we were listening to the rantings of an uneducated, not very bright, but very angry, black man who hadn't the vaguest idea of even the *complexity* of the problem he was claiming to know how to solve.

I had heard that Bruce Franklin considered Stalin a great leader . I was so infuriated at this that I wrote Franklin a letter, arguing that there was too much incentive in the West to reveal the truth about Stalin — fame and fortune to the author who writes a well-documented book revealing that Stalin did not do what he was accused of doing — that it was hard to believe that all the governments of the West had been able to suppress such information. He wrote back saying that our image of Stalin was a false one, entirely due to capitalist propaganda.

From that point on, I no longer believed that the radical left was worth listening to. When the class ended, I still had not been able to get a clear understanding of what "the dictatorship of the proletariat" meant. I had asked what the meaning was during one class: did it mean dictatorship *over* the proletariat (and why "*the* dictatorship" rather than merely "a"?) and who were the dicta-

tors to be?, or did it mean dictatorship *by* the proletariat (in which case, did the "the" mean that there could only be one type of dictatorship by the proletariat — it would just turn out that way, the proletariat would know how to bring about, and operate, this unique dictatorship)? And how exactly would they do that — how could you have all those millions of people exercising a collective dictatorship, and, more important, who were they being dictators over, and why was such a huge apparatus necessary, since, as I understood it, the non-proletariat would be a relatively small number of people — merely a few capitalists (the ones who had survived the revolution) and their associates?

The other members of the class seemed to be surprised that I should ask such a question — as though, if you were a true Marxist, you didn't sit around asking what various phrases meant, you just learned if they represented something desirable or not, and accepted them at that. Only in 2010, some 40 years after the class, did I take the time to settle the matter. I discovered, from several websites on Google, that the phrase meant the dictatorship *by* the proletariat *over* the old bourgeoisie — or, in actuality, by a small group, namely the Central Committee representing the proletariat. During (and even before) the class, I was also bothered by Marx's claim that revolution was inevitable. If it was, then there was nothing to do, just wait for it to happen. But then suppose someone — just one worker in an idle moment — happened to think, briefly, of revolution. Did that somehow interfere with history by introducing an active element where no active element was supposed to exist? On the other hand, if the revolution wasn't inevitable, then his prediction wasn't really a prediction, or at least it should have been couched in language of the form, "if the workers work hard enough, they will be able to bring about the Communist state." I brought this up, too, with members of the group, and never got a satisfactory answer. One person I think said that Marx's prediction was that the workers would in fact work for revolution, and would succeed. There was no chance of them not working for it. But then I thought of all the reasonably contented workers at HP and other Peninsula companies, the vast majority of whom had not even read Marx, much less were working for the revolution.

My Boredom Course

Nevertheless, I still considered the Free U. a good idea, my only complaint being that it didn't seem concerned to apply its egalitarian approach to the learning of hard subjects in mathematics and the sciences. I made one attempt to apply the Free U. format to a problem that I was becoming more and more aware of every day, namely, boredom on the job. So I placed an ad in the next catalog for a course in Boredom, meaning, naturally, not a course in how to increase the boredom in your life, but how to overcome it. I had two students: a young man who was a Stanford graduate student and a young woman who seemed clearly adrift (I am not sure if she was a Stanford student or not). The Black Book of names and addresses that I started at Lehigh when I was a bandleader reveals that her name was Kim Esselsine, but has so far not revealed his name. I managed to collect various articles on the boredom suffered on long flights by airline pilots, for example, Woodburn Heron's "The Pathology of Boredom", in the January 1957 *Scientific American*, plus a few pages by various existentialist writers. I wrote letters to, among others, David Riesman, author of *The Lonely Crowd*, who was then at the Institute for Advanced Study in the Behavioral Sciences at Stanford (he replied with several suggestions of people I might contact); Saul Bellow (no answer); Harold Wilensky, a sociology professor at UC Berkeley (courteous reply indicating books that might be helpful); Capt. E. P. Curry, Manager of B-707 Flight Instruction at American Airlines (helpful answer); and John W. Campbell, Editor of *analog science fiction/sci-*

ence fact (thoughtful reply). People laughed, of course, when I said I was giving a course on boredom.

The class met for a few weeks, then simply dissolved. During it, I had the graduate student read some three or four pages I had written on the idea that if we want to talk about the length of a trip, we need to take into account the length of the vessel we will be traveling in. For example, what is the length of a trip across a river, say, if the ship is almost as long as the width of river? I wrote it in the garrulous rush-of-words style ("first thought, best thought") I had been using for my letters to *The Open Cell*, the little magazine described in the previous chapter. The graduate student clearly didn't know what to make of it, so he uttered appropriate respectful comments. I spent more years trying to decide if the garrulous style was really best. Eventually, I decided it wasn't, and that the slogan should be: "First thought, second thought, third thought...record them all, then work them into the shortest form that does the job." The three- or four-page essay I eventually boiled down into a single sentence: "The longer the ship, the shorter the trip."

Participating in Demonstrations

The demonstrations against the Superblock in Palo Alto were by no means the only demonstrations I participated in. Since I was firmly against the Vietnam War, I was on various call lists, both in the Peninsula and in Berkeley. I remember marching several times in Palo Alto, and in at least one huge march in San Francisco that literally stretched as far as the eye could see toward the ocean. I was also a member of Peace Hostages, and had several meetings with the founder of the idea, which was to send several hundred Americans to live in Moscow, so that the Pentagon would think twice about launching missiles to destroy the Soviet Union.

 I prided myself in being a reliable, no-questions-asked outside agitator. For example, I remember receiving one call to appear in front of the Berkeley campus, at University and Fulton, at nine o'clock on a certain Saturday. I arrived as requested, found a line of people, hands joined, stretching down both sides of the street and then up around the campus. I took a place in the line between two women (I felt squeamish about holding hands with men), turned to one of the women and said, "Excuse me, but why are we here?" She laughed, said it was anti-nuclear.

I must add one of the saddest memories I have in connection with the War, and that is of one weekend afternoon in the Public Library in South Palo, which in memory was a sunny, spotlessly clean place with lots of blond wood in the interior, exactly the kind of library you would expect for such an affluent neighborhood. As I waited to check out some books, I overhead several young men talking in earnest tones about lawyers they had heard about who knew legal methods for avoiding the draft. They spoke rapidly, obviously wanting to believe that there was hope. It touched me deeply that the nation's most promising youth were being put to such torment by the very real prospect of being forced to fight and die in yet another politicians' war.

Car Races at Laguna Seca

I have never had any interest in watching sports, with two exceptions: marathon running and sports car racing on roads. (For me watching the Indy 500 is an unfit activity for anyone except Joe Six-Paks and their loud, overweight girlfriends.) The nearest thing to sports car racing on roads that I knew about in these years was the races at Laguna Seca, which was located on Fort Ord territory near Monterey. Now strictly speaking, these races took place on a track, since it was

a closed circuit. But the track was paved like a country road, and went up and down slight hills and was nothing like the engineered roadway at the Indy 500.

What most appealed to me about these races — as I recall, I went alone — was the music of the car engines. Just prior to the start of the race, I would take a position beyond the first turn. A mighty roar of engines and then the cars streaking down the track and into the turn. The sound filled my ears, filled my entire body, it seemed. I bathed in the racket of these mighty machines hurtling past. Then I would move down to the far turn and take a position where I could not only listen to the engines, but could also watch how nearly identical was the drivers' steering around this turn. The path of the left front wheel of each car could not have differed more than an inch or two from that of the others. And all the while that beautiful, deafening noise. There might have been a bridge over the track farther on, I am not sure, where you could stand and watch the cars zip by underneath you.

I hadn't the slightest interest in who won; in fact, I doubt if I knew the names of any of the drivers. All I wanted to do was listen to the engines. One time, during these years, KQED, one of the local PBS TV stations, broadcast a documentary on new music. One of the pieces included recorded sounds of Los Angeles freeways and the sound of the wind passing over a glider in flight. I thought it a very effective piece, and was glad that someone else appreciated the musical qualities of machine sounds.

(Later it seemed they toned down the sound of the engines. Someone said the noise consumed energy.)

First Programming Job

Working on the Fourier Analyzer manual convinced me that programming was something I needed to learn. I started writing all my zeros with a slash through them, as programmers did, to distinguish them from "O"s. This soon began annoying Marcella, who considered it an affectation. But that is how seriously I took this new discipline.

I applied for a job as a programmer writing test programs for integrated circuits, probably because I heard that the programming merely involved filling in the details of a pre-defined format, which I thought would be easier for a beginner than writing programs from scratch. The manager was Rick Pering, who turned out to be that rarest of individuals, a natural-born engineer who was also a natural-born manager. During the interview, I said, "Give me a chance and, if I turn out to be of use, I promise not to leave for at least 1½ years, no matter what other offers I receive." He took me up on my offer, and I kept my promise.

Our job was to write the test programs in Assembly language. I managed to teach myself the rudiments of the language, which wasn't difficult if you were working among engineers who did programming as part of their job. In our team was a young woman named Barbara (Barb) G., who had recently graduated from Stanford with a bachelor's degree in mathematics. Her family lived in La Jolla; her father was a scientist. She said that he had once pointed out to her that the English name of the great Italian opera composer, Giuseppe Verdi, is simply "Joe Green". She had upper-class grace, and a friendliness toward those less fortunate, which I took for granted was one of the things a young woman got from a Stanford education.

Having been raised properly, of course, she knew that eating donuts and drinking the flavored hot sugar water called coffee that was served in the morning and afternoon was bad for you, and so she, like me, would discretely slosh the hot coffee around in her mouth before swallowing it, in order to rinse away some of the sugar left from the donuts. It didn't dawn on either one of us that

we were rinsing away the donut sugar with hot sugar water.

At the time I was studying a book that, if it didn't change my life (that had already been done by Manny Gordon's course at Beckman), at least gave me the confidence to continue studying what I still privately called "honest math" (in contrast to the calculus, which I still considered "dishonest" because it never made clear what an infinitesimal was). The book was Marvin L. Bittinger's *Logic and Proof*[1], which to this day I still consider the best introduction to set theory and logic ever written. It wasn't even typeset, but instead written in IBM Selectric Times Roman or Courier. Its format was derived from that for programmed instruction, but fortunately it lacked the mind-numbing monotony of that misguided technique. Instead, it consisted of a sequence of sections each giving the definition and a brief explanation of a few new terms, then a few examples, then exercises, followed immediately by the answers. At the end of the two major parts (one on sets, one on proofs) it had a test, preceded by instructions for preparing for it, and followed by answers and a brief analysis of your score, telling you what to do if your score was too low. It was the ideal book for someone like me, and I went through it from start to finish, working all the exercises and taking the two tests. Pete Roth was impressed by the fact I had the discipline not only to study the book on my own but to take the tests. "You are going on an intellectual adventure!" he said.

(I should mention in passing that while I was going through Bittinger's book, or soon after, I bought Robert Stoll's *Sets, Logic and Axiomatic Theories*[2], another paperback that seemed approachable. And yet, although it covered much of the same ground as Bittinger's, I found it very difficult, and to this day am not clear why. Perhaps it was nothing more than the formality of the typeface. Or the dry, academic style, and the fact that there were far more logical statements expressed in logical symbols than there were in Bittinger's book. Now, close to 40 years later, it seems perfectly understandable, though still a bit dry.)

An indication of my mathematical naiveté at the time was the fear and uncertainty with which I regarded the symbol "●" that Bittinger used to indicate the end of a proof. The only symbol for that purpose that I knew was "QED" ("quod erat demonstrandum", "which was to be demonstrated"), from high school geometry. I wasn't too far from believing that only real mathematicians were allowed to use this symbol, that someone like me could never use it because there was always a strong possibility that the proof whose end it marked contained an error (probably several errors). I felt that mathematicians' selection of just that particular symbol to mark the end of a proof was an indication of the depth of their insight, for who else could know that a large black dot was in fact the one and only correct symbol to be used for that purpose? Truly the subject was the most profound of them all!

But my naiveté was not limited to proof symbols. It is no exaggeration to say that I was in my mid-thirties before I understood what was meant by something like "132" — namely, that it means one 100, plus three 10s, plus two 1s. And I only came to understand that from studying binary arithmetic in relation to programming. Up till then, a number for me was a symbol which I knew how to manipulate, for example, in addition or multiplication, and which I could associate with a value, for example, 132 pounds, relative to other symbols, for example, 140, 150. Furthermore, until I began studying programming, I had no idea that multiplication (of integers) was merely repeated addition, and that division of integers was repeated subtraction.

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1. Later revisions were, I believe, titled *Sets, Logic and Proof*.
2. W. H. Freeman and Company, San Francisco, 1961.

Since I was working next to a person with a degree in math, namely, Barbara, I naturally wanted to share my excitement with her. She listened graciously, though I think she was a little surprised at this older man (I was then around 37) being so enthusiastic about something that people normally only faced in school. Once I was bubbling over about the fact there were only a few major techniques for doing proofs, and what a neat idea I thought each of these was. She then revealed that she had never actually studied proof theory. I asked her how she did proofs. She shrugged, said words to the effect, "I just figure them out." I was amazed. Here was a woman who had just graduated in mathematics from one of the most prestigious, and expensive, schools in the country, and yet I, a self-teacher, probably knew more about one of the cornerstones of her field than she did.

At that time, Donald Knuth, a professor at Stanford, was one of the big names in programming due to his multi-volume series, *The Art of Programming*. Knuth was known as a prolific author of academic papers. To me, it seemed that he wrote a paper about every programming thought, important or not, that crossed his mind.

She was a better programmer than I, always completing her programs on time, and apparently without any of the anguish that I experienced. A couple of years later she married one of the engineers on the Fourier project, Dick G., and they moved into a nice house in Palo Alto.

In the early 2000s, long after we had all retired, Webb, his wife Chris, Barb, her husband and I decided to meet once or twice a year for lunch at the Fish Market in San Mateo. After our first lunch, Barb sent me a sweet email that included the following:

> I remember little Jeffery[1] visiting Rick Pering's section at HP and loving to wind up the paper tapes with the electric tape winder. Since programs were on paper tapes then, it was a job that needed doing often and I remember we let him do it as long as he was interested. He always was. If the winder spun too quickly, the paper tape could tangle at your feet and even rip rather than wind up on the spinning reel. We taught Jeffery to go slowly and to be careful but mostly I remember watching and letting him try on his own, waiting to leap forward to untangle tape, cheering him when he wound up a tape without mishap. We wanted him to have a good experience. Clearly he wasn't going to be doing any coding. The tape winder he could do. He was having fun and he was doing something we actually had to do, too. He was helping us.

At least one programmer in our group, and one who worked in a nearby group, were naturals — born to do precisely the kind of work they were doing, and to do it well. They were Don Cross and Pat Mulraney. Both were self-taught.

Don Cross

One of these self-taught programmers was Don Cross, a remarkably modest, even self-effacing man, who seemed to know everything about the machines and software we were using. Ask him a question, and he knew the answer. His one fear in life, it turned out, was that the company would carry through on its threats to require that all programmers have at least a bachelor's degree in electrical engineering. Once, when it seemed that the threat would be implemented, he began

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1. I had brought him to the plant one day so that he could see where his father worked

frantically trying to teach himself calculus so that he would have a fighting chance of passing the courses he would be forced to take — this on top of his more than 40 hours a week keeping the team's software working. I tried to console him, telling him how disgraceful it was that the company was forcing outstanding programmers like himself to waste their time on such nonsense. The company's threat never materialized, at least as far as I know, and so he was allowed to go on being productive.

Pat Mulraney

The other self-taught marvel was an Irishman, Pat Mulraney. He wasn't actually a member of our group, but I often ran into him when I was working in the computer room. He too had the modesty, the friendliness of those who know they are living on borrowed time — who know that, because they don't have the right degree, their high-paying job is always in jeopardy, regardless of how talented and knowledgeable they are. More than once, as I was trying to figure out why my program was behaving so strangely, I asked him something like, "Hey, Pat, what's supposed to be in memory location ... ?" and he would reply, in his Irish accent, "Oh, that's where the address of ... is stored." or, "Oh, that's the counter for ..." He seemed to have the contents of the operating system's storage locations completely memorized.

His main interest, apart from HP work, was the digitizing of music. Once he demonstrated how he could reproduce a piece of music at a much reduced tempo, but without the well-known lowering of pitch that occurs if, for example, a tape is played at a slower speed. He had apparently mastered, on his own, the contents of Bracewell's book on the Fourier transform, among others. But he was also interested in other subjects in computer science, one of them being programs for simplifying complex logical expressions. To this day I can hear the way he pronounced, in his irresistible Irish accent, the term "prime implicant" in this subject — "proyme implic'nt".

"Hewlett's Project"

Every once in a while, word spread throughout the department that "Hewlett's project" was coming through. This was an integrated circuit that the old man himself was developing, or at least was heading a team that was developing. We didn't know what it was for, but we were all impressed that, at his age , and his position as co-head of the company, he would still want to do engineering design work, much less be capable of it. This chip, as it turned out, was for the HP 35, the world's first pocket calculator. The story is by now well-known in the industry: how the company had asked Stanford Research Institute (SRI) to do a market study on the desirability of producing a calculator that would fit in an engineer's shirt pocket, and how the deep thinkers at SRI had come back with a report saying that the product would probably never make enough money to justify the investment. Hewlett decided to ignore the report and develop the product with a team of his own choosing. The HP 35 and its successors, many of which were programmable, made many millions of dollars for the company, gave rise to a new division, and inspired countless imitations by other firms, until now the pocket calculator is almost as common as the wrist watch. I, and many others in the company, I'm sure, when the calculator was first released, and was receiving its initial acclaim, felt particularly proud to be working in a company in which one of the founders had the insight and ability to pull off a coup like that.

I Am A Teacher, Briefly

For reasons I can no longer remember, I was asked by one of the managers if I would like to

give a little course — really, only a couple of lectures — on Assembly language. My answer would have been a resounding *no*, but it was clear that I was not really being being *asked*, I was being told, and so I had to make the appropriate preparations, which amounted primarily to trying to figure out ways to overcome the fear and trembling I knew I would experience when I was standing in front of the class. What made the ordeal infinitely worse was that Sharon Johnson, the gorgeous secretary I described early in this chapter, was in the audience. The fundamental reason why I had never been able to bring myself to get a PhD and become a college professor — namely, fear of the overwhelming anxiety, shame, and embarrasment that I would experience standing in front of a class trying not to look at the legs of the female students sitting in the front row — this fundamental reason now became a reality. I think I sweated my way through two lectures, speaking far too rapidly, face red, hating myself every moment. The attendees left after the second lecture shaking their heads: "No, Assembly language is not for me, no..."

It was a good thing that the subject had been software rather than hardware, because had it been the latter, I might have been forced to use the standard engineering terms "male" and "female" in reference to electrical plugs and sockets, and that, especially with Sharon in the audience, would have produced such blushing and embarrassment that I would have been unable to go on. When I first heard those terms used openly, casually, by the engineers, I could hardly believe it. Sexual language in the workplace and no one even batting an eye! How could it be allowed?

Studying Programming and Math

I worked hard at my daily programming, but I knew from the start that I was doomed to be a mediocrity[1], not only because I had no interest in learning the electrical engineering associated with integrated circuit design, but because I hated all the details that you had to remember in order to program well — details about what was stored in various memory locations, and details about the various program constructs, for example, loops, if statements. I loved the idea of reducing things to a sequence of steps, with no cheating, no hand-waving, no sweeping of annoying details under the carpet, as in the calculus, but I hated the price in increased details. And because it was so difficult to get programs, or at least mine, to work properly, I early developed an interest in program proving, which was then all the rage in some branches of academic computer science.

So, as always, I tried to get by as I had in the past, namely, by knowing as little as I could and by asking questions, a practice which, however, only extended into this new field my reputation for being a nice guy who unfortunately wasn't engineering material. Too bad: it was logic and mathematics that I was interested in.

I wondered what my father would have thought of the computer, which had begun to be discussed in the press only a few years after he died. I never heard him complain about having to do all the calculations he did using his venerable slide rule. I think that, once the power and accuracy of the machine were demonstrated to him, he would probably have been willing to use it. He would also probably have been interested in the moon landing from an engineering point of view. I believed that, up to a point, if the argument were about scientific or engineering subjects, I would have been able to argue with him and perhaps, on rare occasions, change his mind.

Somehow I came across a paper on program proving by John Allen. The author credits indicated he wasn't a professor, and so I thought there might be a small chance he would reply if I

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1. Although a journal entry for Wednesday, Aug. 1, 1973 reads, "Got a $140 a month raise today, bringing salary to $18000 a year. Plus Marcella's $9000. We have a lot to be thankful for."

wrote him. Which I did. I described my idea for proving the correctness of programs by starting with the lowest level programs, proving them correct, then proving the programs that called on these correct, and so forth, continuing in this way until you had proven the entire program correct. He wrote back a kind letter in which he gave what I considered a sound counterargument to my idea, namely, that there were too many programs at the lowest level for the idea to be feasible. I don't remember the details of our communication after that, but I do remember that he invited me to attend a course on LISP he was going to give at San Jose State (SJS). LISP[1] was considered by many of the better minds in computer science to be the most elegant and powerful of all programming languages. John certainly convinced me that this was true. (He used to say, "If you want to think big thoughts, then you need to think them in LISP.") By the end of the course, which I found very difficult, he had become, whether he knew it or not, my mentor in computer science. I liked his earthy manner and his contempt for academics, in particular, his contempt for some of the less enlightened professors at SJS, whom he loved to excoriate. As far as he was concerned, if you weren't studying mathematics, you had no business in computer science. He was the one who convinced me I should do a master's on Dana Scott's denotational semantics of programming languages, which he called "Scottery". Scott had written his first papers with Christopher Strachey, but Allen said that Strachey had died at the end of the sixties. (A friend of his in Oxford had commented how Strachey had suddenly begun looking thin. It was cancer.)

John had been a teaching assistant for John McCarthy, the Stanford professor who, in the late fifties, had created LISP. I should mention in passing that McCarthy was also the inventor of multiplexing, which makes it possible for the computer to do several different things at once, for example, print all or part of a document while another program updates your virus-fighting software and you do typing in another document. The story went that McCarthy did a few calculations to determine how long it took a printer to print one character on a piece of paper. The answer was: enormously long compared to the computation speed of the computer. So, he was said to have asked himself, why not have the computer do something else instead of just sitting idle while it waits for the the character to be printed?

John would relate how concern over teaching was the least of McCarthy's concerns, even though the students had to take the courses to achieve certain academic goals. The teaching assistants did most of the work of explaining what was not clear in the class notes prepared by the professor, and what was not clear from the textbook. (I am in no way criticizing the quality of McCarthy's research work by these remarks.)

A young woman in his class named Ruth Davis seemed always to be in his office during office hours, where I also was. I remember one particular time when, as I entered, the two were arguing intently about some matter in the homework. I sensed there was more behind the argument than computer science, and, as usual in these cases, my instincts were right: several months later they were married. They bought a house in Redwood Estates, in the Santa Cruz mountains, and she eventually got her PhD and became a professor of computer science at SJS.

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1. The acronym is derived from "LISt Processing".