

OUTSIDE PASSAGES

A This & That Memoir



Michael Waterman

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ISBN 9798321501122

For Tracey

Leaving your homeland is a mistake
that can only be fixed by never looking back.

Iman Mersal, *The Threshold*.

If you're writing memoirs, your mother ought to beat you
with a two-by-four.

Percival Everett, *The New Yorker*, March 18, 2024.

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Home, Home on the Range

Steady cold rain came from low gray clouds over the schoolyard of a tiny town in 1950s southwestern Oregon. My grade-school teacher asked each student what they wanted to be when they grew up. I had never been asked that question and panicked. Did I have a choice? What were the possibilities? I knew most people lived in towns but what did they do there? I had no desire to work in a store but commercial fishing, logging and ranching were options. I wanted to escape my father and the heavy work, but I had no idea how. My reluctant answer was “A rancher...I guess.” I have no memory of what other children said.

The first eighteen years of my life were spent on my family’s livestock ranch on the southern coast of Oregon. As with many American families, our European ancestors arrived on the east coast. Beginning in the 1630s, various branches of my family came west as rapidly and as far as they could make it. All four sets of my great-grandparents lived in and around the Blue Mountains, the Blues that stood on the Oregon Trail and jammed up many a westward journey. Northeastern Oregon, west central Idaho and southeastern Washington. My mother’s grandparents lived on adjacent homesteads on Dixie Creek near Baker, Oregon; my father’s grandfather had his final mill job at Priest Lake, Idaho (he had owned ranches and mills); his mother’s grandfather John Crooks established an enormous horse and cattle ranch near Grangeville, Idaho. No wealth was accumulated to be passed on, at least nothing reached Four Mile Creek. The people in my ancestry kept going west until they collided with the Pacific Ocean. They occupied the margins, never belonging to higher levels of society or wealth which was not destiny so much as choice. They avoided the Willamette Valley and California, or if necessary, crossed through them with dispatch. Perhaps they just did not like it there. Unaware of this, I played my part, doing my PhD at Michigan State instead of going to Cornell or Stanford where I was accepted. And

taking my first job after that degree at Idaho State University instead of joining Bell Labs or doing a post-doc at UC Berkeley. As with so many things this had to be a combination of genetics and environment.

The 1862 Homestead Act officially lasted until 1976, but in 1890 the Census Bureau announced the end of the frontier which meant the end of large tracts of available land. In our isolated corner of southern Oregon homesteading started about 1890. The American West ended at the Pacific Ocean. What came next? Most of my family remains stalled there.

Orphaned Mabel Crooks married my grandfather Charlie Waterman in 1903. They creaked across Oregon in an old wagon in 1911, a covered wagon discarded in eastern Oregon by pioneers who failed to make it all the way to the Willamette Valley. They left Huntington Oregon on September 11 and arrived at Four Mile Creek on the southern Oregon coast on October 30. My grandmother Mabel kept a diary showing her optimism and close observance. The trip was as she put it on one occasion “a very hard pulling,” but her confidence in their life-changing journey never wavered. They had a new Edison player, one that used those thick cylindrical records, placed under the wagon seat. They brought it out to play music for people along their journey and for themselves in the evenings. Mabel was a strong sweet woman and reading her diary while in my fifties brought me into close contact with the woman I dimly remembered. She died of cancer when she was 64 and I was three, in the homestead house one-half mile down the road from my home. My mother and I often made that walk on our ranch to visit my grandparents.

I wrote a memoir *Getting Outside* of the years I lived in Oregon. As the song has it, sometimes it was heaven, sometimes it was hell, and sometimes I didn't even know. The hell part had mostly to do with my father, a severe taskmaster unburdened by imagination or empathy. He worked endlessly to expand his ranch, including paying off a decades-old loan on my relaxed grandfather's land. As the oldest son I was loaded with what seemed to be endless work for which I received constant criticism and punishment. While he made my childhood miserable, my father was as honest as anyone can be in real life and there were no hidden aspects to him. What you saw was what you got, like it or not. I did not like it, nor did anyone else.

There was security in our lives although we had little wealth. We did possess land; we were landowners distanced from people who worked for wages. There was no need for bank loans to operate the ranch; our loans were to purchase more land. Cows and sheep ate grass and we sold animals

and wool. Land purchases were made cautiously by my father and those loans paid down as the years passed. We were frugal and worked hard, but the foundation of our lives seemed solid as the earth. Like any child I wanted more: more toys, more fishing equipment, new clothes, books, but I never felt deprived. The food was bland but I was never insecure about having enough to eat. Sitting my office today, however, I reflect on how precarious our lives on Four Mile Creek were. A run of bad weather such as bitter cold and snow would have killed our livestock. Disease could have destroyed the herds. Prices for our animals could have hit a bottom that would have ruined us. If my father were injured or seriously ill, the ranch would have crashed. But people on Four Mile Creek survived the Great Depression so they knew they could survive anything.

Despite the constant heavy work and my father's severe and continual criticism, I felt a solid sense of belonging and safety, perhaps fostered by my grandfather Waterman's satisfied view of life. Ownership flows from the political state to the individual, but seldom do individuals look it that way. Indeed, ownership is intense and personal and prideful, and any intrusion by the state is barely tolerated and often greatly resented. Those acres on Four Mile Creek were ours and ours alone and do not interfere with anything we want to do! And yet, and yet. This region, homesteaded in the 1890s, was occupied by Europeans in the lifetimes of people I knew. We viewed ourselves as the original owners. The deep identification I have with the family ranch remains although I no longer feel welcome to walk the acres that are now my brother's property. Despite that I conjure up the ranch and in my imagination roam about, smelling this, touching that. This geographic identification now includes many other places: a rocky precipice in Idaho's Bighorn Crags, a large part of the Gila Wilderness in New Mexico, the Sierra Nevada in California and the list could go on. Those locations are possessed differently, by an ownership commons that I share with all US citizens.

Everyone knew that Native Americans had been there first, and that contradiction was concealed by what is now called racism. If you take property from a lower life form, it is easy to believe that action is moral. America's original sin is often said to be slavery; it is both slavery and the annihilation of Native Americans who had been here for thousands of years before Europeans arrived. Europeans however viewed North America as virgin land, unexplored wilderness. Note that word unexplored! Our lives in Oregon, cutting down timber and making grazing land, were brutal it seems today, and my romantic ideas about camping, wilderness, and outdoor activities were

intrinsically linked to Native Americans. I have spent a lifetime adjusting those notions. The winter of 2004 I read *One Vast Winter Count* which is an extensive, chilling and depressing account of what happened to the native peoples. The US has addressed in less than satisfactory ways the injustices of slavery; the acknowledgment and atonement of what was done to Native Americans remains largely invisible and ignored. Land and water and air and sunlight—ultimate free goods. Enjoy them while you can, if you can.

Many writers and thinkers have addressed these issues. William Faulkner went at it from multiple directions. This is from the short novel *The Bear*. “...when Ikkemotubbe discovered, realized, that he could sell it for money, on that instant it ceased ever to have been his forever, father to father to father, and the man who bought it bought nothing.” The speaker is struggling with inheritance of property, repudiation is how he describes his choice. I return to this in the last chapter. Sometimes stepping aside is the best choice.

In our part of isolated southern Oregon coast, people referred to the Willamette Valley and anywhere other than Coos and Curry Counties as “Outside” which is where that word in my titles comes from. Except possibly for a helper at haying time we had no hired workers, no one to assist with land clearing, the animals or the land burning each fall. We were fence and barn builders, carpenters, loggers, plumbers, mechanics, road engineers, veterinarians, firefighters, whatever was needed; we did those jobs, however ineptly. Electricity came in 1953 when I was in the fourth grade and then we became electricians. Without the government’s Rural Electrification Association this would not have happened. The REA act of Congress was in 1936 so we were at the very end of the expansion. Even then there was marginal radio reception and no TV signal.

And within our inside world we were isolated on Four Mile Creek. I thought Bandon with nearly a thousand residents to be a good-sized city and Coos Bay with six thousand people a metropolis, at least I did until I took my first trip in a livestock truck to South San Francisco’s stockyards. It is difficult in these days of instant communications to convey how confined our lives were. My father had no friends; my mother had her collection of women but she kept them to herself. Three holidays a year we attended my mother’s family gatherings. There were no guests to dinner and no one came to visit except along the dirt road when we met one of the few neighbors. There were no children to play with or to have as companions until my brother Little Charlie (four years younger) was older. No interest in national or state affairs existed unless there was a direct connection with taxes or the

price of livestock. The world out there was so abstract it did not appear to be real. We lived our remote existence bounded by fences and no-trespassing signs and a fierce passion to keep everyone off our land. This lonely poverty of existence is the likely basis of a deep satisfaction and passion for me: the partaking of public places. The commons, whether a city street or urban park or coffee shop, make me happy. Just to be walking in shared space is a joy; that all the world is not locked up for a select elite is a huge relief. I wrote this at the time of COVID-19 so once again I was sequestered.

Since several men in my family have carried the name Charlie Waterman, I have given them handles: Original Charlie for my great-grandfather, Good Time Charlie for my grandfather. My brother Little Charlie came along later. If my father had been named Charlie as well, I'd have tagged him with Mean Charlie. His older sister escaped Four Mile by seducing her high school teacher and letting the resulting scandal propel her and the teacher to the Willamette Valley. Ray Waterman was the center of his mother's love and perhaps that is what made him spoiled and selfish. He remained immature for his entire life. And he was lazy or just inactive until he was almost 30 and married my mother. That pushed him into a frenzy of activity, almost desperately working livestock and clearing land for the rest of his life. For he was deeply ashamed of his own father, of his father's laid-back approach to life and of the meager goods his father had accumulated. My father was not a brilliant guy and lacked imagination and empathy. So he had to prove himself and make his advance on Four Mile Creek. He was born three-fourths of a mile up the road from the house I was raised in, and one-half mile down that lonely road was my grandfather's house where he grew up. The man hardly budged from Four Mile in his entire life. As Thoreau observed you can get a lot of mileage out of a limited physical geography. "I have traveled a great deal in Concord," Thoreau wrote. Although he walked every foot of it, my father travelled little in Four Mile. He used his opportunity to create a sheep and cattle ranch out of timbered and brushy hill country on the rainy Oregon coast; finally he assembled a baker's dozen of properties into his domain. But emotionally he was a selfish, immature and petulant child for his entire lifetime, which took a heavy toll on those who forced to be in his vicinity.

My mother was born in Huntington Oregon and her father worked on the railroads. Her family went anywhere in the northwest where railroads were built. My grandfather Amos was a good worker, running a crew by the time he was 14. When the Depression came he found a job watching track

near McCloud California. In high school there my mother and her brother belonged to a motorcycle gang, not with the negative connotation gangs have now, but it was a gang. They outran the city cop and seemed not to be crushed by the Depression. Because there were no jobs after high school, my mother went to normal school where high school graduates were trained to be teachers. Before McCloud she had worked a summer in a logging camp near the tiny town of Powers; she went back to Powers and obtained a loan from a gambler who tracked her progress in school. When she graduated and had a teaching job, she was paid in warrants that banks discounted by 6%. The gambler took her warrants at face value—what a great American story! While teaching in Coquille she met a man with whom she had a brief marriage. This was a dark secret, divorce was considered close to a sin, a secret only brought out when she wanted to stop my own marriage 25 years later. After her depression from this personal disaster was fading, she met my father who persistently courted her. Given the heavy judgment about divorces in 1940 Oregon, this was her last chance and she made her second marriage last a lifetime. Hers was the last generation of American women to present themselves to the world as Mrs. Husband's Name.

So what were we doing on the ranch? Land had to be cleared of timber and brush and then kept clear for grass. There are the obvious tasks such as milking cows by hand and raising a garden each year. The cow required hay, the garden required fertilizing with cow manure, and plowing and preparing the ground needed a team of horses. And those horses needed to be fed and their harness repaired. My grandfather had hayfields beside the stream, and my father used fields high on the ridges. Those fields were steep and, the higher they were, the less fertile the land. Horses pulled the cutter, the rake and the wagon loaded with hay. The labor involved was substantial, from putting the hay into shocks to loading the wagon and putting hay into barns for the winter.

Our summers were mild compared to the winters with gale-force winds pushing in almost horizontal sheets of cold rain, but a June rain or heavy dew could ruin the hay. After my father purchased richer bottom land nearer the highway we made most of the hay there. In winter the hay fed milk cows, horses and our herd of Hereford beef cattle. There were many more sheep than cattle, and the cattle were much less work. The sheep had to be sheared and worse yet in the spring we tagged them, clipping off the

tags of manure that had solidified onto their winter wool. Tagging was wet cold smelly miserable work. Shearing lasted longer but wasn't as awful. We spent a long week each year rounding up the animals, bringing them through the pens to be sheared, and the fleece tied and tromped down into long wool sacks. Lambs were born in what could be the worst coldest rainiest weather in January and February, and we were out there on the range to feed them and rescue the animals that needed help. When the lambs had some growth, we castrated and earmarked them and removed their tails, another messy operation. And animals afflicted by some disease, pinkeye or hoof rot, created an endless hell of treatment.

Slash-and-burn land clearing created pasture, and after that, the land needed to be kept clear. (Now fertilizer is cast onto the pastureland from an airplane, increasing the number of livestock the ranch can carry and the pollution that runs off into the streams. In my time fertilizer meant manure.) Brush grew back quickly, and weeds abounded, some poisonous for livestock. And roads, ditches and fences all needed to be constructed and maintained. After shearing, lambs and calves were sold, and in the fall we built fence, a half-mile or more of woven-wire fence with a strand of barbed wire topping it off. The posts were hand-split red cedar from our ranches. I liked fencing the best of all the work I did on Four Mile, with haying coming in a close second. Both activities had a graceful geometry and precision, and they were reasonably clean jobs, plus at the end of the day there was solid accomplishment. In 25 or 30 years a fence post rotted out at the ground level, and as we were pounding dirt and rocks to make a post solid in the earth, I hoped I'd not be around to redo the job. For I had no idea how one escaped that life and my father, but I wanted out. Outside, I suppose, but I had no idea how to get there—and I had no clue what the possibilities were. Life seemed a pretty grim business looking at my own situation, although my grandfathers had not been stuck anywhere they didn't want to be. I wished for the same open world that they had experienced. Instead the Watermans were jammed up against the Pacific Ocean with no west left for us. In my early teens, we were tagging sheep on a cold rainy miserable day in a dilapidated barn. My father insisted I do the tagging using shears powered by the portable Kohler plant. I kept cutting the ewes in delicate places, and as usual when he pushed me I did worse. At one tense moment he asked me in great frustration and anger, "Don't you want to learn to tag sheep?!" "No I don't!" I answered instantly. That afternoon did not improve as it went along.

One fall day we rode out to one of the ranches, and my father gave

directions that were even more tangled than usual. “Turn at the tree,” he repeated. It did no good to ask what tree or which direction to turn. I rode away, having no idea what to do. Then I stopped my horse on a little hill and looked out over some of the range. “Look,” I told myself, “you will screw up and not do what he wants. But these are just sheep, and he went in that direction and here I am. If I do thus-and-such, I will get the sheep to where they have to end up.” So I just aimed at the end goal, and amazing to me, I didn’t get cursed at. From then on, I only listened to my father long enough to get a picture of what we were trying to accomplish. I paid no attention to how he wanted anything done. If he saw me work he usually became angry, but if he didn’t see how I did something, I usually escaped. This is the point in my life when explicitly I learned to think for myself and to take responsibility. There was no gain to pretend or to lie to myself. If I had continued to try to follow my father’s dreadful directions, I would probably still be out there in those hills looking for one crooked bush or another to turn left at. Or was that to be a right turn? In some sense, that is what eventually happened to my brother Little Charlie who now owns all those bushes.

I began to accumulate livestock, sheep and cows that I kept on land I rented from my father. Clearly he expected me to follow him and become a rancher. It amazed me how differently I felt about the animals when I owned them. It was truly satisfying and I made a profit. There is a deep satisfaction in caring for animals and the land, picking up a lamb in ferocious cold rain to rescue it, watching animals thrive on springtime grass. When first experienced directly, it is an unknown and magical country. This made me think more about a life as a rancher which didn’t look as dreadful as it had when working for my father. I discovered pamphlets that the US Department of Agriculture sent free on request and thought about where I could go to start a ranch away from Four Mile Creek; Mexico seemed a possibility and I tried to find out how to do that.

I stopped feeling so strongly about my father as soon as I escaped from his control, which came with graduation from high school. At that point I refused to work for him. As an adult I looked carefully and never located much that I did not see clearly when I was a child. I had to take things as they were to survive, and so later it was left to arrange them in digestible boxes. That took a good long while. Ray Waterman had such limited and childish beliefs he could have become a harmless cartoon, but he managed to block even that position in my life by his clumsy sexual advances, first

to a woman I was living with, and more horrendously, to my daughter. He must have been frustrated sexually, and I suppose he saw these women as outsiders and therefore fair game.

My mother I saw as my ally, my mother who loved me and who wanted the best for me, which was true as far as she took it. Without her and my grandfather Waterman I would not have survived as I did. Electricity freed her from dreadful labor of hand washing clothes and cooking on wood stoves, so increasingly she had time to herself in her home. But when I was in my thirties I finally realized that she had mostly been in that house protecting herself. When my hands were ripped with barbed wire so badly that they required two scores of stitches when I finally was taken to the doctor, she sat in the car and did not insist to my father that I be taken to town. I was injured outside her tiny domain—30 feet away—and it was not any of her business. What adult does not help an injured child, let alone her own son? For years I wanted to ask my mother “Where were you?” but knew the question would not even have been heard, let alone answered. She huddled in that little house for over 60 years, trying to convince herself the outside world did not exist. What a sad waste, what missed opportunities!

The life I led as a child was common a few generations earlier. My deepest desire was to have my own life, whatever that might be. The theme of escaping rural life and returning “to the farm” on a painful visit was a common topic of fiction late in the nineteenth and early in the twentieth century as in Hamlin Garland’s “Up the Coulé” (1891) and Willa Cather’s “The Sculptor’s Funeral” (1905). In these stories as in life, there is a longing for and connection with the land and the people of home along with alienation on both sides. The pain of having abandoned a family and heritage; the pain of being left behind and rejected, even for those at home who wished for and helped with that very escape.

From my grandfathers, I realized that expansion and exploration had vanished for me, as much as I hungered for that life. My childhood gave me a great advantage for what was ahead. I had no sense of entitlement or privilege, instead an appreciation for whatever intellectual and material opportunities, if any, there were to be earned. Of course I was a white male and knew that had I been born female life’s possibilities would have been very different. Speaking to a room full of ambitious Chinese students at Beijing’s Tsinghua University in 2008, I told them I felt as a young person that I had been born too late, that I had missed my opportunity to be an explorer. There was no geography left to discover. The room roared with

laughter! As the title of the session was “Meet the Pioneer,” they had good cause to laugh at me.

Crossing the Divide

Rugged 5000-foot mountains are a barrier between the Oregon Coast and everything else. The Willamette Valley and the Oregon Coast are different worlds and to move from the Coast to the Valley required substantial effort. I had no idea what was required to escape the Coast or even what that meant.

My first choice was between Oregon State College and the University of Oregon. They were the only schools I considered, hovering at the rim of my known world. Oregon State was reputedly the school for practical studies; it then was my obvious choice. What was I but practical? I also decided on a physics major. My mother's superintendent at the Coquille schools had somehow become the head advisor for the School of Science at OSC, and she and I made the trip to Corvallis to consult him. He advised me to major in engineering.

"It is always easy to go from engineering to physics but not the reverse."

I still have no idea what possessed him to advise me so, perhaps he thought I aimed too high with a physics major, but I did as he suggested and enrolled at Oregon State as an engineering student.

The college had almost eight-thousand students, and I was amazed by their numbers and dazzled by their sophistication. Registration seemed a chaotic process to me; it took place inside a large covered gymnasium where I lost my sense of direction. There was no geography to the place and no sky. I wandered randomly, standing in long lines that sometimes were lines I needed to be in, and eventually I was registered as a freshman engineer for seventeen credit hours.

Then wonders began. I attended only twenty-seven hours of classes and labs per week, a very small number it seemed to me. Beyond that I was left alone. No one required me to work mornings or nights, and my weekends were unscheduled. I could not believe such luxurious freedom.

Soon I discovered the library in an elegant old building named Kidder

Hall crammed with more books than I had thought existed in the entire world. I was so struck by this abundance that I had to sit down, shocked. My fear that there were not enough books on the planet to last me a lifetime now seemed childish. Instead, the problem was deciding what to read in that lifetime. How could such riches be coped with; how could the most important and exciting books be located in the endless aisles? As the loggers said when someone married a pretty woman with some money, I thought I'd died and gone to heaven, but how could I cope with this heaven?

The first term I lived in a dormitory. This was a shock to a boy who knew fewer people than lived on one dorm floor and was used to night sounds of wind and animals. It was interesting too, although I didn't sleep well cramped up with all those people. One Sunday I was looking through a newspaper and saw my first Andrew Wyeth reproduction. Printed in color on cheap paper was one of Wyeth's precise stark masterpieces of a working man standing by a window in a plain room with faded walls. He was about sixty years old, wearing a worn shirt, sleeves rolled up showing his muscular forearms with veins standing out. This guy had worked hard all his life and showed it in his stance and his build and his look at the painter. He made me think immediately of my grandfather Waterman who standing by an upstairs window in his house would have looked just like that. I tore the picture out of the newspaper and taped it to my dorm wall. I told someone that men like that were the backbone of our country. Later I heard this repeated to the amusement of the listeners. I was not embarrassed; I had said it and I believed it. It was years before I fully understood this incident. Those boys from the suburbs were right to laugh. The industrial revolution had already occurred, and our entire century was an exodus from the farm, one that continues today. So hardworking Charlie Frank Waterman was a hundred years out of date, something for an artist to represent and for the image to be purchased by people who made their living from factories.

A common dilemma for college freshmen is balancing partying and drinking with studying. I had little money for beer and had to balance recreational reading with studying. I feared that I was not bright or hardworking enough to earn a college degree. Whatever the case, I had an experience for which I was grateful, flunk or not. And I studied as much and as hard as I could, with less background than most of my classmates.

Many of my fellow students like Don Campbell from Portland had the advantage of attending a high school with college-prep courses. Don also greatly impressed me at dinner with his ability to eat any piece of chicken

without picking it up in his hands. Don Campbell was part of the outside world I had wondered about when I was a child. He was as natural and true in it as I was when wading Four Mile Creek above the Wilson Place bridge after a good rain. I was a clumsy visitor to Don's world, and he became my friend as he did everything from engineering to girls, all as smoothly as graphite.

One looming horror was the swimming requirement. We suited up and had to try to swim the length of the pool and back. On the ranch I had taught myself a dog-paddle stroke which did not get me far. So I took remedial swimming where I got to know Don Campbell, who faked failure for an easy first-term PE class. I became relaxed in the water and developed an efficient backstroke. Throughout the two years of PE requirements, I avoided taking classes involving games with a ball. I even took weightlifting which like swimming turned out to be a great class.

After completing the first term, I went home exhausted. My father had saved heavy jobs for me, just as he had collected them for weekends when I was in grade school and high school. Needless to say this further sharpened the divide of the Coast Range. I anxiously waited to see if I had passed my courses. My GPA was 3.24 out of 4.00, which also surprised the Dean of Engineering who taught my beginning engineering class.

"However did you do that?" he asked, and I answered that his class was my lowest-scoring subject. That was not true; I had received a "C" in PE where the grade was on skill, not improvement.

The weather in Corvallis put me slightly off-balance. I knew that it rained less than on the Coast, but that was not quite it. Then one day it came to me that rain in the Valley came from the top of the sky straight to earth. On the Coast the south wind blew the rain in sideways. The Valley was an entirely different place.

All men attending land-grant institutions took two years of Reserve Officer Training. We were issued M1-rifles that lacked firing pins, heavy brown uniforms and uncomfortable black shoes we were taught to spit-shine. Then we marched about the Armory where the grounds contained piles of horse manure left from riding shows. I was not a natural at marching and unlike swimming did not soon discover its rhythm. Spring term I was taken aside by the commander of the OSC-ROTC. It is unlikely that this position was on the upward arc of a military career, but his attitude toward me was one that I had taken toward problem livestock. "I can get this poor creature to do what I want. See here, it's easy."

The unfortunate older man found our session as frustrating as I did, the platoons marching smartly around us. Despite this, by the spring of my second year I could march well enough not to be singled out. There were classes in field-stripping an M1, shooting, map reading, and military history. When we shot a small-caliber rifle for a grade, I approached the firing line confidently: here was something I knew how to do. The rifle shot in a scatter pattern, and when I held the gun up to the light and looked down the barrel, I realized that the rifling was shot out, it became a private joke to me. The rifle was about as accurate as throwing a rock would have been. I quickly fired the remaining rounds and finished the minor ordeal. I saw my first contour map in an ROTC class, and it was the best moment of ROTC, those lines resolving into mountains, rivers, valleys, and cliffs while we waited for class to begin. A Japanese American, Captain Takasumi, taught military history. He had a dry sense of humor and brought the subject alive describing men who became frightened when shot at, who swore, and so on. It occurred to some of the class for the first time that people just like us were sent to fight wars. Abruptly the Captain was removed from the class early in 1961 to become a military adviser in Vietnam. This was the first I had heard of that country and that war. One frozen winter day in the early 1980s in Washington DC, I walked along the Vietnam Memorial, that tragic black gash into the earth, searching for his name on the tragic list. To my relief he apparently survived Vietnam.

While in the dorm during my first term, I made friends with Lowell Euhus from Clatskanie. He was the son of an itinerant preacher, and we had a lot in common including being on the social fringes of university life. We both visited fraternities and had simultaneously rejected and been rejected by them. We were good at science, loved literature, and had little money. Ma Hamer had an eating house on the edge of campus where she fed sixty boys well for a reasonable sum. Lowell and I took a cheap room in the attic of a decaying house nearby, signed up with Ma, and were much happier. This was a few years before being out of the system was fashionable, but we had found our place at OSC.

We learned of an event sponsored by the English Department that featured two people I had never heard of: Dwight MacDonald and Susan Sontag. I did not understand much of what they said but they made such a blistering impression on me that I remembered both names which later I saw in magazines and books.

My second-term English-composition teacher gave us a method to struc-

ture our essays. The first paragraph was to contain thus-and-such, the next paragraph this-and-that and so on to the prescribed end. It made essay writing a form of fill-in-the-blanks, and our essays were far more coherent than they had been first term. I memorized this “little boxes” formula and followed it without difficulty. Unfortunately I cannot recall one detail of that carefully crafted method, and when struggling with some topic that refuses to be pinned to the page, sometimes I think with nostalgia of the nimble writing abilities I possessed the winter term of 1961.

Lowell and I had a hunger for books that our meager funds could not satisfy. We haunted second-hand bookstores, going as far as Portland to collect stacks of old books scented with decay and ammonia. Tennessee Williams and Erskine Caldwell, warm-weather writers, huddled on Portland’s cold shelves. The OSC bookstore was well stocked, and several of us began to steal books from it. The winters were damp even in the Valley, and books slipped under a coat were held by the pressure of an arm. Everyone was bundled up, and we were not caught. Copies of Hemingway, Steinbeck, and then Faulkner disappeared under our coats. Our interests widened, and Joyce, Flaubert and Balzac found themselves thrust into the warm darkness of an armpit. Our thefts were spiked by adrenaline at first, but greed kept us going back. After I moved away from Ma Hamer’s I stopped stealing books, but one of my friends continued. He stole a world atlas on commission for a fraction of the face value, an atlas that was as wide as his back and several feet long. The heist involved a loose raincoat, but it was hard to believe that even he could have pulled it off. Fred Krogh was a graduate student in mathematics living at Hamer’s, and he heard of this feat. Fred threatened to turn my friend in unless he returned the atlas. Using the raincoat again he did so, and Fred checked the bookstore to be certain that the deed was done. Then my friend swiped the atlas again, this time keeping quiet about it afterward.

The second year of college I specialized in electrical engineering, then the most abstract branch of engineering. I enjoyed learning mechanical drawing and many aspects of engineering, but especially in lab I was driven mad by the emphasis on “make it work” rather than on “why it works.” My ranch life had taught me the value of being able to do things, but that was just the point. I had come to college to learn the why of almost anything, otherwise I would have been ranching. It was not, as I had been so confidently told, so easy to transfer to physics, and I transferred instead to mathematics, my easiest subject. It was a huge relief.

I got married that summer. It was not unusual for the times, and in the rural logger culture early marriage was normal. My wife Vicki from that logger life worked that summer in a bank, but when she got to Corvallis she just sat at home doing nothing (so far as I could tell) except a minimal amount of housework. Our apartment with its dusty chaos reminded me of her parents' home. It was a crisis for me—my dreams of soul merging and endless sex disappeared, and instead I was facing personal disaster. A few years later and divorce might have been the solution. Instead I slowly sank into a deep despair. At the term's end I received my grades, the only time my average sank below a 3.0. I was shocked into realizing I could destroy my life by failing in college. My resolution was not to let that happen, and at some cost to my self-image, I rearranged my priorities. My grades never fell below a 3.5 again.

Much of the time I was able to ignore my dying marriage. The university occupied most of my thoughts, but when it was time to visit Four Mile, my mood would rapidly fluctuate. On the way over the Coast Range I was increasingly apprehensive about seeing my family. No one there said anything positive about what I was doing. Instead there was overwhelming and silent criticism, perhaps generated by my strong desire not to become a rancher. My parents disapproved of my marriage, and Vicki was a silent non-participating guest in their home.

A regular stop on the coast was Devil's Churn where there was a slippery, rocky path with the violent churn on the right to a more level area where sea anemones of incredible vivid colors thrived. The path was wet, slippery and dangerous, sometimes impassable due to ocean waves exploding in the churn. Devil's Churn and Shore Acres near Coos Bay always left me in awe, no matter how many visits I made. Another joy of trips to the Coast was Vicki's grandfather Lyle Hartzell who lived in Florence. Lyle had been a commercial fisherman and alcoholic in Alaska. He no longer drank but fished off the Oregon Coast giving us fresh cooked Dungeness crab when he had it. Lyle was a committed member of the John Birch Society and we argued without rancor about politics. Books by Nietzsche and Schopenhauer were on his shelves, and he most often focused on the nonintuitive aspects of the theory of relativity. "How can that be?" he asked, "Are you sure this is correct?"

On the return to Corvallis, leaving the Coast behind, driving the curving roads, I was overtaken by waves of optimism, optimism that with some attention my marriage would turn out well, that I would learn many new

subjects, that I would find the path to permanently escape Four Mile.

Don Campbell and I were bored in linear-algebra class, and I decided that we should invent a student. Jack Rice was the superintendent of schools at home, a hollow, formal man with a job that seemed to me to have no duties other than showing up. We turned in two homework assignments bearing his name, and Jack Rice took the first-in-class exam. Perhaps I should have used the name of a child of my childhood invention Mrs. Bonney but that never occurred to me. Our instructor was Frank Wyse, a finishing-his-PhD fixture of the Mathematics Department. Disheveled and disorganized Frank Wyse tried to locate Jack Rice.

“Apparently he enrolled late ...but...he is doing fine...but he hasn’t picked up the midterm.... Really... he is doing...actually doing very well... Anybody...anybody who sees him...tell him to see me.”

Jack did not do as well on the second in-class exam because there was one difficult problem that took up *our* time. But Frank Wyse then became even more desperate to locate Jack Rice, and I wondered if I couldn’t get Jack a student loan and send him through college.

My new schedule allowed me to take more electives. I mixed mathematics, physics and chemistry with an increasing number of courses in literature, philosophy and religion. Along with many others I was led by J.D. Salinger to Zen Buddhism which launched me into trying to understand what religion was. (Sadly Salinger wrote himself into a corner and fell permanently mute. We never heard from him again.) Professors Warren Hovland and Nicholas Yonkers were extremely patient and encouraged my wanderings in philosophy and religion. I even took a graduate seminar named Advanced Existentialism, a title I thought to be very funny.

Literature was my deepest love. One of my professors was H.E. Childs, a crusty older man who was tolerant of honest effort and opinions but became brutal even at a hint of fakery. He had done his PhD thesis on Sinclair Lewis.

“Among other things I demonstrated that he made grammatical errors,” he said with a sigh. He demonstrated a good deal more than that, but picking out his own weakest point and revealing it was typical of the man.

He was fondly remembered in the autobiography of William Kittredge who was raised on an eastern Oregon ranch. Kittredge’s 2006 novel *The Willow Field* is packed with descriptions that only a ranch kid could reveal. I wonder if there is a bunch of us rural children with literary bents whom Childs influenced. Once I disagreed in class with Childs about the famous Hemingway story, “The Short Happy Life of Francis Macomber.”

“You are wrong,” he said.

“I don’t think so,” I replied.

“Well you are,” he said firmly, and carried on with his lecture.

Later I went to his office and showed him what Hemingway wrote, and then told him my assumptions and how my reasoning went. “I see what you mean,” he said. There was a long pause as he sat behind a desk covered by books and essays. “You know, you are correct.”

He began the next class by recalling the incident from the preceding class and then corrected his interpretation. What a man! Years later I was pleased to see in print the same analysis I had made.

Among the books I read I noticed a theme in novels of a western boy who was sent east to Yale or Harvard. That was beyond my comprehension. Was calculus at Yale different from calculus at Oregon State? What was the point? Today I better understand what was and is going on, but I often tell students that they can get an excellent education in any state.

I took my first graduate-level class in mathematics when I was a junior. Professor Jim Brown used Tom Apostol’s famous book in real analysis, and the material was a shock to me. For the first time I could not just glance at the text, practice a problem or two, and get an “A.” Fortunately I was also enrolled in a course that used Suppes’ text in symbolic logic, so I was learning what precise language and logic were. When in high school, a new OSC-graduate Jim Green who taught science told me that I would flunk out of college. I suspect that I provoked him into making this pronouncement, but I was pleasantly surprised to see him in the back of the analysis class. I scored at least one grade level higher than he did all three terms, but the course was so difficult for me that beating Jim Green was not the sweet satisfaction it could have been. I felt lucky to pass and wished that I better understood the material. A few decades later when I was a professor of mathematics, I met Apostol who was a professor at Caltech. His book had taught me what mathematics was and I think my effusive praise for it embarrassed him. I do not regret it!

I tried my hand at writing fiction, and the once-a-year college literary magazine published my story “A Clean Feeling.” I was informed by a woman in one of my philosophy classes that she was on the selection committee and that the committee had chosen my story because they could not understand it. This seemed to me a strange reason, especially as I thought the story was transparent. Recently I reread my story, and it is not nearly as simple as I thought then. I did not find the drive, talent, or time to do much more

fiction writing. When I was finishing my BS degree, I considered going to the University of Oregon for a master's degree in English and then returning to mathematics. It was just that I loved literature so much that I wanted more of it before I returned to mathematics.

"Don't do that," Childs told me, "You are going on in science, now or later. Don't waste your time on side moves. You can always read and write." I saw that he was probably correct and took his advice.

I stopped going to movies and listening to popular music in 1960 and did not return to those things for years. They seemed a waste of time. Instead I read and increasingly listened to folk music. The foundations of the rock-and-roll I loved in high school were found in Mississippi, the Appalachians, out in the margins, and by 1961 this roots music was being widely distributed for the first time. Woody Guthrie was a dust-bowl refugee, and his songs had the texture of sand and rusted barbed wire. He invented Okie-rap, just take a listen, he called it the talking blues. (This was an adaptation from the talking blues of the African Americans.) When I heard Bob Dylan I sneered that he was just a Woody Guthrie knock-off, and for some time that was close to the truth. Then Dylan's huge poetic gift became obvious even to me. Leadbelly, Robert Johnson, Blind Lemon Jefferson, Jimmie Rodgers all came back to life on reissued records in those days. Miracles happened too such as Mississippi John Hurt found alive and singing in "Avalon, my hometown." I discovered the high-lonesome sound of Bill Monroe in a 95-cent bin in a supermarket. "In the pines, in the pines/ Where the sun never shines." Along with jazz and rock-and-roll, bluegrass is another incredible American musical invention.

October 22, 1962, I was walking home in a healthy wind. Limbs were breaking and falling out of trees, although I could not see why such things should happen in the brisk but mild wind of 65 mph. It would hardly have stirred limbs on the trees on the Coast. I moved out to the center of the street and proceeded carefully. The Columbus Day storm blew over 120 mph on the Coast, and although the Coast Range cut by half its speed, it was devastating and blew trees down and roofs off all over the Valley. It laid down mountainsides of timber on the Coast, and I logged for two summers in the blow-down from that storm.

The civil-rights movement was in full force, and my parents strongly opposed it. My mother referred to *those* people as Negroes, the then-acceptable term, while my father never used *that* capital-N-word. I was foolish enough to argue with them about civil rights, and finally my mother played what

she considered her strongest card.

“How would you feel if your own brother married one of *them*?” For once I did not have to search for an answer. “I would be happy for him if he did, but I doubt that he has what it takes.”

A TV signal had finally reached our highest hill, and ghostly images flickered on their screen. This brought an immediacy to current events that they had not previously possessed. Who could ignore Martin Luther King when you could see his passionate face, hear his cadences, watch the crowds roar their response? When later in the early 1970s I heard that my parents enjoyed the hit show “All in the Family,” I found it hard to believe. But I should have guessed. My mother identified with the long-suffering Edith, while my father laughed with each of Archie’s racial-and-class slurs-and-insults. They completely missed the heavy-handed brutal satire. It gave the show new meaning for me.

There is an afternoon of November 1963 that is almost frozen. I am living on 9th Street in a small cottage, and outside the leaves have already fallen from the trees. Dusty slabs of late-fall sunlight angle into the room furnished with an old spring-broken couch, an oil heater, and stacks of papers and books. Jim Spoerl, whom I had corrupted in the back of a differential equations class with Haiku poetry, had gotten me the cottage that went with the large boarding house his parents ran next door. (Jim began in physics, switched to mathematics in order to understand physics, then to philosophy in order to understand mathematics. He ended up in religion and became a minister.) Jim is at the door, out of breath.

“Have you heard Kennedy was shot in Dallas? He may already be dead.”

We turn on the radio and it is true and probably John Kennedy is dead. I was eighteen in 1960 and therefore unable to vote for Kennedy, against Nixon whom instinctively I disliked intensely. Kennedy is dead and the motes of dust in the yellow light move infinitesimally. There is no traffic on the usually busy street, we hear instead the quiet roar of empty space.

The old tale of returning to a childhood home to find it much smaller than remembered never happened to me. The ranch remains the size it was when I grew up there. But twenty years after leaving OSC, some faculty knew of my work and invited me to visit and give a lecture. It had become OSU of course. To my surprise, OSU was smaller than I remembered OSC from my student years, and I walked around the campus in amazement. In a way OSC was the location of my childhood. Not so many years before my attendance OSC taught plowing, and I saw photographs of students behind teams in

the fields. At my OSC there were new acreages to explore: the equations of modern physics, a system of probability formalizing years of bad crops or low prices, ferns that fling their sperm into the winds with catapults, the Hindu religions with their many-armed and sexual gods, Joseph Conrad fighting his way up a steamy jungle river, Haiku poetry with fourteen quiet potent syllables. Each of these began as an unscaled world of its own and then created its particular system of measurement. These new territories were mine for wandering, and I would not have missed those explorations for the largest ranch in Oregon.

Going On

I could not find a job. I applied for positions the fall and winter of my senior year at Oregon State. An undergraduate degree in mathematics was ample background for employment but my attempt to find work was futile. The Federal Government, Boeing and other industrial companies, none were interested enough to hire me. First of all I had no idea how to interview for anything, unlike today's students who train for interviews from kindergarten onward. More damaging to my attempts were the high grades I received. There were far more As than Bs and a total of two Cs on my record. Years later I wondered if all those literature and philosophy classes hurt my case. Finally one of the interviewers told me he was sure that I was going to graduate school and that coming to his company would be a waste of their time. That wasn't my plan but it drove home the apparent necessity of getting more education.

The lack of job offers made me realize I needed to focus on a field where I would be employable. Numerical analysis and computer programming was one way to go, but I found programming only worth the trouble when there was an explicit goal and not as an end in itself, so I discarded that direction. Of course, programming was to be important tool for some of my discoveries. Probability and statistics were a bit mysterious but had obvious job opportunities. If possible I was not going to be stuck again without job offers. I read about actuarial work that apparently led to lucrative positions. If nothing else showed up after a master's degree I thought I could go into the actuarial field. That might have worked out fine too, although I had no idea what insurance was or what an actuary did.

I applied to Oregon State and Stanford, in both cases to receive a master's

degree. Stanford, where I applied to the Statistics Department, turned me down, and I can remember the shock of rejection. So I was to continue at Oregon State. I had finished my undergraduate credit requirements winter term, and instead of going to the Coast to work logging timber in the awful mud and muck of spring, I took a deep breath and borrowed \$500 to support my wife and me through spring term. Since I graduated from high school, I had summer jobs setting chokers on the Oregon Coast, and while it was dangerous work, it paid well. This was the first time I had ever borrowed money from anyone, but I could not face pulling logging cables through that sloppy landscape until it dried out. Instead I enrolled in a full slate of graduate mathematics and statistics classes spring term. I wanted to see how I would handle all graduate classes—which for the classes I chose turned out not to be difficult.

A wonderful but daunting aspect of graduate school was that I received a teaching assistantship where I taught a college class. I was not working for a qualified professor but had complete classes on my own. For this I was paid enough to support me and my wife. My wife sat in our apartment and continued to do almost nothing, but by this time that was what I expected from her. The first term I taught algebra and trigonometry followed by a full course of calculus over the remainder of two years. The one outside check of my teaching ability came when a professor unannounced sat in on my lecture. I was covering subsets that day and had realized the connection between binary numbers and subsets, something obvious but was not in any book I had seen. There I was presenting material that was not in the assigned text and I was apprehensive that I'd be drummed out of the TA ranks after this transgression. However I never heard anything from that day, positive or negative, and I had no other supervision and zero advice during my two years as a TA.

Teaching was a revelation to me. After the initial week or two of terror, it was fairly easy. Some time spent intensely studying the day's material prepared me for going to a blackboard and presenting. I was deeply learning elementary calculus at the same time, which was useful for my future studies. During my own calculus sequence, I had gotten all high As but after teaching the material I knew it far better. I wasn't a great teacher but reached at least the median of college teachers; this ranking I determined by the performance of my classes on the group finals. The many sections of the mathematics service classes were taught independently but covered the same material from the same textbook. Then came group (identical) final examinations that

were graded collectively so that every student had a uniformly administered final exam. I enjoyed this experience since there was work together over the grading, including determining how to score various answers, and then the tally of the scores to see how my section did compared with everyone else's.

My own path to understanding something was to puzzle it out by myself. After initial frustrating hard work, some key insight would reveal everything in its structure. I had written essays on novels and plays using the same approach—some nugget finally would provide an organizing principle and the work suddenly was all of a piece. Mind you this did not come until after many readings and false starts. Mathematics went the same way for me, and I had the idea that in teaching I'd put up the background and then shortcut straight to complete understanding. This approach was a total failure. The procedure by which I understood something was useless to my classes, and I had to learn to teach a topic quite differently from how I learned or understood it.

New TAs quickly sorted into two groups. Some people fell in love with teaching and almost invariably they were folks who were not doing well in their studies. I thought that they were making up for their anticipated academic failures through the rewards they received from their undergraduate students, but cause and effect could have been reversed in some cases. I liked my students but was too driven to succeed in my now difficult classes to compensate in this way. I tried to give my classes a decent job of it, but I realized my main task was not teaching but learning. During the second year of my graduate studies, the Mathematics Department moved into the old library, that building crammed with books that astonished me upon my arrival five years earlier. To this day the Mathematics Department is housed in Kidder Hall. Some of us had our offices in a large high-ceilinged room and I took an old oak roll-top desk and arranged it so that the back side faced the door. It was hard to believe that desk was available for a lowly TA; it was a splendid piece of furniture. I kept every office hour I scheduled but I did hide from the students behind that many-drawer desk. My students liked me despite my small attempts to evade them and instead work on my studies. A few fraternity members invited me and my wife to chaperone one of their dances and to go to the coast with them. These invitations halted after I caught one of them during a test with answers written on the back of his hand.

My last year at OSC I taught an extra class for additional compensation to pay the hospital bill for my wife's appendix operation. One of the students

needed only that class to complete his undergraduate degree. He was working in a factory to support himself while he finished the pesky mathematics requirement. At the end of the class, he was out for a week, and then I learned his hand had been caught in one of the machines at his job and he had lost several fingers. He did not pass the final, but I took a close look at myself and what I had until then thought of as my integrity. It is easy to have high morals when they are not tested; I gave him the lowest possible grade that would pass him on to his degree. In decades of teaching, few sob stories reached me but this was one of them. I saw his hand.

Among my Oregon State professors, one stood out as brilliant, as looking deeply into the material, as one whose lectures were almost impossible to follow closely, and that was Jim Brown. He was a Kakutani student from Yale and worked in probability and analysis. Brown's advisor was the father of the now-famous critic Michiko Kakutani. As a junior I took my first graduate analysis class from Brown, and I continued to join his classes in graduate school. The most vivid class was Markov chains, and I fell deeply in love with that elegant structure and the associated results. That love remains today. One feature of classes from Brown was his challenging take-home exams.

The community of graduate students was much more involving than I found the students in my undergraduate years. One knew everyone and pretty much how they were doing. We had supplies and access to the mimeograph for exams. I was astonished that supplies were freely available. Now that I could afford them, I no longer had to buy paper and pens myself! Most of us worked in our offices during the day but most intently at night. I used to say that I could not think until it was dark. It was something like a mathematical boot camp and it brought people together. There were odd ducks like Don Cresswell who became a PhD in mathematics because he did not make it big in college sports. Instead he took up mathematics, although even as a master's student I knew his PhD thesis was just a catalog of already known convergence properties from measure theory. How could he expect to get out with such insubstantial material? His advisor was Ed Kaplan who in 1958 with Meier published a landmark paper on survival estimation. We grad students had no idea he had done important work! Dick Hill was already pompous as an algebra student, in love with formalism (over content I suspected).

The smartest person in graduate school was Sergei Aalto, the alcoholic son of an alcoholic longshoreman from Portland. We were all married and

Sergei had a son. Sergei and I worked on mathematics, drank beer and took drives in his trashy car where he filled the back seat with empty beer cans and *Good and Plenty* candy boxes. Oddly that licorice candy and beer go well together. Sometimes we went on picnics and Sergei took up fishing for carp in the backwaters of the Willamette River, the only person I had ever heard of who did such a thing. As for me, I drove over the Coast Range to fish steelhead in the Alsea River. By this time I was an effective steelhead fisherman and other people on the river were amateurs. I never saw anyone else hook a steelhead, let alone land one. I think they thought I was just lucky. The farmers' fields I walked across for access to the river are now planted with trophy houses and non-owners cannot reach the river. Sadly, such lack of access has happened across the western states. Likely Sergei was fishing for carp more as an anti-elitist statement than as sport. I was fishing for sport which could be taken home and eaten. The hum of a reel when a hooked steelhead was heading back to sea, the fried steaks or roasted filets with mashed potatoes!

Little Charlie lived with me during his first year of college. I tried to convince our mother to send him to a school such as Oregon Technological Institute but she wouldn't allow it. There he was at a university trying to pass three terms of English composition. He was not doing well so I helped him with his essays, attempting to improve his prose. I'd not have done this for anyone else, but in addition to helping Charlie, it gave me participation in writing other than mathematics. One of his professors demanded to know who wrote his material, but I managed to help him through two terms. Somehow he managed to pass that final term during the rest of the five years he spent getting his four-year degree.

As an undergraduate I had increasingly associated with literature and philosophy majors. There was the guy who played what he called the Jesus Boogie on the piano in the Student Union. Scott McCleve introduced me to what is now called roots music, the poetry of it. And the clique who took philosophy classes and were obsessed about Buddhism. Doing my master's I was confronted with material that I struggled to comprehend. Even before thesis writing I no longer had time for recreational reading and listening to music. This condition lasted five years.

I took a probability class from Donald Guthrie and I liked his style and relaxed manner. He used material from his Stanford class on the Russian Gnedenko's work and I took careful notes. It was lovely stuff. Before the year was over I found the work was available in translation and purchased a

copy. Don told me to find a summer job and I applied to the Atomic Energy Commission at Livermore California. Now it is called the Department of Energy but the origin was in the secret work to create an atomic weapon during World War II. I had to pass an extensive security clearance at level Q after which Livermore hired me. My wife and I went to California for the summer where we leased a house in Mission San Jose on the East Bay, and I rode to work each weekday with another employee who lived near us. The weather! Smooth warm days with that magnificent odor of dried grasses and eucalyptus. The hills we lived in and drove through were in summertime golden folds, so different from the green ragged brushy hills of western Oregon.

My supervisor was a computer programmer named Duane Kinman and the workload was light. I did some Fortran programming and we had a nice project from a physicist. Duane saw me perk up at the mathematical content, and he used that to motivate me. He had me follow up a successful Fortran program with the same commands in machine language which was educational. Livermore had weekly presentations for the summer students and some were intriguing. There was a large project to produce power from fusion presented in a positive light—success was only 20 years away. Over the decades I have noticed that “20 years from now” seems to be a constant, and we are still waiting. Another presentation was about Project Sherwood, one aspect of which was to bring water from the Arctic by creating a ditch from Alaska using, you guessed it, atomic bombs. This shocked me and of course that never happened. Project Sherwood’s Wikipedia page omits describing this venture. Livermore was working to create a time-share system, and at the end of the summer I was assigned to compile the mathematics software on the system. I had no chance of succeeding at this and the summer closed with a note of failure for me. But being paid decently and living across the bay from magical San Francisco was a wonderful experience.

In July we went to the State Fair, near Sacramento. The abundance and quality of the exhibits greatly exceeded the Coos and Curry County Fairs of my childhood. As we were leaving there was a group of rough characters grouped near the exit. They radiated “looking for trouble,” and I made a wide detour around them. I had never heard of biker gangs or the Hells Angels, but these were people to avoid. Four years later the Hells Angels provided security at the Altamont Festival where they knocked a singer unconscious and murdered someone. When I learned that my fellow Oregonian Ken Kesey hung out with these guys, I gave a shudder.

Coming back to Oregon State I met with Don Guthrie and asked him to be my advisor. Clearly Jim Brown was an obvious choice but I was afraid of his depth. Don was easy to be around and conceivably I could accomplish my work with him. This was important because Oregon State required a master's thesis and not everyone passed muster when it came to thesis writing. Don suggested a problem related to a paper he had written with a colleague at Stanford. I read the background papers that included Laplace's Method for estimating certain integrals. Then I worked on the problem. Eventually in January I realized my failure to prove the result was not due to my inability but to the fact that the conjecture was wrong, flat wrong in an uninteresting way. I went to see Don and told him of my finding. "Impossible," he answered, "it is correct." "No it is not," I said, and then gave a simple example where it failed. He started to object and stopped mid-sentence. This happened two or three times and then we sat there for some time in deep silence. After ten or fifteen minutes I asked him, "What do I do now?" and he answered, "Good question. What do you do now?" After more silence I left the room.

With a taste of teaching and programming at Livermore, I was ready to fight hard not to be forced back to a life of cutting tails off of sheep or setting chokers in the logging woods. In our training there was no indication that we could do mathematics ourselves, except I suppose in those challenging take-homes of Jim Brown, and even there it was not new work but results one might find in an obscure advanced book. Classes were for me received wisdom. There were large and sometimes murky bodies of knowledge I was attempting to master but never as a base to discover something new.

I had been on my own when I was growing up with ranch work, and when I finally came out of shock at what happened with Don, I took a close look at what I knew. That included the material I had just learned on the aborted project. There was an assumption that had been made in Don's published paper that I had wondered about. I eventually showed that it was always true, no need to assume it. The proof was not pretty but I knew it was correct. I took a copy to Don and then went home for spring break where I shortened the proof. When I brought the revision back to Don he said, "I knew that it could be simplified." Of course I didn't believe him, but asked the key question: "Will this work pass as a master's thesis?" Don answered, "I am not sure." This answer I did believe—clearly he was out of his depth and by this time I knew it. So I took my hand-written manuscript to Jim Brown and asked him to read it and tell me if it would be enough

for a master's. I told him how worried I was. In a week I returned to his office, and he handed the manuscript to me saying, "I don't know why you were concerned. This will be fine." Hugely relieved I asked him if he wanted a carbon copy when I had the thesis typed. (The process of typing a document with mathematical symbols was a laborious art—TeX was not even a gleam in Knuth's eye at that time.) "No, just send me a reprint when it is published." I was overwhelmed with relief and surprised that anything I had done might receive publication—it was a glimpse of another world I had no thought or intent of entering. I didn't take his implicit suggestion to submit the paper—it was not usual for master's thesis to be published, and I didn't see it as part of my plan.

My master's oral did not focus on my thesis since the smartest guy in the room, Jim Brown, had approved it. He asked me a question about Markov chains, and while I realized that a straightforward approach would not work, and said that, I did not solve it on the spot. I heard later that Brown was disappointed that I had not produced a solution. However, he said, two PhD candidates on their orals not only did not solve it but they thought that they had. "At least Waterman realized what would not work."

After I finished my thesis, I discovered a paper that claimed to prove the conjecture that Don Guthrie had made and in fact it "proved" the results for n -dimensions. First I wrote the author and received no answer. I continued to write him and then to the journal's editor and did not receive an answer from anyone. Today I would write a note pointing out the error and submit it to the journal, but then I did not even consider that. I thought that papers should be correct and I was so naive that I assumed everyone would correct any errors they knew about, whether their own error or not. Otherwise what is the point of doing mathematics?

With a master's, I could find a teaching job at a small school, which was just what I wanted. A calm secure job with a living wage, perhaps in a location where I could spend some time outdoors. That I felt would be the height of success! But even then I could feel the weight of the frantic post-war post-Sputnik production of PhDs and I thought such jobs were going to be vulnerable in the near future. I had managed to write a master's thesis that Jim Brown thought to be publishable, so why not try for a PhD? I applied in four places, each of which accepted me: Cornell because Frank Spitzer was there, Michigan State because John Kinney was there, the University of Oregon for a backup, and Stanford. When I was accepted into the Stanford PhD program, I took the rejection letter they had sent me two years earlier

and parodied that letter in my own declining their offer. I wish I had a copy of that very satisfying correspondence—the pride of young men! So it came down to Michigan State and Cornell, and I struggled between the more fancy place Cornell and another good school Michigan State. Frank Spitzer was at Cornell, but John Kinney at Michigan State had written a range of innovative papers, and he clearly would not cause a repeat of my master’s fiasco. Michigan State kept upping their offer and I decided to move to Michigan.

The summer between my master’s and PhD I spent at Bell Labs in New Jersey. I had only been as far inland from the Pacific Ocean as Reno Nevada, so the trip across the USA was exciting. I joined the auto club and they provided me with pages of maps call TripTics. We were set with stays in Jackson Hole and Yellowstone. The mountain west began to grab me when we spent a night in Idaho Falls near an actual falls on the Snake River. I began to realize this was new territory compared to Oregon’s Coast Range or even the Cascades. Then we drove over the pass into Jackson Hole and I was astonished. It was early June and snow flurries blocked the sun, and then the dramatic Teton Mountains came into view. I fell deeply in love with the place or was it simply awe? In Yellowstone Park I stopped by a small stream, and trout were sloshing in the water eating insects hatching just subsurface. Such riches! I saw bear, beaver, elk, antelope, mule deer, bighorn sheep, picas, marmots, and prairie dogs and just gloried at the existence of the vast undeveloped country. As we eased out of the mountains into Wyoming’s huge incomprehensible desert, I vowed to someday return to live in those mountains.

After the mysteries of the level Midwest and toll roads, we reached New Jersey. I had no idea such a thing as a toll road existed and was almost stopped dead near Chicago as I tried to work out what to do. My job was at Whippany, not at the more famous Murray Hill location, and my wife and I had a non-air-conditioned cottage in nearby Parsippany. New Jersey was weather shock: the humidity and heat overwhelmed us and we did not know how to combat it. I wondered why people lived there at all. The culture shock was even worse; for example I was used to supermarkets where one could leisurely choose things to purchase. I walked into a local New Jersey market and everything was behind the counter with people demanding something of me accents I could not parse. But there we were living twenty miles from

New York City and getting paid for it. I had no idea what I would do in NYC but it was there and I was going to see it!

For our first visit to New York I drove my silver Pontiac LeManns up out of the Lincoln Tunnel and there was a cop directing traffic. As soon as he spotted my car with Oregon plates, he stopped everyone with dramatic gestures and his whistle. Then he pointed straight at me, and with precise and powerful motions of his arms, he aimed me into the Port Authority. I parked with great relief and duplicated this maneuver on every succeeding visit, never again needing a policeman to save me from driving into the city. We walked up 42nd Street to Times Square; 42nd Street was truly frightening. I was used to ignoring the cautions people gave me; I had great experiences in parts of Oakland where few whites ventured and went to movies on Market Street in San Francisco where “people like you should not be doing such things.” 42nd Street was as gritty a place as can be imagined. Drugs and just about everything else was happening in the open and even I could see it. As soon as we reached Times Square things were sleazy but did not feel dangerous. What a way it was to jack up adrenaline for a day in the city! This was 1966 and interesting people were everywhere. My most dramatic sight was Dennis Hopper with a ragged leather jacket and long uncombed hair striding vigorously past slower pedestrians on a sidewalk. Of course I didn’t know who he was at the time, but retained the image. When I saw Hopper in *Easy Rider* in 1970 I thought, “I know that guy!” Now it could instead have been David Crosby or some other counterculture character, but I am sticking to Hopper. Fifty years later, I still go to New York and amuse myself just walking the streets. Once on a warm summer day to avoid a shower of rain there was Tom Wolfe in his classic seersucker suit and bright bowtie standing in the shelter of a storefront. For me nothing could be more “New York” than that.

Once a week in humid steaming heat of a New Jersey night there was a radio program from WOR featuring Jean Shepherd. Shep was working class from the steel mills of Gary Indiana and his program was stream-of-consciousness, endlessly recursive. The stories of the mills and his childhood kept bifurcating in fascinating and unexpected directions. Jean Shepherd had an air of hipness, of counterculture, of being “in on it,” and his audience including me loved being part of it.

I again had the luxury of unlimited work supplies and also an air-conditioned office. My boss at Bell Labs was an elegantly dressed statistician named Ross Eckler. His father had been director of the national census. That summer

I was assigned a research problem motivated by Ross's contract with the defense department. Many results are organized around the concept of being shot at by missiles and trying to best defend by using a stockpile of defensive missiles. Various fancy assumptions are made about the accuracy of the missiles, but Ross just said, "There are n incoming missiles and you can tell the order or rank in which they are going to come to the target—closest(1), next closest(2), and so on. You have m defensive missiles each of which has a fixed probability of hitting an incoming missile. Find the allocation of your resources to maximize the expected rank of the nearest penetrating missile." This data on the incoming missiles is what statisticians call rank or order statistics. This was a neat nonparametric problem and I spent the summer discovering a nice solution. At summer's end when I handed my report to Ross he asked me about publishing the material. I told him I didn't wish to do that; again, I felt I had done my job and publishing was from my viewpoint remote, pointless and probably impossible anyway. Ross and a co-author included my work in a book they later wrote. Instead I was focused on my next step, the Michigan State PhD program in Statistics and Probability.

Making Beer from Pumpkins

When I arrived at Michigan State University the fall of 1966 after working that summer at Bell Labs in the foreign country of New Jersey, the Statistics Department told me that the person I had come to work with had resigned from the Statistics Department. John Kinney was now 100% in the Department of Mathematics. This was shattering news. I had made a huge error in choosing my master's advisor at Oregon State, and apparently it had gone wrong again.

"You shouldn't worry," Jim Hannan told me. "You can still have him as your advisor, and he can supervise your thesis even though he is no longer in this Department." This still did not sound good. I made a morning appointment with Kinney in the next few days.

That morning was crisp and cloudy. After some wandering about, I located the building constructed as a place to educate earlier generations of agriculture students; it was brick and old and musty. I found Kinney's office in a dark hallway, knocked, and he answered with a gruff command that apparently meant I was to enter. John had a full head of fine wavy grey hair combed straight back from his high forehead. I was painfully shy but managed to tell him I had studied Markov processes under Jim Brown at Oregon State and that I had read the section of *Probability Theory* by Loève (other than Doob's *Stochastic Processes*, the only book on advanced probability I knew of in 1965) that was an account of John's proof that almost all sample paths of certain stochastic processes are continuous. Even though I had received As in a rigorous advanced course in this subject, I could hardly understand a line of Loève's book. John's work was a generalization of Wiener's famous result for Brownian motion, and Loève made a fuss over the result, something Loève was not in the habit of doing. (The storyline went: Doebelin, Doob, Lévy, Kinney. This was big-time probability.) John had insomnia (and probably a hangover), and he must have felt like hell. I

only knew he looked like he wished I would dry up and blow away, as they said back on the ranch. He tipped his head forward, let his glasses slide down his nose, and looked out over the frame at me. “Don’t do that anymore,” he said gruffly, and a deep silence fell over the room.

I went into shock and thought, “Well, what the hell do you do?” but I was not capable of saying that aloud. Instead I started mentioning the papers he had written recently. (At least I could and did use the library.) John muttered something beyond my comprehension about the paper he and Tom Pitcher had written about the support of a distribution function construction of Dubins and Freedman. I walked away from that meeting, certain that I had made a horrible mistake coming to Michigan State instead of going to Cornell where Frank Spitzer was. Michigan seemed a forbidding place, without variation to the landscape and without advisors for me in the Statistics Department. There was nothing to do about the situation but wait and see.

The professors in East Lansing had large impressive houses in nearby neighborhoods. There was a reception for the new graduate students at a home that was not fully moved into yet; at least the large rooms were empty and echoing whenever anyone said anything. No one seemed to know anyone else but I spotted one guy with long hair and a beard who was dressed in a way that suggested counter-culture. His stylish wife was thin as a length of 1 by 8 lumber. Staying by my pregnant wife I didn’t meet him then but that was Scott Guthery and his wife Peter. Scott was by far the most interesting person in our incoming class.

That first fall at Michigan State the student paper announced a reading by a “mountain poet.” I was skeptical; most literary references I had seen to rural or outdoor life were artificial and false. Fortunately the paper printed Gary Snyder’s poem “Riprap” which I read several times. The guy had been there and done it, of that I was certain, and his poem spoke beyond that experience as well. It is a significant accomplishment. In one of his early books there is a poem titled “The Late Snow & Lumber Strike of the Summer of Fifty-Four.” He describes chain saws sitting in puddles of cold oil

On back porches of ten thousand
Split-shake houses, quiet in summer rain

This guy was writing about my life in the logging woods of the Oregon Coast.

I could smell the cold oil, hear the soft rain, feel the quiet days without wages. Loggers all gone fishing.

A bearded Gary Snyder read his poems in a small crowded room. I remember vividly his eloquence and his description of the hangover from which he was suffering. Later I realized I had been in the same room as Japhy Ryder, the Zen-mountaineer character in Jack Kerouac's sweet novel *The Dharma Bums* which I had read in my undergraduate days. In 1971 on a mountainside in Idaho's White Clouds I failed to communicate to Scott Guthery the lesson Ray Smith (Jack Kerouac) learned from Japhy Ryder (Gary Snyder) in California's Sierra Nevada: "Ah Japhy you taught me the final lesson of them all, you can't fall off a mountain."

Ken Kesey also wrote about logging on the Oregon Coast. To write *Sometimes a Great Notion* he lived for a summer near Florence and went to work with the loggers. It was a shock to me that anyone could accurately capture the people I worked with, but there it was, page after page of logging with its memorable characters. Along the Siuslaw River upstream from Florence was the Cox house, then in decay, that Kesey made a major character in his book. When the movie came out in 1971 I was disappointed, as it lacked the energy and spirit of Kesey's novel. When asked why I was so negative about the movie, I answered, "The actors do not pick up power saws and walk like loggers."

I saw Gary Snyder read his poems several times and most wonderful came over 50 years after seeing him in East Lansing. The historian Kevin Starr, a colleague from the University of Southern California, met Gary when Kevin was California State Historian in Sacramento. He promised me for several years that he would introduce me to Gary Snyder. Finally I flew to San Francisco, rented a car, and picked Kevin up at his San Francisco home. It was the Starr-Waterman Road Trip. We stayed in the small Sierra town Nevada City where Kevin expounded its past. The Kevin Starr histories of California will last as long as does California. The next morning we drove to Gary's home Kitkitdizze in the pines near the Zen Monastery he helped build. Gary Snyder is exactly the person a passionate lover and careful reader of his poems expects, a quiet dream that is true.

And the mid and later 1960s were a great time for me, especially stylistically. I grew a beard, and I cut the bottom hem off my jeans with threads hanging off just like I was still working in the logging woods. And my rural talents now were in vogue: I could grow food, butcher animals, build things—why not follow the crowds and drop out, live in a commune? That

notion would be tempting for a few minutes of sentimental thoughts and then a strong “No Way” came out. I had worked too hard, risked too much, just to get to graduate school!

Kinney taught an analysis class I did not need but took to orient myself to Michigan State and him. His lectures were somewhat painfully delivered but also quite colorful. John had the habit of saying things that were reflections and amplifications of the material in the text, but I don't think anyone average or normal who was just starting out could have made much sense of his descriptions of mathematics. I already knew some of the material and I read books without paying my instructors much heed. (My isolated ranching background had fostered this go-it-alone style.) But John gave an account of what this stuff really *meant*. I was soon fascinated by him and by what he knew. Perhaps Michigan State wasn't such a bad decision after all, I began to realize.

Then came the first exam. John wrote all the questions in a list on the board two days before the exam. Anyone who did not do respectably was called into his office and told to drop, that they were failing. As the semester went along he slipped into exams more and more material besides the list of questions he continued to give the class. The final was mostly questions we had not seen before. Some students were surprised, but only a fool could have missed the trend. I have adopted a modified Kinney method in my teaching and astound undergraduate classes with a list of question types before the first exam. Before the semester is over I have taught them how to second-guess an instructor, how to see what is important, and how to determine for themselves what will be on an exam.

My appointment at Michigan State was as an NSF Trainee. I received \$360 per month, and when my daughter Tracey was born in January 1967, the stipend went up by a grand \$50 a month. Having been around so many live births on the ranch, I was not concerned about the birth, and indeed things went smoothly. But when we brought Tracey home from the hospital I became deeply involved with her. Being a parent was, to my complete shock, a wonderful satisfying engaging experience. None of the usually off-putting tasks, feeding the baby or changing diapers, were off-putting to me. Perhaps all those years working livestock had another payoff.

That spring I inherited a moon-light (secret) job passed from graduate student to graduate student. The job was with the Survey & Analysis group

in the Michigan State Highway Department. The group's purpose was the collection and analysis of data. Shocking to me they did not employ even one person educated as a statistician, and most of the people working there had degrees in subjects like sociology. That first summer I worked full-time and then occasionally during the academic year. The extra pay was very nice, and for the first time in my life I had health insurance. Before I did as my family always had and saved money for days such as when my wife had her appendix out or when she gave birth (both paid for with savings). The idea of being covered by paying a monthly insurance fee was not in my mental vocabulary until I had this job. The work was often interesting, and I learned for example about those strips laid onto a highway to count cars. I was intrigued by the spotty accuracy of the devices and by the large numbers of counts. The data was used to predict traffic flow far into the future, out to twenty years—a silly idea I thought, but people took the computed values seriously. Their regression model gave them trouble for many reasons, one being that numbers which in the real world were non-negative would come up negative in the regression. Rather than expecting the equations to read our intentions, that gave me the idea of doing regression when the estimated values were restricted. In my first university job, my simple ideas on this topic were published and well received. But as I had with my master's and Bell Labs work, I didn't think then of sending the results to a journal. I liked the people in Survey & Analysis and going to downtown Lansing was a nice change from Michigan State (which never knew about my secret job, or at least never acknowledged that it did). I still have a petroskey stone I was gifted.

A master's student from England named Terry McKenna had worked in Survey & Analysis before I did. His big project was a study of rest areas in the highway system. He was interested in the time people spent in rest areas which led him collect data. He timed how long people spent in the bathrooms. His plots showed an anomaly: women's length of stay were of a coherent distribution, but the men's appeared to be of two superimposed types. I found this very funny as I realized that men who went into the stalls spent longer than those who went in to stand briefly at urinals. I called it the "One-ing It or Two-ing It" curve. This is an example of a mixture distribution, and it is a challenging problem to decompose the individual distributions. Karl Pearson first studied this in the 1890s, and Bayesian methods using powerful computers have finally made the problem routinely solvable. Some administrators in the Highway Department wanted more detailed information and

seriously suggested having people inside the restrooms, timing individuals and recording their activities. Fortunately I managed to convince them that covertly spying on people in restrooms might not result in positive press coverage.

During my freshman year of college, I stopped listening to popular music; rock and roll after the explosion of the late 1950s became less interesting and I pursued roots music. I had not been to a movie since my sophomore undergraduate year—the movies too were not engaging. So the winter of 1966-67 Scott Guthery opened up certain activities to me. We became friends, and there were traditional trips with our wives to Burger King when we were paid each month. But also we were at each other's apartments, mine on campus in Spartan Village for married students and Scott's upscale apartment in East Lansing. He had some amazing friends, and one night I went to his apartment when a rock group The Lemon Pipers were there. Soon joints of marijuana were being passed around. I was talked into sampling the smoke—I did not even smoke tobacco—and sat there, heart pounding, waiting for dangerous hallucinations or even worse. Nothing happened except for an interesting conversation with one of the band members. How disappointing to undergo what is expected to be a perilous journey and then find it is nothing. Recall that at this time smoking marijuana was punished by jail time.

My second experience with Mary Jane was also at Scott's, and I inhaled not expecting any reaction. Being relaxed for the drug was what it took. I looked around at the room; everything was exactly the same but somehow more enhanced and dimensional. Now I knew why there were those cartoons with smokers saying *wow*. Scott came over and told me that I had to listen to a new album by the Beatles. Now I knew who the Beatles were; I had been forced to watch them dance onstage on the Ed Sullivan Show a few years before and was unimpressed. So what, I said then, listen to Robert Johnson or John Lee Hooker or Hank Williams, and compare them! But Scott tried to tell me that *Sgt. Pepper's Lonely Hearts Club Band* was all of one piece and important. I put on Scott's headphones and fell into an unexpected universe. Wow indeed! What else had I been missing? And I went to a movie theater, Scott again insisting I join him and Peter at a double bill: *Morgan* and *Blowup*. By the time I descended out of those weird depths into late afternoon sunlight, my head was aching and I knew that movies too had advanced into new territories while I was smugly not watching.

Recently a tape of Lou Reed was released, *Words and Music, May 1965*. It transported me back over 50 years to a naive optimistic struggling state of being, reaching for what we all might become. For some minutes I was, as people my age sometimes say, young again. 1965 Reed uses folk, blues, roots, and rock-and-roll, pulling strands together, knowing he has not arrived but also knowing he is on the way to somewhere. The Velvet Underground and one of my favorite albums *New York* lurk in the background when I listen to this young man, young when I was young, putting down his markers on that trembling luminous present.

With Scott and others I watched Chuck Berry play at Lake Lansing. We were his only audience, and it was sad seeing what had been such a dynamic performer. I did not realize that in 1963 he had been released from prison (the Mann Act) and was recording new material. We saw him as a nostalgic figure. More exciting was the Paul Butterfield Blues Band that infused Chicago Blues with rock and roll. Butterfield played the harmonica with an intensity that each night increased as he became more and more intoxicated. He was in a league with Little Walter on the harp. Mike Bloomfield and other great players were with him. Butterfield was my age, and I wondered how long he'd last living like he was. The answer was 20 years, more than I guessed in 1968. The Siegel-Schwall Band also brought Chicago to the midlands of Michigan. They (and Butterfield) had played with Buddy Guy, Little Walter, Muddy Waters, Howlin' Wolf, Bo Diddley and others. A bit less intense than Butterfield, their creativity and inventiveness was superb, and I purchased their records.

My first summer at Michigan State I read Billingsley's beautiful new book *Ergodic Theory and Information (1965)*. By this time the Statistics Department had moved out of its dim basement quarters, and in 1967 we were in the then-new Wells Hall. The Mathematics Department was one floor below us, and Kinney regularly came up to see me and I went down to see him. His conversation was eclectic and veered all over. His father had logged white pine in the Bitterroot Valley of southwest Montana in the same country where my great-grandfathers had ranched and run mills, so we had a common sense of place.

Kinney often talked about history, and he knew by heart that endless string of British royalty. I was hooked by the lessons he drew from the historical record; a favorite was his explanation of the initial slow development

of the American colonies. It was not hardships such as bad weather that stifled them; no, it was that “you can’t make beer out of pumpkins.” Things got moving, John said, when the rum trade with the West Indies began. I imagined the relief with which those colonists pulled at their rum bottles each night. Until then, according to John, the colonists were desperately trying to develop a reliable source of alcohol, and they didn’t have time for much else. John did not mention that shipping slaves, both Native Americans and Blacks, between the Colonies and the West Indies was the source of much of the wealth of the Colonies and also provided that rum. John often spoke in code and deciphering was up to the listener. In this case it took me a few decades. In a connection with modern history, one of John’s aunts was Jeanette Rankin, the first woman to hold federal office in the USA, elected to the House of Representatives from Montana in 1916 and 1940. Strongly supporting women’s rights, she is famous for voting against both the declaration of WWI and the war with Japan (where hers was the only no vote). Clearly John was one of her favorites and he received an inheritance from her. He told me of advice she gave him on house construction.

I met Tom Pitcher on his first visit to Michigan State University to lecture in a meeting John Kinney organized with Bill Root, Reese Prosser, and Tom. I and John’s other students were properly impressed, listening to the lectures of these men who not long before were a wildly creative team at MIT’s Lincoln Labs. They had all been let go at the same time, fired for doing too much mathematics, John said, and they had dispersed to various universities: Tom to the University of Southern California, Bill Root to the University of Michigan, and of course John to Michigan State University. (This was an early sign of the eventual down-sizing of the cold-war mathematics-research funding.) Tom had slightly greying hair with the bushy white sideburns of a Hollywood movie star. John’s students were in awe of this crew, of their accomplishments and their intellectual power. I hardly understood the lectures, but I remember that dark sloped room and the swirling equations that appeared across the darkness. I do recall John, after the festival, uttering one of his famous cryptic mumbles that one of his friends (not Tom) was suffering from “Terminal Forties” which, it was implied by John—but never said out loud—was only fatal to those friends who were made to listen to such stuff. Not to worry: no one suffering and a friend of John Kinney’s was without a shoulder to lean on.

With Billingsley’s book pretty much under my belt, I joined a seminar Kinney taught for his five PhD students the fall of 1967. Scott Guthery, Joe

Matti, Bill Conner and Dan Naussbaum were the other students. The team of Kinney and Pitcher was using communications engineering to motivate and guide their way in pure mathematics, and we were beneficiaries of their deep insights. After initial lectures by John, we each went through assigned research papers. John talked incessantly about Rohlin's formula for the entropy of a transformation. I presented Rényi's elegant paper on f-expansions, and John kept telling me to also cover Rohlin's formula, which he said was in Rényi's paper. I searched desperately in that and all the related papers Rényi wrote and did not find anything faintly resembling what John scribbled on the board and called Rohlin's formula. Finally I summoned my courage and went into his office with all my copied papers, and confessed failure.

"If you can just point to where Rényi does it," I said, "I'll do my best to go through it. I just cannot locate it."

John snorted, turned the pages, and then turned the pages again. It turned out that Rényi had never written about Rohlin's formula.

"My eyes were....then...had glasses problems...didn't read.... It shoulda been there."

John had been, as he put it, reading between the lines. This fit what John implied when he spoke of reading a research paper. It meant that not only did you understand the steps of the arguments, but also that you knew its meaning in a larger sense, where the paper fit into things, what was coming next, what the next paper would be if you chose to pursue it. It has made me cautious about claiming I have read many papers.

Referring to his students' work, John said to me that he was training applied mathematicians. "You are applying one branch of mathematics to another," he said. Indeed we were, although we were far from what was called applied mathematics. Still if you can translate from one specialty to another *and you have other interests and motives*, you probably can do applied mathematics, so John had put his finger on something. When I referred to his statement, he cautioned me not to believe it.

I liked a Kinney concept he called "the right answer," which meant a theorem and proof that was not only correct but perfectly fit the topic. It did not go in circles or indirectly approach the objective and showed what was really going on. Paul Erdős had a related concept which assigned such proofs to *THE BOOK* which is where God keeps the most elegant proofs of important theorems. Paul also referred to God as SF, the supreme fascist. For me there is a symmetric issue, "the right question." There is no doubt that John assumed this as given, but in my wandering about different

mathematical and scientific landscapes, working out what is important and making a mathematical formulation that catches its essence is key to making progress. I love that aspect of discovery while others take already formulated problems and make their contributions there.

Kinney loved to quote one of Claude Shannon's papers in which it was estimated that English text is 50% redundant; one loose interpretation is that, when a random selection of half the words are deleted from a text, the content can still be understood. John went on to say, "Of course, as all freshmen know, on a college campus English is 90% redundant." While John well understood what the redundancy was for, he pretty much eliminated it in most of his conversation, and he dropped out of his speech any word, sentence or paragraph he thought the listener could infer. This often made for confused audiences, but conversations with John were what it must be like playing with a jazz musician who leaves out notes expecting you to hear them and improvise. Other parts of information theory found application. For example he would sometimes be silent when it seemed he should speak. "If you have only one thing to say silence is the most efficient encoding." He would answer the telephone and say nothing. The caller should know whom they were calling and they should know the call had been answered as the phone had stopped ringing. Therefore "Hello" was redundant.

Shannon's genius was evident in 1966, and today we know that his work establishing information theory allowed the internet and cellphone era to come into being. Kinney said that Shannon's results paid for the salaries of generations of mathematicians and engineers.

When Detroit erupted in riots the summer of 1968, Kinney said, "The question is not why. The question is why not before." The weather was hot and humid, and it must have been wretched in the slums. In Lansing, quiet men showed up in the parking lots of stores with arms covered by watches and car trunks full of other consumer goods, all offered at a deep discount. The question is *why not before!*

The Statistics Department was where I became aware of the New York Times and the Wall Street Journal. Scott Guthery subscribed to them both and some of us kicked in. I loved the Times, especially those little quotations from other publications, often revealing incredibly funny or sad misuses of language and logic. I read the obituaries and wondered about those who took a large enough part in the nation's life to be memorialized like that. The

Wall Street Journal I never “got” and I wondered why Scott subscribed to it. Scott and another student joined an investment class, another activity I could not comprehend.

Besides reading the newspapers, important activities occurred in the coffee room where students and faculty played blind chess (kriegspiel). Professor Herman Rubin, one of the smartest people I ever met, excelled at this. Rubin was right-wing politically and frequently said that we should bomb Red China before they bombed us. He conducted incomprehensible classes, and I sat in on his advanced statistics course. Much like reading Loève, when listening to Rubin I had no idea whether it made sense or not. Then he came to exponential families about which I had written my master’s thesis. For nearly 30 minutes I understood Rubin perfectly and he presented real insights. Then he moved past exponential families, and a deep darkness fell over me. But he was a rich resource for anyone who inquired and was very generous with his help. Once I went to his office to ask a question, and after thinking a bit he said there was a publication I should read. He had a circular table stacked to the critical angle with preprints and reprints. If you put a document on the pile, another would slide off. He went three-fourths around the table in one direction, then partway back. Looking abstractedly toward the ceiling, he raised some of the papers, reached far into the stacks and brought out a preprint. He glanced to ascertain it was what he wanted and then handed it to me. What a performance! During department seminars, Rubin would fall asleep, often snoring and passing gas. But at the end of the seminar, he would shake himself awake and ask penetrating and sometimes very critical questions. One famous professor from Stanford stood trembling, waiting for his question. Decades later I gave a seminar at Purdue when Rubin was on the faculty, and I kept checking to see if I had put him to sleep. At the end of the seminar, I waited eagerly for Herman Rubin to ask me a question. And of course he did! It was worth the entire visit just for that! My answer began, “Well, Herman, you see....”

The Vietnam war was increasing in intensity and fortunately I obtained a series of deferments. If a person held a deferment he was eligible for the draft until age 35. Only men were drafted. First I had a deferment for my undergraduate years (when for two years I was in ROTC), then after that degree I received a deferment for attending graduate school. That was valid until 1968, but then I was married with a child so once again I was able to receive another deferment. The December 1969 lottery to randomly choose draftees covered birthdays between 1944 and 1950, so I was finally beyond

the age people were being drafted. The war was on everyone's mind and most young men who could avoid Vietnam did so. I was one of them.

I learned many things from Kinney. One was about what to do when stuck at the blackboard: "Never compute in public." You should be prepared or think it through later; any stab at the answer when under public scrutiny stands a good chance of being wrong. I have failed to follow this dictum on occasion and often later wished I had kept quiet. Another of these gems was about the tendency of new faculty to raise high bars for allowing others to advance, for example to pass a thesis exam. "Upholding standards that never did exist," John called that. At that point I did not realize how widespread that malady is.

The detailed directions I received from John Kinney for my thesis problem were: "There's an Austrian doin' somethin'.... Schweiger.... Go take a look at it." That was all he ever had to say about what I was to do to earn my PhD.

That second summer at Survey & Analysis I worked on my thesis too. Fritz Schweiger's papers were obsessively detailed nightmares. After some hard work, I extracted the key transformation and drew its frightening graph on a blackboard at the Highway Department. No one there even asked me what it was. I showed it to John Kinney and waited three months for him to give me something more manageable until I realized he wasn't going to. In January 1969 I was walking to the drinking fountain when the puzzle solved itself, in one flash I knew what Schweiger had been doing and what he should have been doing. It was an instantaneous mental high and I imagined turning cartwheels down the hall to the drinking fountain. The insight fit into everything John had taught me. John saw instantly that I had it, and I spent four months writing non-stop with one hitch that gave me trouble. When I got through that trouble spot, John looked at my write-up and said, "You spent a long time getting that. Best to write more than one paragraph."

When Tom Pitcher visited again in 1969, I was getting along with my work. By this time I was much closer to John, and I could observe the amazing team in action. Tom and John were great together, serious and simultaneously making sport of themselves, all in and amongst forays to the blackboard where cigarette smoke and chalk dust flew into the air and then settled while they balanced on the silences between their thoughts. They had just finished their best work and were 15 years ahead of everyone. After enough chalk dust, they took it to a bar. Since my thesis idea had lumbered up and taken off, they asked me to accompany them. Supporting a wife and

a child, I didn't often go with them, but being asked meant a lot to me. The invisible line that separates adults from children, men from boys (as we used to say), exists everywhere, but that having an idea (or more correctly, seeing something clearly for the first time) could make a difference was amazing to me. It still is.

John had each of his students give a presentation of their thesis work to Tom, and by that spring I had the key to why my n -dimensional continued fractions were so much more difficult than the classical one-dimensional case and how to handle it. Tom apparently liked the work because he repeatedly tried to convince me not to take a job in Idaho where in such an environment I'd never do any interesting work again. In contrast Tom was dismissive of Scott Guthery's thesis that Tom said was phony and shallow.

After I finished my thesis, two of the smartest and most active members of the Statistics Department faculty sat down with me for a long conversation. They did not come to the point for some time, but I triangulated from their questions what they wanted to know. Did I get any help from John Kinney, they wondered, could I understand what he was talking about? I assured them that he had been of enormous assistance, that he had taught me just what I needed to know to write my thesis. He never corrected a specific detail, but he often caught my errors by some more global process. When I asked a specific question, I did not often get an answer that directly addressed my question. But when I understood John's answer, it usually contained at some level or encoding the solution to precisely the question I should have been asking. When we ended our chat, the two men went away as confused as to what had gone on between John and me as they had been before we talked.

I was from a ranch on the west coast and had no academic ambitions whatsoever. Kinney told me years later that he had bragged about having a student who was "grateful for being in out of the weather." He was apologetic, but I told him he had been entirely accurate, all I wanted was an inside job that wasn't too boring with a paycheck that did not depend on how well the grass grew that year. I told Bell Labs "not interested," and looked for a job that was in the Rockies at a school without a PhD program. But a teaching job seemed a good decision. In addition to teaching people who needed a grasp of mathematics, I might also explore novel mathematics, even report it to the world, the reporting not for financial gain but just to describe something new.

John did not try to talk me out of Idaho, probably he knew me too

well by then. The Statistics Department on the other hand was horrified at what I was about to do to myself, and they repeatedly told me that. They usually sent their best one or two graduating PhDs to temporary positions at Stanford or UC Berkeley, two departments I called the best five statistics departments in the world. Alan Oaten who finished that year was taken at Stanford, and I was supposed to go to Berkeley. "What, continue on as if I were still in grad school? Why?" I said. This stubborn attitude did not make me more popular with the Statistics faculty. Besides Bell Labs, a couple of schools in the east pursued me, but I had no interest in them. If Bell had a facility in the Rocky Mountains, I would have gone there. Bell Labs was one of the most productive and original scientific organizations in history and was where Shannon did his revolutionary work.

Instead I applied to schools in the Rocky Mountains that did not have PhD programs. The exceptions were Sonoma State and Humboldt State (not in the Rockies) and Montana State (with a PhD program). Fortunately my fellow Oregon State students Dick Hill, Don Cresswell and an Indian named Sra had received their doctorates and were at Idaho State University in southeast Idaho. Surely because they knew me, ISU made me an offer of \$10,900 per academic year, and I had found my dream job in Pocatello, Idaho. Kinney told me that Pocatello had two desirable properties: it was a railroad town, and it was on the correct side of the divide. Pocatello was on what was once called the Oregon Short Line, but more important was that Pocatello is on the western side of the continental divide and consequently does not get as many arctic cold-air masses as do locations on the eastern side. John knew about these things from being raised in the Bitterroot Valley.

My dear friends at the Highway Department wanted me to stay and work there full-time. Going to Idaho is crazy, they said. Stay in Michigan for the outdoor activities, hunting and fishing. This amazed me and I asked them, "Do you have any idea where Idaho is? What Idaho is?" They seemed to have Idaho and Iowa confused. I enjoyed this job distant from academic culture. And I saw from their data sets the paradoxical dangers of too much data, where at least one had to rethink standard assumptions and procedures. For one of the projects we used a special selection of inmates from Jackson Prison who worked for us. This was administratively challenging due to legislation to prevent chain-gang types of abuse. I got to know those prisoners well enough that they described the helpless out of control aspect of being set free. One had robbed a small store just so he could get put back into the security of prison. I enjoyed traveling to Jackson and going over their work

with them, explaining why they were doing what they were doing. And one of them was brilliant, as bright as anyone in my PhD program.

My wife and child went to Oregon for the summer, and I worked days at the Highway Department and, in my spare time, wrote up both my theses for publication. While I did not intend to pursue serious research, I saw my PhD work as done under the expectation I would publish it, and I wanted to at least try. I believed my work was superior to Schweiger's tortured papers on the subject. Jim Brown's implicit suggestion that I could publish my master's thesis was not forgotten, and since I was in good condition for writing, I prepared a short version. Both of these papers were submitted before I left Michigan at summer's end for Idaho.

Typing a manuscript of mathematical content was not easy. It required special fonts for the mathematical symbols and Greek letters, and a skilled person had to switch those fonts in and out of the typewriter while producing a manuscript with a handsome appearance. Rae Ann, a salty energetic middle-aged woman who worked in the department, typed my two papers. She and Kinney were on good terms so she typed my two papers along with her other jobs. From her I learned a valuable lesson. Secretaries (good secretaries) know everything happening in a department and that inside knowledge can flow to even a graduate student.

When in the late 1980s I made a trip to East Lansing to see John, I gave a lecture in the Statistics Department and chatted with some graduate students in an office like that Dick Mesic and I had occupied when John Kinney would shuffle down the hall to see me. "I was a graduate student in an office just like this one," I told them, "when the Stat Department first moved into this building, when it was new." They looked quite blank, and then one said, "Well, that must have been a *really long time ago*." Well, indeed it was a long time ago, and then again it was just yesterday, and John Kinney is still here teaching us how to make beer out of pumpkins.

On the Shores of Idaho

For the first time a human walked on the moon. At the end of the summer of 1969, I had a doctorate and a job to begin. With a tightly packed trailer hitched to my silver Le Mans Pontiac, I pulled out of Spartan Village on the MSU campus and started west. My wife and daughter spent the summer in Oregon, so I was alone. This time I understood the toll roads near Chicago and did not need a AAA TripTic to guide me. The interstate freeway system was incomplete, but except for the tangle of roads at Chicago it was just putting in 1500 miles. I had planned to stay in a motel at least one night but instead kept driving through humid midwestern nights. In Iowa marijuana plants were growing in the ditches, and in my exhaustion it seemed as if I were passing through an alternate universe. There was a collection of commercial trucks that I kept seeing as if we were a floating community distinct from usual travelers. Coming across the lower part of Wyoming, I left the road that went on to Salt Lake City and headed northwest toward Idaho. Dazed in the bright morning sunlight, in Kemmerer I realized how little I knew about the country I would now live in—the whole enterprise seemed set to smother me.

Eventually I crossed into Idaho, driving through Soda Springs wondering how there could be springs in this arid country. Then I came to the Portneuf River that Don Creswell mentioned as good fishing. I pulled off the highway and looked down into the riverbed. It was almost dry, and I could hardly believe it supported any fish, certainly not trout. It had been a dry year even for southeast Idaho, and the hills were bare where the little plant life I could see appeared dead. Dusty gray sagebrush and rabbit brush. I was not impressed. Then down the road was Lava Hot Springs where I stopped and walked around. In a little resort run by the State old decrepit people were going and coming from the springs. “Good grief, what have I gotten myself into?” I wondered. As I pulled off the highway into Pocatello, I had to

admit that the MSU Statistics Department and Tom Pitcher may have been right about Idaho. Tom had predicted I would not be able to accomplish any mathematics in such a dead backward place as Idaho, something he knew about since he was from northern Idaho. That did not trouble me, but the apparent lack of fishing did! How was I going to get myself out of this fix? Coming into town I made a mental list of possible schools and research institutes I could apply to the next year, even Bell Labs in New Jersey might be better than dry riverbeds in a parched landscape. Then I found my way to Don Cresswell's home where he generously put me up. At the end of my long trip, out of the car, inside a house, after some sleep and rest, I put the feeling of grave disappointment with Idaho under wraps. Unhitched from the trailer, I drove to Oregon to visit my family and collect my wife and daughter.

After a side trip to San Francisco to buy what I called my assistant professor jacket—a brown Harris tweed—I came back to Pocatello to begin work. The head of the Mathematics Department, John Hilzman, was a colorful ex-New-Yorker instantly identifiable as a huckster, one of those fast-talking guys who says what he is out loud with a wink which means “This is true but we are going to pretend it is just a front. Get it?” I got it and found him amusing but not reassuring for a boss. The first day he met me, we went downtown to Buddy's Restaurant that was a cultural landmark in Pocatello. Good beer, decent pizza, salad with a strong dressing. Mainly Buddy's was draft beer and the hangout for anyone in the university who drank publicly, both faculty and students. Also the place for folks who did drugs, ran rivers, went fishing or managed to live outside the deep shadows cast by the Mormon Church. For the Mormon Church was a major component of Pocatello, perhaps half the people in town were Mormon and how they allowed the godless university to exist was a question I never learned the answer to. We must have been good business for them, Buddy's Bar notwithstanding.

At registration on a crisp September morning, John Hilzman told me a story of an earlier hire. A storm had come in and there was light blowing snow. John said he looked outside and returned to the registration desk saying, “Hell boys, winter sure is coming late this year.” He said the guy left before winter term. The Department had about a dozen faculty, including Hill, Cresswell and Sra, all recently hired from Oregon State. There were two instructors Errol Green and Rose Chambers, excellent teachers without PhDs or the prospect of tenure. This was not a research department. In the entire history of the department there had been six or seven journal publications,

and no one in recent memory had published. This was exactly what I had in mind during my job search. I had been to graduate school and successfully located a school where the pressure to continue research was non-existent. The teaching loads for PhDs were usually three courses, often three class hours per week for each class so the classroom contact varied between 9 and 11 hours per week.

The best teacher in the Department was Frank Lane, an easterner who was in his 60s. He was the fisherman Creswell had told me about, and Frank invited me to join him and his friend Gus for an outing. Frank with no PhD had tenure and a heavy teaching load but kept Thursday afternoons free. I had that time open as well, and we agreed to meet mid afternoon Thursday the next week and go to Soda Springs, a location I was unimpressed by when I came through on my way to Pocatello. Frank told me he and Gus used spinning gear and that I'd need chest-high waders. I had some spinning gear, and I didn't think I needed waders—I used waders fishing steelhead on the Oregon coast but never for trout. Why start now? We went to Soda Springs, Frank and Gus talking about Idaho trout, past and present, and we went to a dam on the Bear River near Soda Springs. There was plenty of water (freeing me from my dry-county no-trout assumptions), and the fishing depended on how much water was being released. The release rate was for power and agricultural needs, trout and environmental considerations were not in the equation. The water was in good condition, and Frank and Gus waded far out into the river, trout rising all around them. They caught many fish, and while I was unsuccessful from the bank, I was now an ardent believer in Idaho trout. Trout were there in water that ran through dry-country lava-flow canyons. Maybe I could hold off applying for another job until I had this worked out! Back in Pocatello I upgraded my spinning gear and bought cheap chest-high waders. Next time I was going to be out there mid-river.

But my second trip with Frank Lane was to somewhere quite different. Soda Springs was east of Pocatello. This time we went north to the Fort Hall Indian Reservation (of the Shoshone-Bannock tribes) and headed across their desolate range land. There were a couple of stock gates and I opened them for Frank's car to pass through. Stock gates held little mystery or difficulty for a ranch kid, and city-born-and-raised Frank Lane greatly valued my ability to negotiate the gates we passed through in our years of fishing together. The goal, an hour of dirt road away, was the Blackfoot River below a reservoir that held water for agricultural purposes. In the fall residual water was released in preparation for the next year's runoff. That made for some

amazing fishing as I was soon to learn. With new boots I was wading as well as anyone and bringing my lure up a strong run of current, I noticed a wake rapidly approaching the lure. What hit with great power was a four-pound cutthroat, one of the beautiful natives of that country. Frank waded up in the weed bed and netted the fish. I carried it to a little sand island where I noticed a distinct bear track marked deep into the sand. As I laid the fish onto the track, I thought, "I am going to stay here forever!"

I knew the story of the politician in Washington DC who after a change of administration was asked what he was going to do. "I don't know," he answered, "but I am not going back to Pocatello." Here I was falling in love with Pocatello and its dry country. In Idaho even bales of hay could stay outside all winter and be ready to feed to the livestock; back in Oregon where I was raised, it would soon have been rotten. Now I began to see the timber growing on the north slopes where the snow was slow to melt, to see the subtle richness of the land. Idaho automobile license plates proudly proclaimed "Famous Potatoes" and for a few years that's how I signed my letters:

Sincerely yours,

Famous Potatoes

In this early part of my life in Idaho, the family took a drive. The Snake River basin is an extinct lava flow and it is 50-60 miles across to the mountains of the Salmon River. We went first up the Wood River to Sun Valley. I knew Hemingway had lived in this resort community and that he had committed suicide there. Somehow I found my way to a Hemingway monument standing beside an irrigation ditch with fast-running clear water and cottonwoods. The text on the monument read

*BEST OF ALL HE LOVED THE FALL
THE LEAVES YELLOW ON THE COTTONWOODS
LEAVES FLOATING ON THE TROUT STREAMS
AND ABOVE THE HILLS
THE HIGH BLUE WINDLESS SKIES
...NOW HE WILL BE A PART OF THEM FOREVER*

I learned years later that was from a eulogy Hemingway wrote for his friend Gene Van Guilder who was killed in a hunting accident in the Hager-

man Valley by the Snake River. But there I was, the crisp air, the cottonwoods, the yellow leaves, the trout streams, the brilliant sunlight.... The dimensions and possibilities of the world were transforming for me as I stood there, hearing water rushing by.

From this moving experience I drove up the steep winding rocky road into the Pioneer Mountains, across the divide and then down Trail Creek. I pulled over and after a few casts caught a vital rainbow trout; I let my daughter hold the rod with a transported abstract look on her face. She carried the fish up out of the streambed, holding its still-living body with both her hands. I felt I had finally arrived somewhere I belonged. Then it was down Trail Creek to the Big Lost River. This country remains some of my favorite land in all of Idaho. The Big Lost runs cold and clear down through the mountain valley out into the lava flows of the Snake River plain where eventually it disappears into the rubble of lava.

The open country, the clear skies, the crystal water, I came to deeply love Idaho. And I kept thinking that my ancestors could have stayed in the Blue Mountains or made a cattle ranch on the Salmon River's Middle Fork. If only, if only. Then when I was reading a collection of poems and stories from the region I came to a dark poem that described a gash of a road on a mountainside with spring snow melt and mud. It hit me then that if my family had stayed on the Rockies, my childhood could have been just as gloomy as it had been in Oregon's rain.

From Pocatello, it was north to Blackfoot, then onto Highway 26 across the lava fields, going by Atomic City with its few residents on to the junction of Highway 20. At Butte City with its dozen people were a few trailers and a little cafe that made excellent chicken-fried steak. Someone told me of fishing in the desert there, and my student Roger Johnson and I drove on a faint track out into the sagebrush and came to the Big Lost that had a good flow before it disappeared into lava. It was a magnificent afternoon catching high-jumping rainbows in a river you would not know was there if you were 300 yards away. To reach some promising water I lowered myself off a boulder and then saw on the sandbar below me large mountain-lion tracks. I hung there a while and then thought "To hell with it" and dropped down to my fishing; fortunately there was no cougar remaining.

The lava fields in the Snake River Basin are home to many antelope, and a biologist at Idaho State was an expert. He spent years learning about their complex behavior, some of which he and his students shared with me. I was shocked when an issue of *Science* appeared with a feature article about those

antelope by someone from the University of Utah. He had learned his facts from ISU's guy and didn't even credit him. It seemed to upset me more than it did my colleague. I have always resented entitled people who exploit others who are less entitled. Another example of this occurred with the 1994 publication of *Rocks Rails and Trails* about the geology of eastern Idaho. My Idaho colleague Tom Ore wrote me that he "either taught [the author] all he knows or flew the plane for the aerial shots." Tom was only acknowledged as a reviewer and for the airplane flights. It is an excellent informative book.

I was in a rural state at a university with 5000 students, a university that possessed no academic pretensions or ambitions. Most universities were aiming at prestigious research and publications but not ISU. So what was the point? Clearly it had to be teaching. And I liked the students who came from small towns (they had to be small, Idaho had no cities of any size) and of course from farms and ranches. Often not well educated from their high schools, they possessed a certain common sense and had at least a slight interest in the world. I decided it was time for me to learn to teach. As I had observed at Oregon State, my approach to learning did not enlighten my classes, so I had to find something that worked. I don't recall all the methods I tried, but in a couple of years, I had settled into my teaching style. Graduate classes I didn't baby along but took pains to describe how the next material fit into what we had already covered, and how to think about the results. Why would anyone want to know this? Why was the method of proof a sane approach instead of being delivered from some other mysterious planet? What were we learning? Sometimes I'd realize that I did not understand what I was to present the next day, and I'd stay up late at night struggling to get it clear. Undergraduate classes I handled differently. I began classes with a monolog as did Johnny Carson on the Tonight Show. I'd think of something while walking the mile and a half from my home to the university, and I'd riff on that, usually somewhat miraculously segueing into the day's material. I'd motivate and motivate again, and then at the lecture's end summarize the material in a capsule version that would be easy to remember. I liked the students and reassuringly they seemed to like me.

Having a PhD in Statistics and Probability, I was naturally assigned to teach those classes. Many mathematicians see the material in the first courses in probability and statistics as elementary, and therefore believe that everyone can teach those classes equally effectively. This is entirely wrong. We live

in a world where almost everything (except perhaps in mathematics classes) is fraught with uncertainty, but we do not learn how to think carefully and rationally about uncertainty. People cannot “think prob” as John Kinney put it. My job, I felt, was to help people to “think prob as well as think stat,” and my lowest-level class in probability taught from Goldberg’s superb book became a delight for me. The class started with no assumptions except that students could do arithmetic with fractions and read the simplest formula. We took them forward from there. Probability theory arose from gambling games several centuries ago, and using games of chance to motivate is helpful for student and teacher alike. My classes had many Mormon students, and no one complained about my use of gambling games. I even presented conditional probability using side bets in the game of craps. At the end of one semester, a student named John Luke Merzlock came to me after class and said that I had no idea how ignorant he had been at the beginning. He showed the flyleaf of his book where he had written how many cards were in a deck and what the suits and face values were. He received an A and was not complaining. I loved teaching those students.

One situation with an upset student revealed aspects of my teaching that I had not understood. A man somewhat older than the other students was vision handicapped. He could see but not very well. Today this situation would be handled by one of those university services but not then. There he was with his thick glasses and long slender cane. As the semester went on I could tell he was getting increasingly unhappy with the class—and with me. I did not understand why, and unfortunately I did not seek him out to learn what was going on. A year or two later I solved the puzzle that had simmered just under my consciousness—exactly what had happened there? The explanation was that I taught visually—geometrically. I would for example write the famous Bayes formula on the blackboard, but I taught students to solve Bayes problems by drawing a tree diagram and using common sense and intuition. The poor man could not even see my trees and had no idea what I was pointing at or talking about. I regret I did not solve the difficulty when it was occurring, but I am glad that I finally understood it.

My grandfather Payne was a railroad worker and after his death my mother gave me one of his watches, a Elgin B. W. Raymond Timemaster in the original box. Purchased in 1950 and manual winding with 21 jewels, it was an attractive watch, gold filled with a white-enamel single-sunk dial and Arabic numerals. I did not wear a wristwatch so to keep time in my classes part of the ritual was to take the watch out of my pocket and lay it on the

desk in front of the classroom. An amusing aspect was that it did not keep accurate time so I had to set it each day that I taught.

The first fall in Idaho I was busy teaching and learning how to get along in a new city, as well as with fishing trips with Frank Lane and doing some camping with my family. After release from graduate school, I never expected to do any research again. But the second term I took a couple of reprints to the student union and sat at a table with a cup of coffee to begin work. It surprised me and I had no idea why I was starting a research project. I knew that almost no one at ISU worked on research projects. The geologists were exceptions as were a few others in chemistry and biology. No one in mathematics had published anything in years, not work done in Pocatello. But that event marked for me the beginning of doing work I wanted to do, for no reason other than I felt like it. It was not that it was applied mathematics or that it was pure mathematics; it was mathematics that interested me. Research had that aspect of struggle and then understanding something I had not understood before, as when I had learned to tie my shoes as a child.

Occasionally I would get a call from John Kinney, telling me how my classmates were doing. He and Scott Guthery had a falling out, and each had things to say about the other. And the first student he took on at MSU, Dan Nussbaum, who had the sweetest problem, made agonizing progress, and Kinney had a lot of pain over him. John Kinney was not for someone who needed their hands held. I believe Kinney called me to keep me connected with research, and I liked getting the calls mostly because I liked him. "It must be wonderful," he said, "to catch fish in drinkable water." It was and I knew it.

That spring, after my trip to the student union, my thesis paper was accepted in *Z. Wahrscheinlichkeitstheorie* with a minor revision. I was pleased and could not have anticipated the effect of the reprints of my paper of 27 pages arriving in the mail. It was thrilling, perhaps I should not admit it, but it was. Reprints were magic. There was my effort, published in an excellent journal and placed into libraries around the world for as long as libraries would exist. I also submitted my master's thesis that the next year appeared in *Ann. Math. Stat.* In spite of my reluctance, my life as a researcher and explorer had begun. Actually it had begun years earlier; I just did not recognize it.

In the Mathematics Department office was a first-rate secretary who carried on imperturbably in spite of the erratic actions of the Department Chair. Marge Ingram helped make the Mathematics Department operational, but

more importantly, she gave it humanity. The students all knew and loved her; she got the class schedules and budgets done properly. Until I arrived there was little preparation of technical manuscripts to submit to journals. She took up typing my papers with accuracy and never hinted that I was causing her extra work which I was of course. People like Marge Ingram keep the world humming!

The first summer after starting my job, I went to Los Alamos National Laboratories in New Mexico where Bill Beyer, John Kinney's first PhD student, worked in the math group T-7. I had with Bill's help received a grant from Associated Western Universities, and we tackled a problem from my thesis. My and Schweiger's work established the existence of an "equilibrium distribution" for higher dimension continued fractions but no one had any idea what it looked like. I wanted to use a computer to reveal this mysterious object. After that summer, which eventually resulted in two publications, I wrote a grant application to NSF. I had one good idea and other notions, so why not ask for funding? John Kinney gave me one of his successful NSF grant applications, and after reading the rules, I saw that with grants, as with everything else, Kinney made it up according to Kinney. I followed the directions but was freed by Kinney's example to go off track when it felt useful. Although funding levels were devastatingly lower than in memory, my request was funded, and I had three summers (1971, 1972 and 1975) of NSF salary. This was the first NSF-funded research in the ISU Mathematics Department.

Bob Fried at the Highway Department in Michigan told me that Eddie Bauer was an excellent place for outdoor equipment and I obtained a catalog. (This was long before Bauer became a fashion brand.) Arriving in Idaho I purchased sleeping bags from Bauer, goose-down but rectangular and adequate to 28 degrees Fahrenheit. Who would want to sleep outside in below 28 degrees? Well, the first family camping trips we took had us shivering in the bags hoping to make it until morning. My wife Vicki was not enthusiastic about camping, but she was not enthusiastic about anything else either and I thought doing this together was a good idea. I had such a surging love of the mountains that I could carry on without much encouragement. That first winter I bought mummy bags, huge blue goose-down bags good far below zero degrees. On our slow month traveling to New Mexico, we camped in late May on Wildhorse Creek in the Pioneer Mountains, and I only brought

the light bags. After one agonizingly cold night, I drove back to Pocatello to fetch the mummy bags. We went through Idaho into Oregon, down the coast to the San Francisco area where we stayed in a commune in the Oakland hills, then across northern Arizona, and finally into New Mexico. I liked all these places, but none were as wonderful as Idaho.

On our return, rentals were tight in Pocatello and buying was cheaper than renting. I had identified ownership with being a real bastard to anyone and everyone (something learned from my father's example), and I did not wish to own anything. However I could not avoid it. New tract houses were \$18,000 and up, which I thought was far too much money, plus I did not want to live in one of those houses. Instead we found a brick house in the older part of town, next to a struggling church. This place built in 1905 cost \$15,000, slightly more than my annual income. I obtained an FHA loan, put \$500 down and the payments of \$153 per month included taxes and insurance. My hand shook when I was signing the mortgage papers. For several months I fearfully waited for the old place to throw up expensive problems but it just hummed along. The house was well constructed, and later I built two new rooms in the basement, rewired the whole house, tore off layers of dingy wallpaper and re-plastered the thick lathe-and-plaster walls. My ranch training had given me skills for home repair and maintenance. As with Idaho, I came to deeply love that old house on Hayes Street.

When searching for a house, I read in the local paper of a ranch for sale. Slightly under 640 acres (which is a section or one square mile of land) including a house, it was along the Portneuf River not far from the city, and the price was affordable if the bench land was leased to grow wheat. I thought about it for a few days but realized it would limit my explorations of Idaho's outdoor wonders and block research summers in New Mexico. I never even went to look at the property, another path not taken.

New faculty would arrive at ISU, decide the facilities and intellectual environment were inferior to their previous locations, and soon give up their scholarship. The geologists were different, perhaps because everything around us was either textbook examples or begging to be explained and studied. Unlike western Oregon where the land was under a stout coating of brush and growth, in the mountain west it was all out in the open. This brought geologists to ISU; Idaho was near geological action. They were interesting guys (all of them males) and I liked talking with them. Their students took my

statistics classes and I sat on their degree committees. Other than that there was a physicist named Frank Harmon, a smart guy who knew Sergei Aalto from Portland. Frank had done Nuclear Magnetic Resonance research for his thesis and had a great excuse for giving up—ISU had no large magnets. I remember when he came up out of the basement of our building and said excitedly, “Waterman! You are not supposed to be able to do NMR with small magnets. They are wrong!” Frank and a chemist did some NMR experiments with cytoplasmic fluid from cells and were a big hit with NSF. It was a wonderful example of what can be done with less. I regularly had lunch with the few other active researchers on campus, and it was expected to be able to explain what one was doing and why. In an odd way this resonated with Los Alamos where interdisciplinary communication was a given. I knew almost every faculty member at ISU, not just in the sciences, and it was a wonderful community. There was no tenure committee looking over my shoulder judging whether what I was doing was significant. I worked on some substantial problems and on some that might not have passed muster as recreational mathematics. I didn’t care so long as I found the work rewarding. Part of that reward was seeing something into print in a journal.

Frank Harmon’s wife Judy took up some form of sociology, and at a party I asked her how she could tell if she was accomplishing anything. This stopped her cold, and some days after that Frank attacked me for listening to old blues songs when, as he correctly said, I had not had the sexual experience that they were referencing. I had enough manual labor experience, also in the songs, and believed I well understood what they were saying. Eventually I deduced why Frank acted as he did. We stayed friends although I was not Judy’s favorite person.

When I came back in the fall after New Mexico there was a new long-haired guy around the Geology Department. This to my surprise was Tom Ore whose wife had left him for someone in the chemistry department. Over the summer Tom went from short-haired whiskey-drinking conservative to long-haired drug-taking liberal. He ended up living for years with and then marrying Pat Lewis who was a serious feminist. When I met Pat she was getting an advanced degree in counseling. I took a mental deep breath and brought out my old question: How do you know when you are accomplishing something? Pat answered a slightly different question. “Listen,” she said, “some people are good at helping others and some are not. I am good at it. I am getting a degree so I can do more of it and be paid better for it.” This was an answer even I understood, and in spite of my reprimand for asking

that question the first time, I still use it. You are welcome to ask me the same thing any time you wish. Tom became one of my best friends, someone I called when struggling with a difficult issue. There are a few people who remain present after they die. Tom Ore is one of them.

Don Cresswell was an exercise fanatic, and I joined him and others for daily jogging. Each day I ran three to five miles at noon and would appear for my 1:00 p.m. classes full of energy—pity the poor students who had just eaten lunch! Running was where I met Harrison Hilbert, known as H (I wanted to call him H-squared or 2H but no one else did). H started a truly innovative outdoor program at ISU, one of the first in the country, taking students and faculty hiking, rock and mountain climbing, river running, camping and other outdoor activities. His crew was an inspiring bunch of young men and women who were becoming trained guides and teachers whose goal in life was to be active and outdoors. Many of them went on to be professional guides and run outing businesses. Ron Watters followed H as director of the Outdoor Program and has written books about Idaho's outdoor wonders. H was my age and we became life-long friends. When I purchased cross-country skis, I called him asking how one turned around and he told me. I went into my snow-covered yard and then called him again, saying what he described was physically impossible! Finally I put the skis on top of my square-back VW and drove over to his house to see what the heck was going on. H existed to show the rest of us how to do it; he was a gifted and natural teacher.

Just as I was beginning on cross-country skis, I went to Skyline Ski Area with a group from the outdoor center. I had never ridden a ski lift and that was scary enough. Then we went from the top of the ski area up to the pass across the mountain. We sat there and ate lunch; it was a rare day with the sky clear enough to see all the way to Grand Targhee. Down the other side there was one place with avalanche danger, and a young woman named GG (Geraldine Grady) stayed back with me, watching me fall repeatedly, quietly encouraging me. After I was safely through the tough spot she went ahead, skiing down a steep ridge with a dramatic plume of snow rising against a backdrop of pines and a brilliant blue sky above the green, I realized this apparently plain woman was quite beautiful and never forgot that image. After skiing eight miles out to the highway, we had brandy at a little joint called Whiskey Mikes, and then went to Lava Hot Springs to soak in the pools. There I realized how wonderful hot springs are.

GG was an accomplished climber: she made it to the summit of Denali in Alaska and several peaks in Patagonia. She and H made the first ascent of the North Face of Mt. Borah, the highest mountain in Idaho. Another trip I joined was to the City of Rocks where a group was climbing. I have a fear of heights, but GG and her friend Chris Lovgren decided it was time to take me on something easy and fun. I trusted these women and had no trouble going up a nice chute. Then we went over the top and down to what they called the fun part. They roped me up and lowered me down a hole in the rock, into a cave. Chris was below me and when I was suspended in midair I started to shake (sewing machine knees, it is called). Chris began to laugh and then I finished the ordeal. Later she apologized, but I told her that when she was laughing I realized I was not going to die there—her laughter brought me through. “If you hadn’t laughed,” I told her, “I’d still be there twitching at the end of that rope!” I would go anywhere with those two!

H moved me along on my hiking adventures. I found a round trip I could make in the Salmon River country when H sat me down with a map and showed me how the trip would be more interesting if I were to do a leg of it off the trails. I decided to try H’s suggestion and set out on my adventure. (The next year Lowell Euhus and I made a 100-mile hike from Grand Teton Pass to Yellowstone with some serious cross country. We did a side trip into Teton Park and climbed the South Teton peak.) The first day, starting a mile in elevation above the Salmon River, I did 18 miles without water and dehydrated myself so badly that I couldn’t eat anything for a few days. So on the third day, coming up out of the Middle Fork of the Salmon climbing over a mile of elevation with no food intake, I was light-headed. Suddenly I was backpedaling on the trail, my heart racing. When I stopped I saw a rattlesnake coiled and rattling. It was beside a squirrel it had just killed. Adrenaline coursed through me and I made a circle uphill around the snake. Starting out along the trail again, I realized I wanted to see the snake more closely, and I cautiously returned toward it. The animal had begun to ingest the squirrel and was already up to the shoulders. I tossed a stone near it to hear it buzz again, not to hit it but to see it rattle. It stopped engorging the squirrel and I tossed another stone. Then it began to lever the squirrel off the trail. The more I thought of this incident the more impressed I was. I only saw the snake because it was protecting its kill, and its behavior was civilized if I can use such an inaccurate word. I went from being terrified of snakes that I never saw to having a deep respect for them. After this I frequently saw rattlesnakes. I had feared snakes and Cutter snakebite kits

with razors and orange suction cups were in my car, hiking packs and fishing gear. After this they were slowly discarded.

Past the snake the trail went on to some lakes, and here I set off on my cross-country adventure. I came to an extensive region of blowdown lodgepole pines and there was no trail to follow. My head was light from no food and exertion and the challenging tangle seemed endless. The short small dead branches of the pines kept stabbing me as I struggled by. I came into a cirque with jagged peaks in a semicircle and had no idea where I was except that this was the Bighorn Crags and far off trail. I stumbled across some bones and skull of a full-curl ram that died of old age years before. It was as if I was caught in an experimental film that I had no hope of understanding. I climbed up and down the crags and finally oriented myself by the configuration of small bodies of water. In three days I had eaten only a handful of trail mix, and I wondered about my ability to make the rest of this trip. As I tried to sleep that night, shooting stars flashed across the sky and clouds of mosquitos gathered around my sleeping bag. I carried the sheep skull out but left the heavier horns. Using the map and my guess of where I was, I plotted a route, climbed over the ridge at the lowest point and discovered a sheep trail that would have been much easier and safer. After several challenging miles I got to a trail. Two years later I went back and brought out the horns. I met an older guy working on the trail for the Forest Service who looked at my treasure and asked where I found it. Clearly he had been there. Then a pause and he asked what route I had taken. I told him of my confusion the first time when I tried to cross the divide at the lowest point and missed the higher and easier crossing that the animals used. Then I described how I went this time. "Good," he said, "so did you see any sheep or goats at the pass before you descended to the lake?" I had not and told him I didn't know even where to look. He explained in a few minutes where sheep bedded on the stony slopes and where goats did, and it was enlightenment for me. Even after that, when I saw sheep I'd try to stalk them and they'd vanish. Later I learned to sit in the open, move toward them only when they moved. This showed them I was harmless while when trying to stalk them I was taken to be a predator. After learning that I was able to much more closely observe wild sheep.

An earthen dam was to be built on the Teton River which flowed from Wyoming into the Snake River. Before construction I floated the river with H and others including a reporter to create opposition to the dam. We were photographed catching trout in the canyon which would be lost from the

dam, and as I had fished the headwaters I knew that an ugly Mepps lure with a plastic simulation of a minnow behind the silver spinner was very effective. He stuck with dry flies and I don't think he caught one trout. Our efforts were doomed and construction began in 1972. In my literary dreams I imagined an environmental novel, ending with the hero approaching the dam with a backpack full of explosives. In reality that was not needed. The geological surveys were ignored and as the dam was nearly filled it collapsed in 1976. Eleven deaths resulted and two small cities were destroyed with much additional damage. I might not have thought to put that in my imaginary novel.

The long dirt road to reach the Middle Fork went by Yellowjacket Mines, a large strange aging wooden construction. There was a story that John Wayne owned the mines. I liked the idea that somehow tough old John Wayne had a stake in Yellowjacket Mines, but a decade later I learned to my disappointment that it was owned by an ordinary mining company. During these summers, I was not getting much research done but I was experiencing Idaho firsthand. I said to some of our graduate students that I had been camping so often that I would wake up and not know what trip I was on. One of the more psychedelically inclined long-haired guys said, "That's how my summer went too." That student became a dean at a major midwestern university where he warned students to avoid risky behavior. If they only knew!

At this time I only smoked marijuana in town. I'd tried smoking on backpack trips but it did not affect me when I was in the mountains. Being in magnificent unspoiled country was so exhilarating I couldn't get any higher. His penniless staff who lived on almost no funds had a great saying. At a campfire someone would poke a stick at the coals and say, "I wonder what the poor people are doing tonight." This joke came from public testimony about wilderness preservation; an often-used counter argument was that wilderness was only for rich elites. And while we were poor, we were rich beyond belief. The public lands of Idaho make up over 70% of the state, 63% Federal and 9% state. The freedom and openness were inconceivable to someone raised on a ranch in Oregon where we defended our property against invaders with fences and no-trespassing signs. In Idaho anyone was welcome. This openness has sadly vanished across the American West with everyone from homeowners to farmers and ranchers blocking roads and access to public lands. It was inevitable but it breaks my heart. I have returned to locations where 50 years ago I had deep experiences that live in my memories, just to

place my feet on that ground. Inevitably there are barriers and I cannot get there so depart from my efforts with profound sadness. I have decided to treasure memories and only to venture to new locations.

My family ate a lot of trout and some venison during our Idaho years. Native Americans used chokecherry fruit for pemmican and we harvested it to make an excellent jelly. But the best discovery was that Mormons had dried food available (perhaps storing up for the last days). Other scruffy guys and I would show up at home-based businesses and purchase #10 tins of goods like dried fruit. We had a last-days joke, "Your banana flakes or your life."

I often returned to the Salmon River country, especially to the Middle Fork. Parking at Middle Fork Lookout, I walked six miles along the ridge where I saw many sheep in an area where various drainages linked up. I could sit and watch the Bighorn Crags across a wide deep canyon. It was stark rugged country without any water and I loved it. One Friday Jack McCowan and I left early from our university classes to make the 5.5 hour drive to Middle Fork Lookout. We made it in time to hike the six miles before dark. The motive was elk hunting so we carried heavy loads including rifles, hunting equipment, food, water, shelter etc. As we reached camp, I asked Jack, "Wouldn't it be great to have a beer?" And after Jack said oh yes, I revealed two cans from my pack. Snow and ice began blowing in as I pitched the tarp to protect our sleeping bags. Next morning there was a crunchy skiff of snow on the country but it was clear on the ridge where just below us the entire valley of the Middle Fork was filled with a mile-deep cold cloud. It looked like an inland sea and we were just above its shores. I sent Jack along the trail as I descended into the tangle of Jack Creek (where I never saw water). As the sun hit the frigid cloud mass below us it expanded and began to rise by us. I was in the drainage when I heard hooves clattering on the boulders far above me. I expected it was elk and instantly thought I could not shoot as Jack was on the trail somewhere. But among the wreaths of streaming cold cloud two mature bighorn rams appeared in the field of my binoculars. Then they stopped and took a big detour uphill as they realized Jack was there. Later I came onto a big herd of elk in the drainage that I heard bugling and watched as they departed through the timber with a clatter of stones.

Sunday on our way home, we took a road I had not traveled before, closer to Montana and not visited by anyone but ranchers. We came to a cafe and stopped for some warm food. It was one of those joints where food was on

one side with mostly women and kids while the men were in the bar on the other. We entered to a busy atmosphere with lots of conversation. When they saw our long hair and beards, conversation stopped and people began to stare. We went to the counter and I was nervous. To say something to Jack and try to act normally I reached in my pocket and brought out two hand-loaded cartridges, one of which had the bullet pushed into the casing, put the cartridges onto the counter, and explained them to Jack. Instantly conversations started again; we were just hunters and therefore okay to be there and look like we did. Going out to head home, a pickup with two men pulled in and I could feel the antagonism. Rather than making more symbolic displays of bullets and guns, we quickly got into the car and kept watch to see if we were followed.

My brother Charlie was engaged for a few years to Sharon whom he met at Oregon State, and they were getting married in the Willamette Valley. My family took a slow trip, camping along the Metolius River, a beautiful stream where I did not raise even one trout. I had a recent haircut and trimmed my beard but did arrive in my usual worn clothing. That evening I met Charlie's friends, young men who had played high school football and didn't read newspapers, good guys but dull, except for one with whom I stayed up late drinking whiskey. He probably was gay, but no one seemed to have guessed that. Eventually he told me that Sharon's mother had met every incoming guest after I arrived with "Have you seen Charlie's awful-looking hippie brother?" That seemed a bit presumptuous and arrogant (she was a grade or middle school teacher, I recall), and I thought it was very humorous. The next day I wore my new suit and had the luxury of knowing why people were surprised at my neat appearance. My wife remarked that it was the most sexless wedding she had ever attended. It is not unknown for a man to marry a woman with certain resemblances to his mother, but it was unsettling that my brother had managed to find a woman who looked like his middle-aged mother (and not as his mother had appeared as a young woman).

Years later I wondered if such a supremely confident, uninformed, and judgmental approach to life such as Sharon's mother displayed derives from genetic inheritance or if it is learned behavior. Nature or Nurture? Probably, as with so many things, it is a complex combination of the two, but I lean toward nurture. When there are three generations of such smug behavior,

unblemished by doubt or introspection, it is clearly not just random. In our era of alternate facts, not much will jar a person from that self-reinforcing view of the world. Another example involves sporadic dark shouting anger in a father, son, and grandson. In that case it began with the father, lending support to an environment (nurture) explanation.

The Mathematics Department had a master's program and decided to put in a Doctor of Arts degree for students who wanted a terminal degree but who did not have a research career in mind. Chairman Hilzman pushed this and I didn't object much even though one of ISU's attractions for me had been the lack of a PhD program. I had some good students, including Dick Fritz, a statistics graduate student at Michigan State who refused to continue there for a PhD. Our friendship survived this in spite of the new roles. I made life-long friends among the ISU students. Roger Johnson and David Gilliam went on to careers in mathematical sciences.

The Mathematics Department did not have guest speakers but the Outdoor Program did. I met world-class mountaineers such as Yvon Chouinard and Galen Rowell. Maurice Hornocker gave a presentation about his pioneering mountain lion studies in the Middle Fork. Bill March wrote the first book on ice climbing and spent a year working for the Outdoor Program. He brought to ISU for two years Eric Ryback, the first person to through-hike the Pacific Crest Trail and the Continental Divide. In a talk he was negative and bitter about the Continental Divide in southern New Mexico, a place I was later to love deeply. Royal Robbins, the rock-climbing pioneer, gave a talk structured as an antidote to the notion that "the golden age of mountaineering is over." This was current opinion and shows how wrong we can collectively be. He gave examples where a little imagination could yield a splendid accomplishment, simply by taking advantage of what was nearby. This is how I felt about mathematics, and I gave a talk inspired by his, telling the Doctor of Arts students that they could find exciting mathematics to do that was right under their noses. Frank Lane with no PhD was the only member of the Mathematics Department ever to ask me what I was doing and listen to what I said. By this time I had published more papers than had been published in the history of the Department—less of an accomplishment than you might think. Frank was a great teacher, and even at his age he still was interested in mathematics. How can one spend a lifetime teaching something that just sits there? Not well, I fear. Would we employ people to

teach woodworking who had last sawed or planed a board in training school years before?

My wife Vicki had sat through ten years of our marriage most of the time doing nothing. She did minimal housework, prepared quick-and-easy meals and was not present emotionally. This was like her alcoholic mother lived, but Vicki accomplished the same thing without alcohol. She had wanted six children and I had wanted none. My reasons were based on my childhood misery and I am uncertain what her reasons were. When my daughter Tracey was born I discovered depths of real love and relished being a parent. Vicki later accused me of “stealing” Tracey from her—as if only one parent can have a deep and genuine connection with a child. After two years in Pocatello, Vicki started classes at ISU and did well. She was going for a five-year degree in microbiology, but during her second year of classes, I discovered she was taking speed to get going and sleeping pills to get rest, all under prescription.

I contacted the physician and the drugs were cut off then. Vicki had a collapse and spent a few months in bed, now absolutely inert. It turned out that she had been trying to show herself superior to my accomplishments, which made as little sense as did her view of parent-child bonds. I took over everything in the house along with my university duties and became tense myself. I had put research aside and at this point I wrote a couple of papers standing at a tall bureau in the basement. I was so nervous I could not sit down. One of the papers was routine and the other became one of my favorite papers, although no one has ever cited it. I loved the results, but when I looked at it recently, I saw that I never explained why it was such neat work. I clearly stated my objective and followed where that led, but I never remarked on what was then revealed. Oh, well. The paper was a few years ahead of its time too. I still am pleased with it.

ISU was the country cousin of the University of Utah which going by their Mathematics Department faculty had a high opinion of itself. One of our instructors Larry Kratz later got a PhD there and other faculty were hired from Utah. Kratz, an instructor Errol Green, and others collectively owned a cabin on the East Fork of the Salmon River. We’d sometimes go there for large gatherings. When their bridge was washed out, a big group got together to build a new bridge. I never thought anything useful would be accomplished (and nothing was), but it sounded like fun and I went with my family. Errol took a great photo of my daughter; Erroll had many talents, but drinking far too much, far too often, was near the top of the list. He told great stories, was a fine friend and everyone loved him. George Parker,

getting a master's in fine art, was in this crowd, and when he and I saw most people were sleeping off their hangovers, we decided on a hike. We picked out a peak and headed for it. It was a long steep climb up through a pine forest, and then we came out on an open ridge under the crags. Two nice mule deer bucks jumped off stiff-legged as if on stilts and I felt pretty good. Then we tried to get onto the top of the peaks. George, more of a technical mountaineer, got farther than I, edging along a narrow shelf against a high cliff. We returned to the cabin to find that Hilzman and another equally egotistical jerk from Utah had had an argument and a pushing match on the collapsed bridge, and Hilzman, toupee and all, had been dunked into the icy water. A few months after this George had an exhibit of his art for his master's degree. They were "fantasy landscapes." One of his artworks was a box with sculpted spun insulation. The title was "Climbing a Peak Near Pass Creek with Mike Waterman While Taking Acid." I had no clue.

Using my NSF funding, I attended a large mathematics conference in New York City in 1971 or 1972. The Russian Ibragimov also attended and after his lecture there was a long line of people to speak with him. At some point he became impatient and walked down the line staring at our badges. When he came to me he smiled widely, and we began an intense conversation. People from highly ranked universities stared, wondering why they were passed up and this important guy was talking to someone from nowhere! Ibragimov knew my name because John Kinney had made me send copies of my thesis to Russia. This inspired a student of Ibragimov's named Gordin to make a significant and important generalization of my work. While at Los Alamos I had guessed such a result was possible and included it in a grant application although I made no real progress in proving it. Gordin did not include any proof, and when I asked Ibragimov about it, he said he had failed to get Gordin to publish details. Later Ibragimov spent time at Michigan State and the University of Southern California, and we renewed our friendship.

John Hilzman was a proud chairman of the department and had a sleazy used-car-salesman aspect about him. He liked having, displaying and using power, although he had a low reputation within the university. John showed me off as an example of how great a department he had. There were two big struggles with the department in my six years there. The first concerned the reappointment of someone hired from industry. This person acted superior to the rest of us, and Hilzman in particular did not like him. When the reappointment came, I had a long talk with Frank Lane about the case, and eventually joined almost everyone in voting against reappointment. There

was a big fuss with a hearing and lawyers, but the university stood behind the decision. I am unsure how I'd vote today on the same case in the same place. Much later Hilzman decided that conversion to the metric system could take the math department into a triumphant future, and he created a course on the metric system for graduate credit. I could image about three lectures on this topic, three maximum at a high-school level, and this was the breaking point for me. I couldn't go along with such appalling academic behavior. I thought Hilzman's term as Chair would come up during 1975-76 when I was going to be on leave in Los Alamos, but alas it came up the year before. I had been asked by the administration since my first year at ISU to take over the Chairmanship and had repeatedly refused. But I could not support Hilzman to run his little ship any longer. Hilzman then assigned me to the worst office in the department and tried to make my life miserable, but there wasn't much he could do to me, such is academic life. Most of the faculty didn't talk to me as much, so things were less pleasant than in earlier years but again not much so. In the end removing Hilzman as Chair accomplished little, and this case, if I had it to do over, I wouldn't bother. Or would I?

During my final months at Idaho State, I served on a committee for a new library. The last committee meeting I attended was with architects who presented the planned artwork for the building, a generic and boring fountain to go in front of the building. "This is completely inappropriate. It just will not do," I told them. Men in business suits looked askance at my bearded long-haired presence. "Really?" they said. "Really. Do you wish to know why?" They considered my offer and smugly waited for me to say more. "Do you know where you are? This is not Lincoln Nebraska or Columbus Ohio. This is Pocatello Idaho." This did not enlighten them. "The Portneuf River runs through this town. According to the famous fur trapper Osborne Russell, the Portneuf was the best beaver stream in the Rockies. Just downriver is Fort Hall sitting on the Oregon trail. The British sent people to tell the pioneers to go to California, not Oregon, that the Blue Mountains ahead on the way to Oregon were impassable. They got enough folks to change course that the US gained both California and the Oregon Territory. For god's sake, make us a work of art that shows this great history, not something that would go unnoticed in a midwestern mall." Our visitors were speechless at my plea, and while they eventually said they'd consider it, of course ISU did not get anything that reflected its grand setting.

Having had a manual labor childhood with an unpleasant and critical father, making my way through college with no support from my family, finally getting a PhD, I came to Idaho without having taken much pleasure in life. In Idaho I had minimal pressure, great friends, and a landscape and trout streams from my dreams. Years later someone told me that the most determining factor for success in a research career is the rank of the school of one's first job. He was astonished that I started out at Idaho State University. I came alive in Idaho to experience the happiest years of my life. It was a timeless period, like a summer when you are a child, over in an instant or did it last forever? I was so happy that I did not register time. Just watching the snow blow in, the river flow by, the mule deer take the high ridge in the sagebrush. Limitless skies, endless stream banks. My birth certificate says I was born in 1942 in Coquille Oregon. Actually, it was the fall of 1969 in southeast Idaho. *Famous Potatoes!*

The Day I Met Temple Smith

On the Occasion of His Sixtieth Birthday, March 1999

I was an innocent mathematician until the summer of 1973. It was then that I met Temple Ferris Smith and for two months was cooped up with him in a dark office at Los Alamos National Laboratories. That experience transformed my research, my life, and perhaps my sanity.

My first job after receiving a PhD was at Idaho State University. The first summer I spent at Los Alamos, and then I had three summers with NSF grants for work on iteration of functions. But by 1973 I had burned out my mathematics funding and was invited by Bill Beyer at Los Alamos to join an NSF-funded summer project to study the mathematics of molecular biology and evolution. Stan Ulam and Bill had begun this work already and someone named Temple Smith was to join us. Temple had already worked with these people, and although he had a PhD in physics, he was considered by Bill and Stan to be an expert on biology.

At the Labs biology was intellectually isolated from the “real thing” much of which was physics and explosions. To emphasize this distancing, the life sciences were in a building across a deep canyon from the Laboratory complex and remained there for years. It was a physical expression of the lack of prestige biology had at the National Labs. I recall walking on the bridge high over the dramatic cut through the mesa to attend the first biology lecture of my life. Mind you I don’t follow much of a serious lecture in mathematics, but this was of another order. I just didn’t get it. Then the lecture ended, the audience drifted away, and Bill Beyer introduced me to an incredibly intense character, Temple Smith. Even then he had a mustache, and we both had more hair on our heads than we do today.

Temple was from a small university in Marquette Michigan which was

as isolated and anti-intellectual as my own in Pocatello Idaho. He was not happy there and had come to New Mexico to do some earth-shaking research that would spring him from the Upper Peninsula of Michigan. So he had a lot at stake. I didn't know these things at the time, but anyone could see that he was so intense that sparks seemed to be coming off him.

After Bill introduced us he said that we should get organized. At this point Temple took over. He was as short as Bill was tall, but suddenly he seemed to be the only one doing anything. He pulled a little blackboard from behind a dusty curtain and started lecturing to us about biology: what it was, what was important, what was going on. It made quite a tangle to someone who knew nothing. Somewhere in there by implication was what we should work on, but if truth be told he didn't know what that was either. He was exerting his substantial will in order to make something happen. I was totally confused. Temple spoke loudly and rapidly, and so far as I was concerned, he could have been speaking in the language of one of the pueblos from the Rio Grande Valley below us. Amino acids, PAMs, Jukes, hydrophilic, nucleoside, beta pleated sheets. What were these things? Where was the mathematics hiding?

Temple went on and on, working off a winter's claustrophobia, dispelling Marquette and its lackluster students. Bill was a patient man, older than we were and he had been one of those kids who was interested in science in high school, in today's language a nerd if ever one did exist. Occasionally he would try to make sense of something, but there was no stopping Temple. The contrast between Bill's high squeaky voice and Temple's booming barking roar was remarkable. Each of Bill's interruptions deflected Temple in a different direction. I sat there in an awkward uncomfortable metal chair wondering what the hell I had gotten into, vowing if I ever got back to the mountains and trout streams of Idaho I'd never leave again. I wish I remembered how long Temple went on—it seemed forever.

Later we settled for the summer into that little window-less office behind the security fence, and I learned enough to help formulate a few problems. "The right problem" is still the key to our business, and we did make sense of some things. Two papers came from that summer: one on sequence alignment and one on molecular evolution. Unlike today with more rapid pathways to publication, they did not appear until 1976 and 1978. Both are still quoted although I doubt that many people read them anymore.

Bill Beyer tried to bring more biology into the project and he choose an Indian geneticist named Singh. This man didn't have a security clearance,

and we only met with him once or twice a week. He had the narrow focus of a classically educated British geneticist and never knew what we were trying to do. Of course we did not know what we were trying to do either! But Bill agonized over his exclusion, and repeatedly sighed, “Poor Singh. Poor poor Singh.” We listed Singh as co-author of one of the papers, but it was for Bill more than for poor Singh. Bill wore a salt-and-pepper crew cut in a style that had been out of fashion for 15 years and was not to come back into fashion for another 15 years. Bill never blinked in matters of style and was there waiting when crew cuts were again cool. In my opinion the National Science Foundation got their money’s worth with that grant; they should draft a memorandum of thanks to Bill Beyer for pulling it all together.

I don’t think Temple had on his western wear that first day, but I want to end this by saying something about those clothes. He wears boots and a big hat and gripper-snapper shirts, and he imagines himself to be dressed like a cowboy. People from Paterson New Jersey and Toulouse France think so too. For those of you not from the rural American West, I can assure you that he just doesn’t pass. Once while I was sitting in a Santa Fe hotel lobby with a woman from West Texas, Temple came through in that get-up. “And what the hell was that supposed to be?” she asked me, quite startled. But Temple is more of a Westerner than I’m making it sound. If you sleep enough nights under big Western skies, carry packs over enough miles of trail, scale the North Face of enough mountains, you do become a Westerner. It is just that with the West as with Biology, Temple Ferris Smith has taken a traditional activity and then has come up with his own unique creation. We wouldn’t have gotten here without him!

Skiing the Sun

It is a bright August morning in 1970 on the mesa at Los Alamos, early enough that the thunderheads have not yet gathered over the mountains as they surely will in a few hours. My square-back VW is stuffed with family, clothes and camping gear. I have just come over the bridge from the townsite to get the books and papers I have accumulated during the summer. We are set to drive back to Idaho. I pull over beside the road and get out of the car. I do not expect to set foot on these mesas again, so this is a last look before I drive back to my future, Idaho. I have that all wrong.

The title of this chapter comes from a 1970s slogan advertising New Mexico that referred to the fact that the New Mexico climate was so good that people did not need to ski in bad weather. Coming from Idaho where there was not much sunshine in winter, I was struck by the reluctance to venture outdoors in anything but ideal conditions. Then there is an obvious connection to that incredible ball of fire when the atomic bomb exploded at White Sands on July 16, 1945. Throughout the twentieth century, a complex of nature, cultures, science, and circumstance brought creative people to New Mexico to ski the sun.

The atomic bomb was developed on the remote mesa of Los Alamos in the crash effort of the Manhattan Project during World War II. Being 35 miles from Santa Fe gave an advantage of nearby culture, and the Lab was known by its PO Box Number 1663 during the war. The military leader of the project, General Leslie Groves, said that he was stuck up on the mesa with all those prima donnas. Groves, impatient with the scientists, was a crucial component of the project's success. And I suppose prima donnas they were, all that intelligence, everything that was at stake. When I came to the mesa in 1969, there still was a guard house at the entrance, and I had to declare the purpose of my visit. The town was truly dull and boring, filled with scientists and their families, with more churches than bars since many

people did their heavy drinking in secret at home.

I heard a story of two Laboratory employees who went to the far end of the Jemez Mountains to hunt deer. They had a camp, and when they left it for some reason, their rifles were stolen. I imagine them a pair of intense physicists who hadn't yet figured out why the athletes got the pretty girls in high school and college or why some dumb guys were rich and they weren't. They resent those things and compensate for example by doing their own complicated income-tax forms, reading those dreadful volumes of rules and regulations, saving themselves paying a professional, neglecting to calculate their return at this task which is far less than minimum wage. So these men saw tracks in the snow leading away from their tent, and they played Kit Carson following the trail to a shack. A Chicano answered the door and refused to speak English. Eventually the man brought out a gun to defend his home against the surly gringos. One scientist was killed and the other badly wounded, so the story went. I do not know whether the Chicano was guilty of the theft, nor whether he was convicted of murder. That was not in the story which may not even be true. I often fantasized that a quiz should be given to Lab people, and if they fail simple questions such as what to do when the other party is armed and they are not, then they simply should not be let out of the township of Los Alamos. The imposition of the Laboratory onto northern New Mexico was and is both a blessing and a curse; a blessing in that it brings employment and services to an incredibly poor region of the US, a curse in that it has disrupted culture and ownership practices of the last few hundred years. However that disruption is tiny compared to what occurred to the Native Americans when the Spanish themselves arrived in the 1600s.

To enter the Laboratory one needed a security clearance (Q or top secret) and a badge. Heavy bodied Chicano men at the entrances looked at and tapped approval onto the badges with their index fingers. My clearance came easily since I had received one for my Livermore summer. Otherwise it could have been a problem, because it would have been easy to discover that I had on many recent occasions smoked marijuana. Past the guard, one was "inside the fence," and surprisingly I liked it there. One aspect, weird to me, was that every letter, incoming and outgoing, was read and copied. But I loved the amazing library that had been accumulated so that science could be done on a remote mesa in one of the poorest states in the country. And the scientific atmosphere was wonderful. It was a given that a chemist such as the guy in the office next to me could tell a mathematician

what he was doing, and the mathematician could communicate with the chemist. There were no apologies for being too abstract, too technical or not practical. Los Alamos set my notion of an interactive scientific environment, but from Idaho I brought the idea of a liberal arts institution that was a connected interactive community. In Los Alamos I missed having the folks in the English or History Departments around to talk with. Those people would have significantly improved the sterile life in the town.

Listen carefully to the next words: “Hello.... This.... Is.... Bill-Beyer” with the pauses inserted. Many people at Los Alamos picked up the telephone to hear exactly that. The first time for me was when Bill invited me to Los Alamos Scientific Laboratory to speak in the fall of 1969—I had a fresh PhD and it was my first invited talk. John Kinney, Bill’s advisor at Penn State, was also my Michigan State advisor, so we had shared ancestry. My thesis referenced C.J. Everett at Los Alamos so during my lecture I tried to guess which audience member was Everett. When I asked Bill after the lecture, he said with amazement at such ignorance, “Why C.J. never comes to any talks!” Along with his legendary computational skills, C.J. Everett was famous at the Lab as a recluse, while none of this was known off the Mesa.

I returned the summer of 1970 on support from Associated Western Universities to carry out some computations related to my thesis. Then I came to know first-hand Bill’s extreme care; he took nothing for granted and often would go back to incredibly basic material and slowly incrementally work his way forward. The idea of my project was to capture by numerical methods the elusive equilibrium distribution for two-dimensional continued fractions. I had become fascinated in graduate school that I could simulate the corresponding distribution for one-dimensional continued fractions. This distribution was famously discovered by Gauss and not news to anyone, except that a simulation could come close starting from binary numbers as represented on a computer was not obvious. Fortunately I later found that the pioneer computer scientist Don Knuth had come up against the same issues; this gave me confidence that I was not alone in asking these somewhat weird questions. The two-dimensional case was much more difficult. In Knuth’s books he listed problem difficulty on a scale of 1 to 50, 50 representing the most challenging, such as Fermat’s Last theorem. He had one 50-point problem on algorithms for greatest common divisors of three integers, linked to

two-dimensional continued fractions. After one of my papers the problem was listed at reduced difficulty 38, but alas he removed the problem from his book in later editions. I never gave a public lecture on my results. For me these computational connections with pure mathematics were important and motivating. Firtz Schweiger wrote a nice book in 2016 about continued fractions and f -expansions but it included no references to computing. The times, they have changed but not everyone has noticed!

The computer I used was amazing. One of the first computers in the world was the ENIAC in 1946. At Los Alamos a team led by Nicholas Metropolis in 1951 built a computer called the Mathematical and Numerical Integrator and Calculator: the MANIAC. In the early 1970s there was the MANIAC II. There were supposed to be two manuals of instructions on how to use it but they had vanished by my time. You learned to code by reading other codes and just doing it by trial and error. Programs were stored on paper tape with holes punched for the code. And integers of any size were accommodated. There was a speaker that sounded as the vacuum tube machine did its work. When I ran my program for the greatest common divisor of large integers I could tell by the sound if it was properly executing my algorithm. What fun! I wanted to record all the standard mathematical algorithms.

Let me illustrate Bill Beyer's stubbornness. We needed a sequence of digits for our work and instead of using boring digits produced by a random number generator—which Bill knew were not actually random—I suggested using the digits of my favorite number, Euler's constant. Bill came to ask, how do we really **know** the 300-th digit we have computed actually is the 300-th digit of Euler's constant? It was evident that we did not know this with certainty, but I countered that since almost nothing is known about Euler's constant, who cares? Of course we then launched into a project to produce the correct digits, guaranteed. And we even published a paper of our analysis. We held the Digits-of-Eulers-Constant record with over 7100 digits for two years. Then I received one of those famous calls from Bill. Not only had an Australian named Brent done over 14,000 digits, but we had an error that came about halfway through our 7100 digits! Eventually we found that with about 50% of the runs on the MANIAC computer that still used vacuum tubes a bit was flipped and from then on the "exact computation" was not exact. We had been so confident that we had made only one run which took hours.

I am at heart and practice a much sloppier mathematician than Bill, but I was to learn that many parts of every paper we wrote together was improved

and influenced by his care. There would be long pauses after which Bill would say, “Well, I really do not see why that is correct,” and often enough it would not be. I was a trial to him, but Temple drove him to distraction, as they say. Temple’s intuition opposed to rigorous mathematics was hard enough on Bill, but his arguments were often based on almost nothing but optimism, hope and momentum. This made it difficult for Bill to get any traction. And Temple’s prose could be overblown and frequently did not make sense if one read it literally, the only reading of which Bill was capable. “Smithisms,” Bill would say, “we must remove the Smithisms.” Bill said that on every page of every paper and book of mathematics there was an error, from grammar and spelling to deep mistakes in reasoning and logic. He would open a book and choose a random page to illustrate his point. He knew the assertion was hyperbolic but it is true more often than we would like. Stay awake!

In 1972 I was given a clue about the coming crisis that became known as Watergate. Frank Church, Idaho’s liberal senator, was in Boise and on public radio he said, “Watch this Watergate situation. It is not getting much attention yet but it is going to be big.” Then in 1973 I was in New Mexico when the Watergate hearings started. I came home to watch it on television, mystifying my daughter as to what I was doing because I never watched television. In 1974 in Santa Fe, Bill Beyer and I were taking a visitor to dinner at the Compound restaurant. There was John Ehrlichman being escorted to a private room. When I said something, Bill was concerned Ehrlichman might hear us. “Hear me hell, he committed the crime and he’s the one going to jail. Criminals get special treatment?”

During my various summers at the Lab I was a dedicated backpacker. Bill became curious about that, and eventually he and his son Tom went on a hike into nearby Bandelier National Monument. I loaned them a light tarp in case it rained. I confess I loved my blue tarp. Bill reported that they had not needed it for rain but that he’d found a fine use for it as a ground cloth to keep off the rocks and dirt. Fortunately they didn’t put many holes in my rain shelter! But most notably for me, Bill returned from his experience in nature repeatedly to ask me, “What are you supposed to think about out there? What do **you** think about?” I did not possess a good answer. Tom said years later that I had told his father that I made close observation of nature, and that had satisfied him. I can believe I said it, but not that it was a completely satisfactory answer to Bill.

Mexican food did not exist on the Oregon coast but I had enjoyed tacos and especially cheese enchiladas in the San Francisco area. Metropolis and other old hands recommended the Rio Grande Cafe, a small unassuming place at the edge of Española. Indeed it was both homey and exotic to my eyes. But while my wife ate the spicy food without any difficulty, I found my mouth so burned by the first bite that I could not go on, try as I did. Each stay in New Mexico I tried the local food which so many people praised, and it was not until the third summer that when I took a bite I could recognize flavors, not fire. Then I learned to love the red-chile green-chile culinary culture of New Mexico. The earthy almost musty red-chile enchiladas on a cold snowy Santa Fe day, the vibrant green-chile stew which cleared out the sinuses. Part of the New Mexico charm is the vivid unique Mexican food.

The summer my daughter Tracey was five she spent in New Mexico. I was reading the Laura Ingalls Wilder series to her and Tracey loved it. One night she said to me, "I wish I could read it myself." I looked at her and said that indeed she had all the basics, she knew letters and sounds, and that she could do it if she would work hard enough. She was ecstatic and the following night we began the next chapter in the book. It took a while to go through the chapter but for the one following that I just watched as she stumbled along. After that I was not needed, and she raced through all the *Little House on the Prairie* books, and then reread them. Returning to Idaho I recalled my painful lack of reading material as a child and bought a box of 100 paperbacks from some publisher. The books went from elementary to high school level. Within a year Tracey had read most of them. This was before she started first grade.

In the critical summer of 1973 Bill Beyer brought Temple Smith and me to Los Alamos to work on an NSF grant. That summer is described in the Temple Smith chapter previous to this one. It introduced me to a new subject and to Temple, both to have a significant influence on my life. I had avoided biology in school, not for lack of interest but because the classes seemed long and boring, lacking the precision and depth of chemistry, physics and mathematics and involving extensive memorization. I loved the natural world but avoided studying biology. But that summer we confronted a large data set of 27 cytochrome C protein sequences from different species. This statement causes my students to laugh but a large data set is scaled by what is known at the time as well as the standard methods to analyze it. There

were no standard methods. Cytochrome Cs move electrons in cells and are an important and ancient invention of living organisms. The approach was to look at the sequences to find which were closest and so on, to infer a family or evolutionary tree of their relationships. “Looking at” or comparing sequences had to be done with a rigorous computer algorithm. At least that was what we believed.

The method of comparing sequences has its origins in a simple picture of relatedness, done letter by letter. For example to compare the words **WHAT** and **WHY**, we can arrange them in what is called an alignment.

WHAT
WH-Y

In this display we are asserting that the letters **W** and **H** are present in these positions in the ancestral word from which these two words evolved. For the letter **A**, either it was present in the ancestral word and was deleted in the derivation of **WHY**, or that letter and position was absent in the ancestral word and was inserted in the derivation of **WHAT**. The last aligned pair meant that **T** evolved into **Y** or the reverse. This is a naive picture of sequence evolution and it is still amazing to me that it has proved so useful.

It is the deleted and inserted letters at unknown locations that make alignment a challenging computational problem. Temple who gave the project biological insights told us that deletions and insertions occurred with blocks of letters, instead of one letter at a time. The data supported this statement. We started from the dynamic-programming algorithms David Sankoff and Peter Sellers had published, and we created an algorithm that included such transformations at increased computational cost. I knew no modern biology except what I learned from this project. My wife was studying microbiology and I was wary of intruding on her territory. Still the stories Temple told us were fascinating. The fact that informational molecules were coded in the genomes in a linear scheme had been known since 1953 with Watson and Crick’s celebrated discovery of the DNA double helix, but now we were taking advantage of that linearity using computers to study the genetic texts. I had no idea that I would spend the remainder of my scientific life working on these and related problems. One feature of working with Temple who provided the biological facts and insights was that his assertions were not always accurate. I have a low tolerance for those who tell falsehoods, and for

some time wondered why I put up with it in Temple. I'd ask him repeatedly, "Is that true? Is it really true? Is it really really true?" But Temple was not telling lies; he was just saying things he wanted to be true, wanted them so intensely to be true that he believed them. This was one situation where "it's not a bug, it's a feature."

Our first paper was rejected by what we thought to be an appropriate journal, and the experience was frustrating. We were working on problems that did not have a large following and in a general field, mathematical biology, where the work was often either mathematically flawed or biologically irrelevant, often both. Bill proposed a journal called *Journal of Mathematical Mathematical Biology* where the mathematics would be correct. I came back with *Journal of Biological Mathematical Biology* where the results were relevant to biology. We had a series of bad jokes where a string of adjectives to Mathematical Biology were chosen from the set {Biological, Mathematical}.

Peter Sellers at Rockefeller University was working on these problems, and one of his papers gave me my beginnings into the area. Peter was a Quaker, and at Los Alamos he was said to be the richest mathematician in America. In Maine he built a wooden sailboat with hand tools. Rich or not, he was a gentleman in the truest traditional sense of the word. Peter commuted to NYC on the train from Philadelphia where he lived in a row house filled with his family and books. His classic blue Brooks Brothers shirts were threadbare at the collars and he had no pretensions. Peter had spent time in Africa working for the Peace Corps, and he would glow when he talked about Africa and native Africans. Peter was our main competitor for some years, but there was never any incivility or lack of support for our work.

Idaho, it was increasingly clear, was not a place for an active research life, and my daughter was running into problems attending schools with a Mormon majority. Los Alamos was the obvious place to go next and fortunately there was an opening in the statistics group. I preferred being in the statistics group rather than the mathematics group—the statisticians had real data sets to study and had more of a service component. I have always preferred having a job with at least some explicit duty such as teaching. This gives one something to do when research is not moving along, but the sense of worth from teaching is also important as well as the great learning experience for the teacher. Also with the energy crisis of the early 1970s the Lab was going into energy research in a big way. Given my deep convictions about environmental matters, derived from my ranch life, the chance to work

on energy problems greatly attracted me. And Los Alamos was a good place for someone with drive and ambition. It could set me up for a move to a better university; few people left a school such as Idaho State and moved to a better-ranked university. I was approached by the Illinois Institute of Technology and the University of Southern California, but I thought Los Alamos would give me the most options.

In 1975, my first year at Los Alamos as a full-time employee, I wrote approximately one research paper per month. The longest of them was the first solution of the RNA folding problem. Single-stranded RNA molecules fold back on themselves and form base pairs in a secondary structure. Charles Delisi, a biophysicist at the Lab who was to play a crucial role in the Human Genome Project, told me of the problem of predicting secondary structure which he thought I could contribute to. The state of art, recently published in *Nature*, was to make a matrix and put in dots where base pairs could occur. In other words, almost nothing was known. It was time to learn the science and I devoured a little book *The Biochemistry of Nucleic Acids* first published in 1950, but revisions have kept it up to date. It was known as “The Child’s Guide to Nucleic Acids,” and I carried it everywhere. I fell in love with these structures and was able to define the objects of interest and formulate basic problems needing to be solved, some of which I settled in the first paper. Later on I worked with Paul Stein at the Lab to count the number of confirmations such molecules could take on. It was a dream subject and I knew my good fortune to have found myself in such uncharted territory. I had always wondered what it would be like to lay out a new area of mathematical inquiry, to define novel objects and create or discover new mathematics. And would it feel like creation or discovery of what already existed? This is just a mindset, but for me the objects were there already and I was delightedly wandering the unexplored landscape, documenting what I found.

In the 1980s I mostly stopped working on RNA structure. Many people entered the area but not much genuinely new was discovered. A 1994 paper with Bill Schmitt finally proved an identity that Paul Stein and I had discovered but couldn’t solve. It used a mathematical device called Poincaré duality. Bob Penner was a colleague in the Mathematics Department, and we took annual fishing trips on day boats out of San Pedro. Bob works in Teichmüller theory, and on the windy slippery decks of the boats, we sensed a connection with my RNA structures. The resulting paper, along with the one with Schmitt, was at the beginning of an explosion of bringing mod-

ern geometry and topology to RNA structures. The beautiful mathematics of RNA structures has moved into three dimensions with the work of Bob Penner, Christian Reidys and many others.

When I moved to Los Alamos, the frequency of John Kinney's calls and letters slowed considerably, confirming my suspicion that John had been concerned about my well-being in Idaho and wanted to keep me in touch with mathematics. Bill Beyer and I convinced him to visit Los Alamos the summer of 1975, and after dinner at my house, John and I smoked and drank far too much wine. The next day I got up late to a phone call from Bill Beyer who asked, "Whatever did you do to John Kinney last night?" Some questions are best left unanswered.

After I was at Los Alamos, I ventured to John Kinney that I was doing other things in research and was unlikely to work in function iteration anymore. "Don't know why you should," John answered. Some people are upset when their students leave the path they have been set out on. Instead John was always interested in what I was doing, especially with computers and biology.

The statistics group had several times moved organizationally, probably because there was not a traditional place to put it. One wonder of the group was Cheryl, a young woman who was the talented secretary for over 30 people. She did everything, even finding places for me to stay during complicated overseas trips. She is another example of the critical need for excellent support staff. Another was Dixie Hanks, my assistant when I ran the USCG projects in 1980-81. My style is to shove everything on one topic into one folder, and although the USCG project had a dozen people working on it, there was just one bulging folder. Dixie was shocked at this disorganization, and with no deep understanding of what we were doing, her redo on the file system was perfection.

The boom in energy work had the group expanding as it moved from T-division to Q-division to S-division. The various names included C-5, T-1, T-13, Q-12, S-1. Since my time the evolution continued: A-1, TSA-1, D-1 and CCS-1. While we were S-1, in the acknowledgment sections of our papers, many of us thanked S. Juan for his assistance. I think this came from Dick Beckman; no administrator caught on to the S-1 joke. One of the delights of the group was Keith Ziegler, who may have been the first statistician in the Atomic Energy Commission. Keith was approaching retirement, and he had that bit of crust that made it fun to watch him operate. He would come to someone like me and announce that he had a question. Then he'd say what

it was. Sometimes he knew the answer and was checking to see if I was up to snuff; sometimes he thought he knew the answer and wanted support for his ideas; finally there were times when he had no clue as to the answer and he was searching for any reasonable idea. After I saw the scope of his “I’ve got a question for you,” I enjoyed interacting with him very much. Gary Teijan was raised on a ranch southwest of Socorro, and since that was country I knew a bit from my Gila Wilderness walks, we had a lot to talk about. Dick Beckman was without doubt the best statistician in the group, and I learned from watching him approach data.

The group’s expansion included economists including Greg Mann and a geographer Randy Provan, so the intellectual dimensions of the statistics group expanded also. Greg taught me how to read certain papers: go through the paper and mark all assumptions in yellow, then mark all conclusions in red. Then see where they overlap! But the Labs’ close association with physics led to taking seriously a book by Georgescu-Roegen, *The Entropy Law and the Economic Process*. The closer I looked into the ideas, the less content they appeared to have.

When I visited Temple Smith during his sabbatical at Yale, I opened a recent copy of *Nature*, and there was an article on the Olduvai Gorge, where Leaky found his human fossils. There was a sequence of strata on each side of the gorge. It hit me that inferring the relationships between the layers of strata was sequence matching, just what we’d been doing. The idea is that the strata should once have been continuous across the gorge and might on one side have been removed by erosion or on the other side a deposition occurred. The task was to relate the geological records on each side of the gorge, just like matching letters in genetic sequences. I showed the figure to Temple and he immediately got it. We talked excitedly, and walking to lunch, we saw a display in the geology department which further encouraged us. There were colored ribbons connecting strata, the missing parts from erosion looking more and more like the deletions in our bio-sequences work. After lunch we went to see the Yale Geology Chair, and he knew that the state-of-the-art in geology was elementary, saying, “No, that is not really a solved problem.” Later we found that insertions and deletions, so frequent in geology due to spotty deposition and erosion, were not included in the current methods. We wrote a short paper and contrary to our experience in biology where our work was uniformly rejected at the big journals, our paper was soon accepted in *J. Geology*.

Later at the Lab I had a joint project with Robert Raymond, a bright

geologist. We extended the methods to accommodate more sophisticated geological processes. We had a PhD computer scientist who was our programmer. She didn't contribute anything except to translate my formulas into code, and even that was not smooth. Temple helped correct some of her programming. We had not published when I left the Lab, and the project was inactive for a couple of years. A friend called me to say Robert and I had been scooped, and when I looked up the paper, I found that our programmer herself had published a paper of our work without mentioning either of us. I talked with Mark Kac and Gian-Carlo Rota and their advice was to let it go. Any public accusation would harm us at least as much as the guilty party, they said. I could have destroyed the woman's career as she was still at the Lab, but that was not appealing. Instead, when Robert and I published our work, I included the following in the acknowledgments: "The authors are apologetic that they have so long delayed reporting these results and are grateful to ***** for publishing some of our preliminary results. As reported in her paper, she translated an earlier version of some of these algorithms into FORTRAN." This did her no harm and gave me a satisfactory way to achieve closure on the disturbing incident.

Living in Los Alamos, my daughter was happy at school. The other kids were smart and motivated, and all of the parents worked at the Lab, so she fit in as she had not in Idaho. My wife had received medical technologist training at Idaho State University and was working in the laboratory of a hospital in Española, a Spanish town down in the valley. Two incomes were nice, and now I cared for the house and my daughter almost 100%. That winter Esquire magazine advertised a Christmas feast, prepared at a few restaurants in the USA. The Compound on Canyon Road in Santa Fe was one of them, and the meal was the best of my life up to that point, amazing food and paired wines. But later that spring my wife became increasingly unhappy, and just after we purchased a new house of her choice in the bedroom community of White Rock, she announced she was leaving. Daily I argued against this, but at one point I saw an MD who told me I had high blood pressure. Walking across the bridge between the town mesa and the Lab mesa, at the beginning of the crossing I was nervously thinking how to save my marriage. By the middle of the crossing I thought that my health was too important to destroy. As I exited the bridge onto solid land, I resolved to fight the divorce no longer. Even though I was my daughter's principal parent, in 1976 there was no way

a man could obtain custody, and after my wife and daughter went to the west coast, I was left wrecked, much worse off than I could have imagined. Nothing seemed important and my work slowed. My life had steadily improved, from grade school to high school to undergraduate school to graduate school to my first job. Now it had crashed. I drank and smoked marijuana as often as possible and lived a different life when I was not at the Lab.

I am not religious and didn't have that to support me during this empty period. Drinking and smoking only dulled the sense of my failure and I was struggling. One night I walked along my bookcases and wondered, in all this stored knowledge and wisdom, was there anything that could be useful to me? The only book that helped was a paperback *Collected Poems* of James Wright. Wright, alcoholic and deeply depressed, had looked into black emptiness and reported back in poems that I thought were incarnations of Tang Dynasty poetry into mid-century America. "Where is the sea, that once solved the loneliness/ Of the midwest?" Wright had a working-class background, and it was visible in his work, probably helping make my connection with him. See for example "Autumn Begins in Martin's Ferry, Ohio." One of his best-known poems describes lying in a hammock at William Duffy's farm in Minnesota. Robert Bly and others have criticized the last line

I have wasted my life

and suggested it would be a better poem without that final line. The first time I read the poem this line was a shock, the peaceful rustic scene shattered. I went back and read the poem again, one time, two times, three. The words chicken hawk are a warning—Wright did not use red-tailed hawk or Coopers' hawk but instead the rural term "chicken hawk" which is a prefix of "get the gun" and implies a bird that slaughters barnyard poultry. One of the most famous poems in the world is Basho's haiku where a frog leaps into a pond. Wright's poem without that final line would be like Basho's haiku missing the frog, the frog that jumps in to create all those ripples and waves. Wright had been there and survived; by the time of my troubles he had found his Anne and sobered up. "J'ai perdu ma vie."

My office partner was Tom Bement, a pleasant conservative statistician. I came to work with hangovers and Tom was sympathetic. I was a window to experiences he had only faintly heard about. One day he was telling me about a problem with the analysis of data gathered by flying an aircraft in straight lines across vast amounts of country. Tom needed a way to locate intervals

of the data that had high variability. Hearing his description, I told him I knew how to create a good solution. He was skeptical, but I soon convinced him, and the funding agency (USGS) was pleased. Tom and I became close friends, and as his brother Rob was building Tom a house in White Rock, I also became friends with Rob who was a rough contrary person. I may be the only person who was friendly with both. Then I made trips to Colorado where their parents lived. Bob and Thema Bement were warm smart people who took me into their family when I needed one. I shall never forget their kindness. The next winter Tom had a bare house without siding; Rob had gone back to Colorado. Tom complained about his house problems when I told him they sounded easy enough to me. He was shocked, and I told him that I could not solve my own problems, but his could be taken care of, one board at a time. Do that one board enough times and you are done, I said, and that's just what he and I accomplished in nights and weekends during the next months.

Tom and his wife Judy had two children, Jenny five or six years old, and Matthew who was older. Matt was at the center of his father's eye and Jenny was unnoticed. Not unloved but unnoticed. Surely due to the loss of my daughter and my experiences raising a girl, I had a vital connection with Jenny, so strong that even her father noticed. I made two photographs of her, one in midair tossed up by her father and the other where she is looking intently at the photographer. They were such good pictures that Judy's conservative parents looked right past my appearance to tell me repeatedly how great the pictures were. Later, when I was living with Sandie Douglas and her children in Santa Fe, I brought Jenny to my home for a day. At first she sat quietly on the sofa, but then she took part in the swirl of activities. When it came time to take her home, she asked if she could come again. I told her she was always welcome on my home, anytime. What an effect environment has on children....

Here are two descriptions of alcohol and Los Alamos. On July 16, 1945 the first atomic bomb exploded at White Sands in southern New Mexico. While it was top secret, I heard that when the explosion came, there were many cars parked along the highway from Albuquerque to El Paso. One of those people may have been a guy who loved his martinis dry. For the record a classical martini has gin and vermouth, with perhaps an olive or two in the glass. A dry martini has minimal vermouth, perhaps 1 part vermouth to 8 parts gin and sometimes even less vermouth. Well, our dry martini lover is said to have strapped a bottle of vermouth to the bomb which was

subsequently vaporized. Thus a New Mexico dry martini is made by just pouring the gin into a glass. It picks up molecules of vermouth from the air. But I also learned how to make atomic bombs using the following recipe: Take a frozen container of orange concentrate. Dump it into a blender with equal volumes of beer and vodka. Run the blender. The resulting concoction is an innocent-tasting drink which is quite powerful. Who says Los Alamos Laboratory has not contributed to high culture?

Driving down a twisting road in the Jemez Mountains with Terri Devine, we came to a sports car in the ditch. We brought the couple back to Los Alamos. Bob was the son of the family that owned North American Van Lines in New Mexico, and he'd been sent to Los Alamos from Albuquerque to turn around the operation there. Bob and Libby, his wife, were grateful to us, which began a long friendship. They were hot-air balloonists and planned to take us flying. The morning we were to go, I had my usual hangover and never intended to go anyway. But Terri pushed me out of bed and we drove to Española, a town I had a grudge against from my divorce.

Laying out a hot air balloon is a lot of work and then it must be inflated with a fan and by heating the air. Bob then insisted I go up first. I never meant to get in as I have an intense fear of heights. Later I understood that before daybreak the air is most dense and the balloon has more lift, so the heaviest passengers ride first. But there I was in a beat-up wicker container, slightly larger than a laundry basket, rising upwards with the roar of gas burners. My hands gripped the basket desperately, and I was cursing myself for weakness of character, saying to myself, okay when I get off this thing, if I get off this thing alive, I'll never do something this stupid again. Then Bob turned off the burner and there we were, suspended in crisp clear pre-dawn New Mexico air, the town completely silent below us, dogs slowly crossing yards and smoke rising from the few fires going that early. It was a revelation and made me an enthusiastic balloonist for many years. I evolved into the person who drove the chase vehicle, an old bread truck with room for people and the balloon, to track where the balloon was drifting in the wind and be there when it landed. It was necessary to have permission to enter private property, and I became adept at asking Spanish households if we could land in their fields. Cool low-riders, arms covered with tattoos, would drive up and want to know what was happening. Even they would talk with me, something they'd never have done in normal life.

Through Bob Russell I met Prudencio and Gloria Garcia who lived in Albuquerque, and Prudencio so closely followed the meaning of his name that he had exactly one gringo friend, Bob. When I met him I noticed that he had a Ford pickup like I did, and I said "I thought you guys only bought Chevys." This got his attention and I knew it might cause him to lump me in with the rest of the white folks. But instead I became very close to him and Gloria. Old Spanish families in New Mexico greatly resented Anglos; somehow I slipped across that barrier. They shared that they were unable to conceive a child, something unbelievably personal and private. Prudencio had an uncle with a large ranch that he wanted sell to a relative. We went to look at the place and discussed buying it. I had dodged buying an Idaho ranch, and I knew I would not stay in New Mexico so I did not go into partnership with Prudencio, once again avoiding ownership of land. The Gracias revealed a dimension of New Mexico I had only dimly sensed and are among the most genuine people I ever met.

My love of wilderness hiking had vanished during my divorce troubles, and to re-establish contact with that, I took a solo walk the fall of 1977 along 70 miles of the continental divide in Colorado from Silverton to Wolf Creek Pass. The trail went below 11,000 feet once in that distance and threaded among dramatic peaks with vast scenes below. It was a lonely place and I began to feel better. One of my occupations was counting elk, and once when I heard elk running, I squatted down to catch sight of them among the trees. Instead two pine martin, a rarely seen weasel, ran down the trail by me. I straightened up and, past me now, one of them stopped to look back. It seemed puzzled as to what I was. I read later that they are seldom observed and their breeding habits unknown. Pine martin are so agile that they can catch squirrels running in the branches of trees! I was sure that I had seen a male pursuing a female, otherwise they'd not have been seen by a clumsy human. Elk gathered, and the males were fighting for control of the females, whistling and grunting their bravado. The hike ended with a fierce rainstorm, and I felt it was a success, with many locations now on my list to visit in future years. One of those places was Ute Creek in the headwaters of the Rio Grande, where a hike the following year would bring on a mysterious chronic illness that almost ended my life. More about that later.

After I had sold the White Rock house, I purchased a small home in Santa Fe. Casa Alegre was the first subdivision in Santa Fe in the 1950s, and the neighborhood was diverse. When I was moving in, an older woman came out from the next house and asked me if I knew who was moving in. I said it was

I, and then she looked up and down my frame, not impressed by what she saw. “I am Mrs Delgato and I certainly hope you are going to be as good a neighbor as the last people.” With that she abruptly walked off. I didn’t see much of her for a few months until I had to dig up and replace my decaying sewer pipe. She came out while I was sweating and filthy in a deep ditch. She asked me what I was doing and listened carefully as I explained. I remember holding up a piece of the old pipe that had so deteriorated that I could tear it with my bare hands. Then she said she wished she were a little younger because that’s just what she’d do. Mrs Delgato and I became close, dear old Mrs Delgato whose Spanish ancestors had been in New Mexico for hundreds of years, and me a bearded gringo newcomer. Her stubborn independence reminded me of the tough women who were my mother’s friends in Oregon, and I liked her. However her family had no idea what she saw in me. And that ditch work came when Paul Stein and I were doing our RNA enumeration work. I knew the configurations first-hand and had a nonstandard way of approaching them. I would be working in the ditch and the telephone would ring. When eventually climbing out of the trench and getting to the phone, I had to further move my mindset so I could talk with Paul about whatever issue he’d come up against. Those two, Paul Stein and Mrs Delgato, never met, but they are together in those summer days when I was doing hard labor in my Santa Fe front yard.

The houses in Casa Alegre were Spanish style, flat-roofed stucco made to look like adobe, hardwood floors and varnished logs (vigas) across the ceilings. I was interested in installing some Mexican quarry tiles, and Bob Gorrell, a friend and contractor in Santa Fe, suggested I look into Tiles de Santa Fe. I went to Pojoaque and met the owner Bud Watson who had a wonderful Texas drawl. He took me through his operation that processed material mixed with some cement compound and hand-troweled into forms. Then the tiles were cured by drying, not by heat. The tiles were consistent and durable with hand-made craft. After our tour, I ordered enough tiles to cover the floor of my converted garage. I told him if I could gain some confidence doing that, I’d get some other tiles for my kitchen. “Maybe we can trade work,” he said, and I responded with, “Whatever can I do that you need doing?” It turned out that he had specifications for the number of tiles with stated grout width for jobs for various sizes and shapes of tiles. People would come in later and claim that the amount he sold then was inadequate. Almost all the complainants were scientists from Los Alamos. He knew they were wrong but didn’t have any rigorous way to show that. “That I can

do,” I answered and took down some critical information. A few weeks later I brought Bud my calculations for the number of tiles per square foot for various patterns, and some pages showing exactly where the numbers came from. Bud was fascinated by how I broke the figures into simple geometrical objects, e.g. a regular hexagon into triangles. Weeks later I returned and he told me how pleased he was with my work. A Los Alamos resident had come in asking for more tiles because he had been given too few. Bud said, “I told him how surprised I was. I said to him, why I had a guy, a mathematician fellow, do some work on this and I use his numbers. Here,” he said, waving my pages gently in his direction, “do you want to check his formulas over?” The guy backed up and stopped complaining. Then I knew how brilliant Bud Watson was! I showed him mathematical articles on tiling, and we talked about shapes and the covering of two-dimensional surfaces. I designed a tile for him which he called cobblestone, a single shape that, when appropriately placed, will cover surfaces and look like a random cobblestone surface. The first fancy Santa Fe home that used that tile was being finished when Bud and I went to see it. I was thrilled with the floors, but Bud stopped and said, “Michael.... Michael, there’s somethin’ wrong here.” I couldn’t see it and told him so. Then 20 minutes later I realized he was right, and eventually we found the exact point at which the tiler had lost the pattern and what he did to recover. I had a lot of fun with Bud Watson. We even made Penrose tiles, those famous kites and darts, and they exist today in some New Mexico homes, Penrose tiling in earth tones.

Molecular biology and DNA sequences became an increasingly active area; rapid DNA sequencing came in 1976 and introns were discovered in 1977. In March 1979 there was a meeting at Rockefeller University to consider the creation of a national DNA database which Temple Smith and I attended. (For a useful history see T.F. Smith (1990) “The History of the Genetic Sequence Databases.”) The only mathematicians at the meeting were me and Peter Sellers from Rockefeller University. There was general agreement that it was time for such an effort, although I was too naive to see the greedy self-interest of some of the participants. I returned to Los Alamos and on my initiative gave a short presentation to the Theoretical Biology Group T-10. There were two components to such an effort as I saw it: one was creating and maintaining a database and the other was data analysis such as sequence alignment, which Smith and I had been working on. I strongly

emphasized that the first job would overwhelm the second, and since analysis was probably the main motivation for a Lab effort, the implications of taking on a task needed to be carefully considered. T-10 did not hear even one cautionary word I spoke; the insight I had came from a USGS project that the statistics group had taken with similar motivations and consequences. Although at this point only Ulam, Beyer, Smith and myself at the Lab had done any work in this area, we were not included in subsequent discussions or proposals.

NIH had a request for proposals to create a DNA database to be named GenBank, and Los Alamos applied. During the site visit to Los Alamos, T-10 requested that Smith and I be available to the committee when they saw the CRAY. Then the most powerful computer in the world, the CRAY had a vertical tower and a surrounding circular bench set about seat high. The darn thing looked like it belonged in the lobby of an inexpensive hotel. I knew that Smith, Waterman, and the CRAY were just window-dressing to impress the committee. T-10 didn't intend to use any of us for the real job. There was a strong move against Los Alamos, as having the genetic data stored and processed at the place where the atomic and hydrogen bombs were developed was unacceptable to many. I don't know what the influence of Smith and Waterman had on the positive decision but I am confident that the irrelevant CRAY was a key component.

The Lab did get the GenBank contract in 1981, and there was zero effort to engage me with the project. Strangely, an introverted scientist Walter Goad became project leader, and in my opinion, he failed properly to manage the project. In fact, ten years later GenBank continued its struggle to include all the DNA that had then been sequenced. This was a rapidly moving target, which was the point I made when I let T-10 know of the opportunity. I was approached once for my RNA code, and when I handed it over, I said that I'd be pleased to collaborate with them. The postdoc silently took my code and I heard no more from them until I came upon their publication which overlapped papers Smith and I had published. Temple Smith spent 1981-1982 working with T-10 getting ready for the project, and then he spent the academic year 1982-1983 with me at USC. There were severe tensions between Smith and Goad.

David Lipman was a medical student in New York City when he came upon a remaindered copy of Lila Gatlin's 1972 book about information theory and biology, *Information Theory and the Living System*. This book, with a thin but enthusiastic understanding of information theory and its applica-

tions, created in David Lipman a passion for bringing an analytical approach to biology, especially to biological sequence analysis. Not published in the area yet, David contacted Smith and me when he was on his way to a medical residency in Tucson. I met David in Albuquerque and we went to a Mexican restaurant. He was very intense and it was not clear what he intended to do, but I liked him. Brains and enthusiasm are always a good bet. That winter I went to Tucson in connection with a small research project we had begun. Then the summer of 1981 on his way to a fellowship at NIH, David stopped again in New Mexico and stayed at my home in Santa Fe. He visited the Lab and brought a small Olympus camera inside the fence. When I realized this, I was concerned he would be caught. At the Lab we had to accompany our visitors everywhere, even to the restrooms, and having a camera inside the fence was strictly forbidden. Outside the fence he took a photo of Smith and me (*Smith & Waterman by Lipman*), all copies of which were lost until I moved my office years later. Since then I have widely distributed the image that has Temple in a cowboy hat and a New Mexico belt buckle and me in a Hawaiian shirt with a sash for a belt. I wish David Lipman were also visible in the photograph. My final point is that a silly little book like Lila Gatlin's had a huge impact on science. David Lipman: FASTA, BLAST, NCBI. This work is unlikely to have happened but for her book. You never know!

In October 1981 there was a meeting in France, the EMOB Meeting on Pattern Analysis in Nucleic Acid and Protein Sequences, which was the first of its kind anywhere. I was 39 years old and had never been outside the USA except for border towns in Mexico and Canada. I flew to Paris, and at midnight Temple and I wandered the streets of Paris with no map and much wonder. I told him that we two hicks should congratulate ourselves just for being in France. Jet lag that had never bothered me struck me here, and I could not sleep at night or stay awake in the daytime. I went to sleep on the couch of the Director of the Pasteur Institute while Temple and everyone else went to lunch. When you miss lunch in France, people notice! The conference was in Saint-Agnan which was somewhat remote. My sleep patterns did not recover and I attended few talks; I'd wake up for dinner and then spend the evening in the bar drinking beer. Bob Cedergren, David Sankoff's collaborator, also spent time in the bar where he'd use his Canadian-French accent to drive the French people crazy. I liked his robust personality and many times was amazed at the odd corners of biology where Bob made unexpected discoveries. Ninio had two brilliant students, Phillippe Marliere and Jean Dumas, who were interesting to talk to.

One afternoon I made it to a session where I was asked to say something about RNA folding algorithms. After I stated the time complexity of predicting even cloverleaves, Michael Zucker got up to strongly object. He used a faster heuristic algorithm which he seemed to think was rigorous. After this awkward exchange, David Sankoff explained that I was correct. I confess I never had to change my impression of these two even when I got to know each of them well. Even more humorous was when Ninio approached me to ask about my political statement of not attending the talks. Somehow he didn't interpret my lack of attendance to jet lag or laziness; instead he took it as a philosophical and political stand. I could not convince him of the mundane truth.

Sandie Douglas, whom I lived with off and on for several years, had a brother who was in Haig's Senior Policy Staff for President Reagan. I visited him in Washington DC and he was different from his sister, arrogant and pompous. But he told me that the Reagan administration planned to put the National Labs back to doing what they were uniquely qualified to do. By this he obviously meant that the administration would put an end to energy research and make the Labs focus 100% on weapons research. I have nothing against such work when it is critical, as for example with the Manhattan Project. But in 1981 it was not what I wanted to do. I thought, "Ronald Reagan has just told you it is time for you to leave the Lab!" I spent some time thinking about what came next. I considered two directions: geology and biology. I loved both those sciences, although I had never taken a serious university course in either. Finally I decided that while geology had a lot of data, biology with gene sequences was an upcoming area where more verification was possible. I had no idea how correct this was to turn out to be. Hugo Martinez at University of California at San Francisco invited me for a half-year visiting appointment, which was a turning point for me.

Although it was not something many PhDs did then, I rode to the Lab from Santa Fe in a vanpool. The other passengers were plumbers, secretaries, electricians and service people. I enjoyed their company, and they accepted me after they worked out that I was a real person, not just a PhD. Support staff found it expensive to live in Los Alamos, hence the necessity of their commutes. They asked my advice on their children's education, and one Hispanic man told me his sister was divorced and asked if I was interested in meeting her. One dark winter Monday morning, I got into the van and asked

if anyone had seen 60 Minutes the night before. I had been struck dumb by learning of Star Wars, with Edward Teller standing in the Lab museum talking about shooting missiles out of the skies. It seemed to be a fantastical notion that must have appealed to Ronald Reagan's delusion that he was the cowboy of the western world. After I had finished running on, telling my van mates about this, someone said, "Oh, Mike! EVERYONE knows about that!" I was so naive and out of it at the Los Alamos National Labs that I was completely uninformed about any of the weapons' work.

The Lost Art of Conversation

Gian-Carlo Rota
1932–1999

It was the summer of 1970, and I was in a covered plywood tunnel joining some offices to the computer building at Los Alamos Scientific Laboratories. Complete with security clearance I was inside the fence on a summer grant to approximate the equilibrium distribution associated with n -dimensional continued fractions. Although in the 1950s Stan Ulam and Paul Stein had looked at function iterates on a screen, using a computer to experiment with measures was not yet common. Los Alamos seemed an excellent place to do the work.

I met Nick Metropolis along this walkway, and he stopped me for an introduction to an elegant man, Gian-Carlo Rota. I was carrying a stack of IMB punch cards to submit for an overnight run. Nick went on but Gian-Carlo stayed and asked me a question. He spoke excellent English with a rich Italian accent which might have been flavored by the years he spent as a teenager in Ecuador.

“So, who was your advisor and what did you do for your thesis?”

I had heard of this guy and had seen his name at the masthead of various fancy mathematics journals. I almost asked him how he knew I was a fresh PhD but fortunately thought better of it. Instead I gave a terse answer: John Kinney was my advisor and I had done such-and-such in my thesis. Gian-Carlo gave me an intense look.

“No, no, no,” he said with some impatience. “I mean: what did you do for your thesis?” I elaborated, and he asked several insightful penetrating questions. When he let me go in ten or fifteen minutes, I walked on to submit my computer job certain that he now knew more than I did about what I

had just published in the journal *Z. Wahrscheinlichkeitstheorie*.

It must have passed muster because we became friends. As many are aware, Gian-Carlo was very supportive of other mathematicians, and in the 29 years I knew him, he spent a considerable time listening to people put what they knew (as well as what they thought they knew but didn't) onto blackboards while he would inscribe the material into one of his heavy notebooks. He would switch between pairs of glasses during these sessions, and in later years there were sometimes as many as three pairs hanging from cords around his neck. Gian-Carlo was as absorptive as a dry sponge and quite discriminating. "Ummhumm," we all have heard him say, "and just what is the connection with covariant functors?" Of course the person may never in their life have considered that connection. It all went into Rota's notebooks which must be a vast treasure-house of digested mathematics.

When I was a student, many people did not consider discrete mathematics (the mathematics of finite sets) to be genuine or serious mathematics. I remember the shock when my advisor showed me that even the ergodic theorem was essentially discrete mathematics. Gian-Carlo brought discrete mathematics and combinatorics to the forefront of modern mathematics. But also he seemed to know everything.

The translator of us all is gone, died the weekend of April 17, 1999. I spoke with him about two weeks before his death. He had written one of those compact confident flamboyant letters of recommendation for one of our job candidates, and I wanted to say thanks. We compared current teaching loads, displays we loved to make, showing that we were each doing our job. Undergraduates scored higher than graduate students in our contests. He told me that out of all of mathematics the thing he most wanted to understand was the maximum entropy principle. "No one really knows why it works," he said.

Gian-Carlo published our first computational biology paper, although it was not called computational biology then. It was not called anything at all, the subject did not yet exist. We were so far out of the mainstream that a paper with "biological sequence metrics" in the title elicited the following referee report from a Berkeley mathematician: "There is a vast literature on metric spaces. The authors should consult it." (Of the reviews my papers have received, this is my favorite.) The editor added that the paper seemed to satisfy neither mathematicians nor biologists. Bill Beyer was furious at the ignorant review but this is the usual reaction to something genuinely new. No one knows what it is, and the odds are good that it is not important.

Except when it is.

We told Gian-Carlo of our rejection and showed him the paper and its reviews. Instead of another put-down, Gian-Carlo placed the paper in *Advances in Mathematics*. It is still quoted, and Bill Beyer, Temple Smith and I had him to thank for it seeing the light of day as soon as it did.

Gian-Carlo Rota ran his journals as a total autocracy. He and only he decided which papers would be published and exactly when they would appear. When I recounted my difficulties as editor of a journal, he became impatient with me. “I have no idea what you are talking about,” Gian-Carlo said. “If you have to have a paper refereed to find out if it should be published, you shouldn’t publish it.” He had a point. I wonder if an important journal ever again shall be run as he did his journals?

Non-standard analysis was the rage in the early 1970s, and elaborate treatments of infinitesimals seemed to appear right and left. It looked to me to be what I would learn to call abstract nonsense, and I ignored it. When one summer Rota announced a series of lectures at Los Alamos on the topic, I decided only to attend the first one. The audience was physicists, chemists, computer scientists, and mathematicians; the approach was nothing like I had seen in the journals. He connected infinitesimals with rates of convergence to zero that had their “mates” that were rates of divergence to infinity. His treatment was crystal clear to anyone who knew real analysis. He gave short crisp lucid proofs of results that took pages in the literature. Sometimes he had the audience supply a proof on the spot. “Now you know what Leibniz knew,” he said with pleasure. At the end of the series which I attended faithfully, the audience was proving theorems that had not yet appeared anywhere. Gian-Carlo Rota was without doubt the most gifted teacher I have ever seen.

Gian-Carlo spent much time nurturing his students and others he thought deserved help. He published their papers, suggested them for jobs, nominated them to societies. For example, he put me up for Fellow of the Institute of Mathematical Statistics a decade before that establishment noticed my work and made me a Fellow. He did this for many people. Perhaps more significant than that was the amount of time he spent on the telephone, keeping up with things, but also providing advice and company to an enormous number of people. I heard him say, “I did two hours of telephone therapy this morning.”

When I met Gian-Carlo I had a job at Idaho State University, which he thought to be purgatory although I loved it there. He was relieved when I came to Los Alamos Scientific Laboratory in 1975, and occasionally he would

reveal his fear that I would chuck it and head back to those mountains. The outdoors was a domain like Asian food which he dismissed. But he could sense the dangerous influence of Idaho and wished to guard me against it. How many of us did he watch over?

One afternoon I was in a car on the mesa the city of Los Alamos sits on, across the canyon from the Lab. My fellow passengers were Nick Metropolis, Stan Ulam, and Gian-Carlo Rota. As I age my dreams become more vivid and that memory is like a dream I had last night. Brilliant sunlight, the origin and destination of our trip completely missing, my total happiness at just being in that car, my profound sense of incredible good luck.

Gian-Carlo visited Los Angeles often after I joined the University of Southern California in 1982. His friend Mark Kac was at the university, and at the time USC was flush enough to sponsor regular visits. Once Curtis Green and I took him to a Chinese restaurant where Gian-Carlo made one of his dramatic absurd pronouncements. Instantly Curtis and I broke into laughter. I thought about this later, both of us knowing what he said was funny and laughing at him. I asked Gian-Carlo about it, saying that some people took such statements seriously and were mightily offended. His answer was an equivalent to the one Jesus makes about those wearing sackcloth and ashes: they have their own reward, leave them to it. Of course there was more going on than that. Gian-Carlo Rota was always poking us with sharp sticks, hoping to get our attention, doing his best to get us to look at something from a new angle. Intellectual fakes and frauds be damned.

As I learned more molecular biology, I put in my turns at the blackboard trying to give an overview of that exciting subject. Gian-Carlo delighted in the combinatorial power of genes and proteins. "We must write a paper together explaining biology to mathematicians," he told me several times. In the early 1980s I was far too busy, and when I finally thought I could find the time, he told me, "No, it is impossible now. You know too much!" By this he meant that I now knew so much about biology that I would obscure the essential message to mathematicians.

He enjoyed eating good food and drinking good wine. He would not tolerate ice in his water; that was one American trait he did not incorporate. When asked how he found the nerve to send expensive wine back, he answered, "If it tastes like ink, why shouldn't I send it back?" As a rural schoolchild I remember getting ink in my mouth, the bitter flat persistent taste. Yes, send the blasted stuff back!

He loved European food and had an understandable fondness for South

American cuisine. Asian was out, his biggest culinary weakness in my estimation. But on Italian or French he was 100% accurate. Often he went for expensive and ornate restaurants; just look at The Palace in Santa Fe, Loche Ober in Boston, and Madeo and Valentino in Los Angeles. At Madeo you descended a half-floor underground into plush old-fashioned red luxury where there was a rolling vat of garlic-and-rosemary baked veal-and-potatoes and plenty of grappa. Often there were relaxed film stars at the other tables, but they did not interest Gian-Carlo. On arrival, the head waiter would recognize him, fuss over the table location, and go to fetch the first bottle of champagne. Then the manager would arrive for a long conversation in Italian.

“He’s been here 15 years, and he hasn’t yet learned English,” Gian-Carlo confided to us as we began with the wine. “The Mafia owns this restaurant,” he said, looking around with satisfaction. “They don’t advertise and they don’t have a sign out front.” Those heavy-duty locations in cities around the globe were rooms in his home, and he entertained many of us in them. What a privilege that was.

I was a member of a large dinner in Santa Fe that included the famous Richard Hamming who was visiting the Lab. At the close of dinner Hamming made a show of looking for the bill that he was going to pay. But the waiters ignored Hamming, and he fussed at Rota who said with a slight gesture of his hand,

“It is taken care of. You are my guest.” This went on for a time.

“You must let me pay,” Richard Hamming finally burst out. “I make more money than you do!”

“Yes,” Gian-Carlo answered sympathetically and reassuringly. “Yes, I am certain that you do.” And that was the end of it.

In Los Angeles Gian-Carlo found many restaurants to love. The new California cuisine was just right with him, so long as it didn’t get too Asian. He delighted in the fresh inventive upscale restaurants: Michaels, Citrus, Silvo, Patina.... When three French chefs started Fennel on the bluff in Santa Monica, he took to it. Each of the cooks was to spend a couple of weeks at a time in Los Angeles. The idea of toque-topped French chefs rotating through LAX baggage claim waiting to be picked up by various “in” restaurants has its certain charm. I had dinner at Fennel with my beautiful friend Sheaufang Chang, the brilliant and sardonic David Berlinski, and Gian-Carlo. We wore our best clothes, and it was a dazzling evening. At times like this Gian-Carlo would sometimes pronounce, “The art of conversation is lost.” And I would

sit there feeling fortunate to be somewhere people still carried on the art of conversation.

Part of Rota's time in Los Angeles was spent working on a book of character studies. His essay "The Lost Cafe" was to be the first. There he gave an analysis of Stan Ulam that had never occurred to me. I had observed certain things, such as Stan's short attention span, but thought it was simply that Stan was so much smarter than the rest of us that he was soon bored. And smarter he was of course! I still wonder about Gian-Carlo's analysis. He spent a good deal of time with Herb Taylor, an odd eccentric character who hung out at USC around the engineering school, and he worked hard on Taylor's chapter. I'd love to see it but never had an opportunity. Gian-Carlo asked me if I would allow him to do a chapter on me, and I refused saying there were many things about myself that I was probably better off not knowing. In his book *Indiscrete Thoughts* we can see shadows of his book of characters.

For a long while Gian-Carlo traveled with a copy of Proust's long novel and read a section each evening before sleeping. When the movie "Swan's Way" with Jeremy Irons appeared, he told me it was just as he had imagined Proust's scenes. His small ornate pill box somehow fit with reading Proust. Just what it contained I can only guess, but knowing my difficulty with jetlag, on two occasions he gave me powerful sleeping pills fetched from that mysterious container.

Gian-Carlo was one of the worst drivers I have known. I tried to drive whenever we went anywhere, but sometimes couldn't escape being his passenger. Riding with him in Los Angeles was like being in a tunnel with the nearby drivers swerving and honking and waving their arms and fists at him. He had only a vague sense that he was not with it and occasionally wondered at the fuss going on around him. Gian-Carlo hated the necessity in LA of making left turns across traffic.

"I'm writing a book," he would announce. "The title will be *Los Angeles on Three Left Turns a Day*. It will be a best seller!" The detached retina in his left eye may have made left turns especially difficult; he never mentioned it.

Once Schützenberger was visiting from Paris, and I learned Gian-Carlo was picking him up at a hotel to bring him to the university. They were late, and I spent a tense hour fearing that there had been an accident. Two of the most famous men in combinatorics in a car with Rota driving! Somehow Gian-Carlo managed to do a lot of LA driving without any accidents or

tickets that I learned of. In this connection I discovered one of his secrets. He had a second driver's license in New Mexico in the name "Juan Carlos." He made me swear not to reveal this fact to anyone, but I think this is the right time to tell the story. He can't lose his security clearance now. After I made this public, I learned of the possibility of a third license!

After Gian-Carlo's death his many notebooks disappeared. It has been estimated that there were at least 50 notebooks. The notebooks would be of no value to anyone except mathematicians, and certainly the MIT Mathematics Library is the appropriate location for them. However, they were offered for sale on eBay for an extravagant sum. They did not sell, and Joel Stein, who received his PhD under Rota and was then teaching at Nankai University in China, made arrangements to purchase them. One estimate I heard was that the price was around \$20,000. Alas Joel died before the purchase was accomplished and I know of no solid information about these historical records.

So now we are here without Gian-Carlo Rota. He told me once that if you die or retire, no one will mention your name again. In his case that is false, but I am not ready for this. Bill Beyer and his daughter Elizabeth have suggested a pleasant romantic image of Uncle Stan and Gian-Co meeting at the Lost Cafe. Bill has them going at Cantor's hypothesis and visiting Stan's inaccessible cardinals, but I know for certain Gian-Co hasn't yet given up on the mysterious maximum entropy principle. I am unprepared for life on earth without my friend. Here I sit in a noisy cafe where I cannot make out anything that is said. And I can tell you that being here still tastes just like ink.

Silhouettes on the Mesa

“I have never known Stan Ulam to last longer than ten minutes of anyone else’s lecture,” Gian-Carlo Rota wrote, mimicking the famous irreverent first sentence of Chapter 1 of James Watson’s *The Double Helix*. Nevertheless Rota tells of meeting Ulam in New York City in 1964 when Mark Kac prevailed on Ulam to attend a lecture Rota gave. Ulam made it twenty minutes before bolting, and one need not be an expert on extreme value distributions to know that was a rare event.

Kac and Ulam were great mathematicians born in Poland, and each came to the U.S. at the beginning of World War II. They had broad European educations and did not observe boundaries between mathematics and other sciences, let alone between mathematical subfields. It is natural that Kac and Ulam each became friends with Rota with his multiple languages and wide-ranging intellect. And they both were gifted writers of American English.

Soon after meeting Ulam in New York, Uam invited Rota to Los Alamos National Laboratory, known as the Lab, the Hill, the Mesa, and most famously as Santa Fe Box 1663 during the war when brilliant men of science, physics especially, worked feverishly to create the atomic bomb. By 1964 Stan Ulam was one of those who retained a regular association with Los Alamos. The Lab at 7400 feet is on a mesa top with ponderosa pines just above the pinion-juniper zone. The crisp clear air has a distinctive fragrance of cedars, pine, ozone, and sunbaked tuff, and one can see for tens-of-miles. In Santa Fe thirty-five miles distant is Native American and Spanish culture with good restaurants and art galleries. This exotic high-altitude sun-bleached locale captivated Rota, but surely it was Ulam who kept him coming back. One can find each of them writing about the other in Ulam’s *Adventures of a Mathematician* and Rota’s *Indiscrete Thoughts*.

Rota soon became part of Los Alamos. He gave lectures that were deeply informative polished works of art that made him known throughout the Lab.

The topics were wide-ranging: differential equations, ergodic theory, non-standard analysis, probability, and of course, combinatorics. I attended the series on nonstandard analysis, and it was the equivalent of a course with an approach that had not appeared in print. These notes exist as a Los Alamos report. Over the years Rota helped organize several conferences at Los Alamos: History of Computing in the Twentieth Century (1979), Science and the Information Onslaught (1981), and Frontiers of Combinatorics (1998). He was made a consultant of the Lab in 1966 and a Director's Office Fellow in 1971. When asked what he did, he said "I wish I knew. I manage to snoop around and every once in a while I pop into the Director's office and have a chat with him." Director's Fellows could come whenever they chose and could stay as long as they wished. For Rota this meant at least a week in January and a month in the summer. He hated Boston winters even more than New Mexico winters! As a Fellow he soon became involved with high-level Lab politics. In the late 1970s he was at a dinner party in my home when a new Director was being chosen. He received so many lengthy telephone calls that I feared he would not get enough to eat.

Other than Ulam, his closest collaboration at Los Alamos was with Nick Metropolis, an elegant man with a long association with the Lab. Metropolis was educated as a physicist at the University of Chicago where he took many mathematics courses. He had a distinguished career as a physicist and pioneer in the development of modern computers; he passed away on October 17, 1999. In wartime Los Alamos he and Feynman repaired Marchant manual calculators to the disapproval of Hans Bethe. In 1945 at von Neumann's invitation, Metropolis began to work with the ENIAC, and in 1947 he started a computer research group at Los Alamos that produced the remarkable series of MANIAC computers. At Los Alamos I used the MANIAC II which was a joy. The MANIAC III, based on significance arithmetic, was built at the University of Chicago. For the last twenty years of his career Metropolis worked in mathematics, often with Rota. One of their major contributions was in using concepts created for computers such as binary representation of numbers and "carry" operations and applying them to the foundations of real numbers. They brought forward a new idea, distinct from the usual Peano and Dedekind construction. There are four papers on those topics. They also studied the lattice of the faces of the n -cube, and they gave an explicit decomposition of the lattice into a minimal number of chains of lattice faces. And they had the good fortune to discover a fact missed by all the early workers in symmetric functions: that every function in three variables is

uniquely expressible as a sum of a symmetric function, a skew symmetric function, and a cycle symmetric function. The underlying idea was extended to n variables in several papers, including an introduction of two new classes of symmetric functions.

Innumerable people gave Rota private lectures, which he carefully inscribed in one of his heavy notebooks. “It’s my job,” he would say with pride. It was much more than a passive activity, and here is an example of one of those exchanges. Jim Louck, a Los Alamos physicist, listened to Rota lecture in the late 1960s on a set of matrices with non-negative integer entries that have specified row and column sums. During the lecture, Rota remarked that he knew of no physical applications. At this time physicists were active in developing explicit representations of the general unitary group, and Rota’s matrices thus enter into the physical theory of quantum systems. Jim Louck’s observation, which emerged after Rota’s lecture, led to thirty years of interactions among Louck, L.C. Biedenharn, and Rota. Louck and Biedenharn gave many informal presentations on the tensor operator theory they had created. “Rota never really bought it,” Louck told me, and he and Biedenharn wrote no joint papers with Rota. But when Rota’s student W.Y.C. Chen came to the Lab, Rota said, “Go to Los Alamos and look up Jim Louck. He’s a gold mine for mathematicians.” Chen was delighted to find this to be true, and he and Louck went on to mine that rich ore in an ongoing series of papers.

Biology is another area that Rota helped along although he did not entirely buy into biology either. (I refer especially to his doubts about Darwin’s theory of evolution.) When my first paper on sequence matching was rejected, Rota placed it in *Advances in Mathematics*. It is still being quoted, and I (along with Bill Beyer and Temple Smith) have Rota to thank for the timely appearance of that paper. “There are so few people working on those problems,” he said many years later. In the late 1990s David Torney began to give Rota lectures about his work that arose in classification of DNA sequences. The result was an elegant joint paper on probability set functions and help in organizing a conference.

It is of course impossible to list all of Rota’s interactions. Some of the most unexpected to me are those relating to Rota’s interest in philosophy. David Sharp is a multi-talented mathematical scientist who shared Rota’s passion for philosophy. Their dialogue “Mathematics, Philosophy, and Artificial Intelligence” in *Los Alamos Science, No. 12* is fascinating. Rota had a tremendous impact on students who took his philosophy classes. Mark

Ettinger and David McComas are two of those MIT physics students who came to the Lab because of Rota. McComas became Director of the Center for Space Science and Exploration.

Rota served on the Advisory Board for Non-Proliferation and International Security (there was a Lab division of that name), but it is impossible to learn any details. While he did write short classified reports on national security issues, they are not available to “unclassified eyes.” At Los Alamos this activity, just as with almost everything else there, has gone under various names, but it is often called “the Spook Shop.” It will be many years before much more is known. For example I am curious about whether Rota’s relationship with the Spook Shop or the National Security Agency came first.

He also proposed a scientific and mathematics institute based in Santa Fe. It materialized as the Santa Fe Institute but not under his leadership. There were some excellent people involved, but it seemed to attract people like Stuart Kauffman who wrote popular books about science and mathematics which had the property that the more closely I read them, the less content there seemed to be. Another person in this circle had received his PhD from USC and he worked to convince me to be his front person in grant applications. That did not happen. In recent years the novelist Cormac McCarthy spent time at the Santa Fe Institute, and I deeply regret that I missed meeting him!

Let me return to Rota’s vital connection with Ulam. The fascinating essay “The Lost Café,” the final version of which appeared as Chapter VI of *Indiscrete Thoughts*, is a sketch of Ulam’s life with details of his health, work habits, mathematical abilities and state of mind, and some of it is far from complimentary. “The Lost Café” was very controversial at the Lab, with the Ulam family, and elsewhere. “It’s a scandal,” Rota told me with evident satisfaction. I believe “The Lost Café” is filled with respect and love, but it is radical. Among other things Rota writes that Ulam was lazy. Ulam’s widow Françoise remained bitter about the chapter and did not forgive Rota, not even after his death. When I went to Los Alamos to gather information for a memorial article that appeared in *Notices of the American Mathematical Society*, I learned my every move was reported to Françoise. I assumed after the article appeared I would go on her enemies list. However that was not the case, and we had a warm and pleasant correspondence by email and telephone. She was a charming woman who believed that Rota had taken unfair advantage of his relationship with her husband. And at Los Alamos and elsewhere there are resentments, grudges, and judgments; although Rota

would say “We should tell it like it is,” I have neither space nor desire to list them here.

This chapter is taken from my contribution to a memorial article for Rota published by the American Mathematical Society. One editor was upset with my reference to an affair between Georgia O’Keeffe and Nick Metropolis, but that was just the start of it. They deleted the sentence “Rota loved gossip at any level” and I cannot recall where to reinsert it. Then came the deletion of “Mrs. Ulam remains bitter about the article and has not forgiven Rota, even after his death.” The reaction to my writing is captured in the following (by Knapp, the Editor of the *Notices on the AMS*): “The level of informality in your segment is rather high for this kind of article, and I hope that you will not be offended by my efforts to make your segment conform to what is normal for the *Notices*.” I cherish that sentence and I know Rota would encourage and delight in my apparent unconventionality!

Palombi writes in the “End Notes” of *Indiscrete Thoughts*, criticizing Rota’s brash comments about others, “... one does not say this kind of thing about great men.” I can hear Rota use these exact words; I would not be surprised if as a post-modern joke he did write them, scolding himself, laughing at himself and all the rest of us. Palombi appears to be a real person and he should let us know the truth. Gian-Carlo was very hard on memoirs because of “the nauseating personal details that make most autobiographies painful reading experiences.” It occurred to me to make a compilation of sentences from his critical book reviews (which could be scathing), carefully shaped into a Palombi-like “editor’s remarks” lambasting this book. If only he were here to set me straight with his laments about our anti-intellectual anti-truth times.

In winter snowstorms come to northern New Mexico, and the following day dawns clear with deep-blue sky and subzero temperatures. Every snow crystal reflects light, and the vast landscape is dazzling. Rota planned an article about Los Alamos entitled “The Desert Is Covered with Snow.” It too would have dazzled, and just as likely, shocked and upset some of us. We can never know all that we have lost, what Gian-Carlo Rota would have revealed to us about mathematics and about science and about ourselves.

Uncle Stan

Stanislaw Ulam
1909–1984

As I was finishing my thesis in 1969 and applying for jobs, my advisor John Kinney was insistent only on one letter I should write, and that was to Stanislaw Ulam then Chair of the Mathematics Department at University of Colorado at Boulder. I had heard of Ulam but had a limited notion of what he had done in mathematics. He had been at Los Alamos during the Manhattan Project, and among a long list of accomplishments, he'd been an inventor of branching processes, the probabilistic study of objects such as family trees. I sent a letter to Boulder although it was not on my list of schools—it was in the mountains but had a PhD program which eliminated it from my list. Eventually I received an answer from Ulam and it was not coherent. I became less sure of what he was saying each time I read it. Surely he meant there were no positions at Boulder but I should try Los Alamos. As I didn't desire a job at either place, understanding the letter was unimportant and I filed it. Unfortunately all my records from that time were lost so I can't quote the letter here. I attributed the unsettling incoherence to a secretary's transcription, but as I was to learn, the imprecision was likely due to Ulam. More on this later.

That fall I went to Los Alamos to give a lecture where I met Bill Beyer, Nick Metropolis, Paul Stein and others. Stan Ulam was in Colorado but he still had a noticeable presence; everyone was aware of and conjectured about what he might say about something. When I came back the summer of 1970, one morning I heard someone say, "Is Uncle Stan here yet?" Then I met Stan Ulam, a slightly ruffled man of medium height. One would not have pegged him for an intellectual giant, and he did not care at all what anyone thought.

He had a slightly abstracted calm air about him. The avuncular aspect was definitely there—he was not the warm engaging uncle that my own war-hero Uncle Ben was, but Uncle Stan somehow fit. Stan came from Santa Fe in time for lunch, which he took with Nick Metropolis, Carson Marks, Paul Stein, Jim Louck, and others. I would watch them at their meal, careful not to draw attention to my staring, thinking that table contained what the amazing place was about, brilliant men whose conversation moved over the landscape of mathematics and science gracefully as a glider. Stan would leave the Lab mid-afternoon, so his workday was short. I assumed he received a full salary and thought it appropriate in acknowledgment of his enormous contributions. After all no one got rich by inventing mathematics. Many years after his death, I learned his pay was \$1 per year. Whose penny-pinching idea was that, I wonder?

As Gian-Carlo Rota noted, Stan did not attend talks and he seldom gave talks. When he did, the lectures were like improv theatre. Certain people who needed things nailed down and organized, hated his talks. I was of the other camp; I found them remarkable, as one never knew from the title what he'd actually speak about. Neither did he, I am certain. And he wrote on the board in little scribbles; you had to listen carefully when he spoke because what he wrote was incomplete and almost illegible. An Ulam quote may reflect that: "Whatever is worth saying, can be stated in fifty words or less."

And the first lecture I heard Stan give was amazing. In the summer of 1970 there were rumors that he'd speak, and when the time came, the room was packed with chemists, engineers, physicists, and of course mathematicians. His topic was the complexity of an integer that he defined as the length of the shortest number of additions, multiplications and exponentiations using only the numbers 0 and 1 to compute the number. In slightly more general terms, complexity was the length of the shortest program to calculate the number using those primitives. This general topic was hot during this time; the area could be said to go back to 1934 and Turing machines, and Richard Karp was to publish his groundbreaking paper on classes of algorithmic complexity in 1974. I am certain Stan knew about Turing but not about anyone else working in complexity. He'd have his ideas and pursue them as if no one else was on the planet. And consistent with that, he seemed not to concern himself with publication or priority, at least when I knew him. Many years before in Poland, he had published vigorously.

Stan Ulam was one of the great mathematicians of the twentieth century. His early work was in pure mathematics, in the so-called Polish School, and

Ulam's name is on an amazing number and variety of mathematical objects. From point set topology to branching processes, from functional analysis to complexity theory, from the foundations of probability to chaos, from computers to physics, Ulam looked, saw, and started us out on some amazing intellectual journeys. Monte Carlo methods and cellular automata are two more that come to mind. It seems inconceivable now that anyone invented Monte Carlo—wasn't it there when the world was created? In fact, Monte Carlo was started by Ulam and von Neumann. Ulam describes a drive in 1946 from Los Alamos to Lamy, remembering what was said at turns in the road or certain rocks. They knew the probability integral transform and the rejection method, keys to performing Monte Carlo simulations. He and von Neumann also began the study of cellular automata. We are still working on Ulam's problems.

Anyone who wishes to know more about this remarkable man, please see his autobiography *Adventures of a Mathematician*. It is lucid and revealing. There is little doubt that his wife Françoise had much to do with the clarity of the prose and length of the work, but I can hear his voice when I read it. (Rota says that Ulam read "the whole repertoire into the tape recorder, with the omission of a few prurient episodes to be made public at a future date;" the arranging and typing were done by Françoise.) He was a complex elusive man and this chapter was difficult to write. The person I knew kept evading me. I do not mean that he was consciously hiding anything; he was deep with many layers. Françoise said about him, "Not anyone, I think (myself included of course), ever viewed the whole of him." Now there is a movie with Stan's title: *Adventures of a Mathematician* and apparently it also relies on a memoir by Françoise, *From Paris to Los Alamos*, unpublished in English, of which I was unaware. I could not watch the movie; at the first scene I was repelled. "That is not Stan," I thought and signed off.

For details of his early mathematics, I recommend *The Scottish Book* that Dan Mauldin edited with much help from Bill Beyer at Los Alamos. This problem collection was created in the Scottish Cafe in Lwow Poland. In 1933-34 Banach brought in a large notebook that was slowly filled with challenge problems. Here is what Stan said: "It seems to me now that the food must have been mediocre, but the drinks were plentiful. The tables had white marble tops on which one could write with a pencil, and, more important, from which notes could easily be erased." During WWII some Russians left problems and offered prizes. There were a total of 193 entries, and some problems were later solved. After WWII the book was taken to

Warsaw by Banach's son and buried by a goalpost; true or false, that's part of the myth. The book survived the war and a copy reached Ulam. I heard someone say, "Stan Ulam is the last living cafe mathematician." Surely it was an American who said that!

Stan came to the USA just before the second world war as a Harvard Fellow, 1936-39. In 1939 with his fellowship expiring, he traveled from Europe to New York City with his younger brother Adam. On a hot night in a hotel on Columbus Circle Stan received a telephone call that Warsaw was bombed. He knew the world had just changed and that there was no going back. Adam went to university at Brown and became a distinguished professor of history and political science at Harvard. It turns out that Adam concealed his Jewish ancestry from his colleagues. But in Stan's published autobiography there are a number of places where the family's Jewish roots are unmistakable, and Adam's secret was out. After Harvard Stan went to Madison Wisconsin where people at Los Alamos told me he had been unhappy, something to do with the weather and the midwest. Rota too emphasizes this in his essay "The Lost Café." However one does not get that impression from Stan's autobiography. He was pleased that there was less pretension than at Harvard, and the University of Wisconsin was "not at all the intellectual desert that [he] expected it to be." In Madison he married Françoise, whom he met in Boston. Also he became friends with C.J. Everett who "as a young man was already eccentric...." Everett became the person who made many of Stan's ideas work out. He was a reclusive high-level mathematical thinking and calculating machine. Stan came to New Mexico in 1943 to work on the Manhattan Project with all those scientific giants, and after the war he brought his friend C.J.

One reason my discussion is brief is that I hope to send you to definitive accounts of Stan Ulam, his autobiography and an essay "The Lost Café" in Rota's collection *Indiscrete Thoughts*. As is always the case with Rota, the essay is beautifully written. It discusses Ulam's work and life and is insightful, opinionated and controversial. There is extensive discussion of what Rota claims was Ulam's laziness with flashes of brilliance. Many people including Stan's wife were very upset at the essay. There was a public meeting at the Lab auditorium when the essay first appeared, and many expressed outrage. Carson Mark made a remark at that meeting, "Ulam was thinking all the time," and I doubt that Rota would have disagreed. The café which is lost is the Scottish Café', and the loss derives from WWII. Rota writes, "When the catastrophe came, those who were alive and watched their world

go up in flames remained emotionally crippled for the rest of their lives, never recovering from the shock.” I’d reply to Rota that Stan Ulam did a good job of recovering, and back it up with a quote from Ulam: “The Los Alamos community was completely different from anywhere I had ever lived and worked. Even Lwow [...] did not have the degree of togetherness of Los Alamos.” Lwow and Los Alamos each possessed extraordinary cohesion and interaction. But Lwow did not possess the grand landscape and weather of New Mexico nor a hotel such as the La Fonda in Santa Fe, which was said during the war to be full of scientists and spies. Ulam loved this drama!

After the war, Stan checked to find his chances of advancement at Wisconsin were dim, so he took a job in 1945 at the University of Southern California where his former Madison colleague Don Heyers was professor. USC and Los Angeles were a let-down after Los Alamos. Stan invented a LA metric: any two points were at least an hour’s drive apart. Not knowing of this prior work, my LA metric was identical despite the increased traffic. Great ideas can be rediscovered! But in the spring of 1946, he contracted encephalitis and could not even speak. His doctors performed an emergency trepanation and sprayed his inflamed brain with penicillin, and he recovered. Paul Erdős showed up and told Stan, “I thought you were going to die and I’d have to write your obituary and our joint papers.” Rota leads us to believe this incident was a phase transition in Stan’s life. Stan did not remain in Los Angeles and returned to Los Alamos. Ulam went from being a spiffy dresser to the rumpled presence he had when I knew him. According to Rota, Ulam’s ability to calculate was impaired to being almost nonexistent, and he tells of Ulam fumbling to solve a quadratic equation. I will leave it to readers to decide about these touchy points. As these pages illustrate, I remain uncertain about some of Rota’s claims.

For the remainder of Ulam’s career he was affiliated with Los Alamos Labs. During the academic years 1965-1977 he was chair of the Mathematics Department at Boulder Colorado. Otherwise he spent the rest of his life in New Mexico with some winters in Gainesville Florida. His first house on Canyon Road in Santa Fe was a remodeled church. Eventually he moved to an adobe house built on land he had purchased for \$150.

During the wartime effort at Los Alamos, Ulam and Edward Teller were not friends. After the atomic bomb was developed, the hydrogen bomb was the next goal, the weapon Teller called the “Super” and promoted at every opportunity. Teller’s first approach was shown to be incorrect by the Ulam-Everett team, not improving relations at all. I am not an expert, but as far

as I can tell there were three big steps to developing the hydrogen bomb, and Ulam was responsible for two of them. Richard Rhodes in his definitive book *Dark Sun* on the hydrogen bomb writes “The totally different scheme that Ulam first conceived” which settles it for me. Ulam and Teller jointly held the patent for the hydrogen bomb; that there is a patent for such a thing astonishes me. Patents were uncommon during my time at Los Alamos 30 years later. Teller spoke dismissively of Ulam and worked to gain full credit. Ulam did not enter this public debate. Certainly in the end Ulam’s approach was a winner, if anyone can be said to be a winner in such a gruesome development.

The 2023 movie *Oppenheimer* credits Teller with the idea for and the creation of the hydrogen bomb. Movies cannot include all details and Teller’s character must be irresistible to a filmmaker. Teller is, in my take on it, Dr. Strangelove in the 1961 movie *Dr. Strangelove*. I did not meet Oppenheimer or anyone represented in the film except for Richard Feynman who appears as a few beats from his bongo drum. I knew many people in Los Alamos who had been in the Manhattan Project; the morality or justification for nuclear weapons were never mentioned in my presence but I’m certain everyone had an opinion. Because of the cold war, the United States created pathways for people like me to have a career in mathematics and science. The military-industrial complex we were warned about in 1961 by Dwight Eisenhower has completely entangled us all.

Ulam regularly traveled to Washington for scientific and political matters. He was a favorite of the Kennedy administration, and he remarked that John Kennedy as an undergraduate may have been in his mathematics class at Harvard, but he forgot to ask Kennedy if this were so. I had one political moment with Stan. Jerry Ford was President of the United States, and he had the undeserved reputation for being clumsy and worse; people quipped that he couldn’t walk and chew gum at the same time. Ford was visiting the Lab, and people crowded to the windows to see Ford. We were on the second or third floor, and I could look down to the President’s limousine and watch Ford get out to walk toward the buildings. Stan, shorter than I, couldn’t see and asked what was happening. I replied, “Ford is here and he’s not chewing gum.”

We less attractive men often can see why women might be charmed by certain men, as for example when they are movie-star handsome. Other times it is a mystery as it was with Stan Ulam. At a gathering, women would end up collected around him, and he loved the attention. Even Stan

did not understand it. He said, “Women seem to like me, I am not sure why.” Another quote I never forgot was “There are only three things in life better done more slowly.” Food and sex must be two of them, and I have no idea what the third one was but loved the mystery so much that I never asked him. Fill in the blank.

Around 1970, Stan was teaching a class in Colorado that Temple Smith took. There had been a perceived mystery about the information content of genetic sequences. For his class project Temple gave a treatment of this subject that did not but could have calculated the entropy of the genetic code, the transformation from DNA to protein, and he cleared up some misguided and naive work. Stan recognized the quality of Temple’s idea and saw it into print. Temple tells a wonderful story of a champagne brunch with Stan in Boulder, and they were friends thereafter. I don’t know if Stan already had the idea that there was mathematics to be found in the new biological sciences, but he brought this notion to Los Alamos: “Do not ask what mathematics can do for biology but ask what biology can do for mathematics.” He and Temple Smith in numerous visits stirred up things, and Bill Beyer got involved. Bill got me going in what is now called Computational Biology (on an NSF summer grant, to give funders credit too). There was no label then for what we were trying to do.

I spent much of my spare time for six months working with Stan on what he called pair trees. For these trees, pairs of members of the current generation were chosen at random to mate and produce a random number of offspring. I don’t know whether he could do the calculations or not, but I know he was very quick. We would meet sometimes after Ulam’s lunch, before he returned to Santa Fe. We made some progress, and I began to write up what we had learned. At the conclusion of our sessions on the most productive days, Stan would say, “Well, I think we have learned a little something today.” High praise! Then one night in the library, I discovered that someone else recently had studied the same objects and had written a series of papers. I reported this to Stan who didn’t seem to hear me. He did not care in the least that the topic had been closely studied. I was perplexed since my goal was to do original research that I could publish. I don’t understand Stan’s reasons, but he worked in isolation from most published results.

Here is another Ulam example. When around 1970 he gave a simple version of sequence alignment as a challenge problem in his lectures, my friend David Sankoff went up to him after a lecture to say that he had

recently solved the problem. Understandably David held Ulam's failure to acknowledge his work against him. But Ulam lived in his separate world, sometimes oblivious to the rest of us. In this case he was wrong to ignore Sankoff's work. Whether it was arrogance, inattention, or misunderstanding what David had done, I do not know. Los Alamos did claim more for Ulam's contribution to biology than was deserved. However all the activity at Los Alamos in genetic sequences, including Genbank being built there, all that happened because of Stan Ulam. And my own career and life would have been very different.

In contrast with Sankoff's experience was that of Ted Harris whose Princeton thesis was on branching processes. When Harris saw the paper by Ulam and Hawkins on multiplicative processes done at Los Alamos during the war, it "had a discouraging effect, because I had obtained a few results and this paper had them all and more." But Harris went on to obtain other results. "Fortunately Wilks and Ulam both attended a mathematics meeting in New York at that time. I got them together and heard Stan assure Sam that I had some results not in the Hawkins-Ulam paper. That was my informal oral exam, although I had a regular one soon after."

Los Alamos was for me an amazing place, interdisciplinary as a matter of course. It was a given, no hyphenated-program-projects requiring people from different fields to speak to one another, no proclaiming signs on the door. We just did it. When I was at the Lab some of the intellectual aristocracy of the war years remained. How did leaders such as Metropolis, Mark, Bell, and Rota make their judgments? How did Ulam? There are sometimes tiresome discussions in mathematics and computer science about "depth," and great emphasis is given to what is called "technical." I don't think this was in Stan's vocabulary or frame of reference. Obviously Stan saw very deeply, but it appeared to be without effort. I believe he just wandered about his world, gazing at this and that, sometimes moving something a bit to see what it was. Occasionally he reported back to us. It seemed to me he thought he was going slowly while the rest of us thought he was lightning.

Early in 1984 Mark Kac, slightly younger and also from the Steinhaus-Banach clique in Poland, was able to lure his close friend Stan Ulam to visit the University of Southern California where Kac and I were on the faculty. USC was the site of Stan's terrible illness in 1946, and he had not liked the place anyway, referring to USC as second-rate. Hopefully with Kac in Los Angeles he thought USC had improved a bit since the 1940s. I took the lead in driving Stan to and from his hotel, and he was excessively grateful. I was

happy just to breathe the same air that he did. We had conversations about sequence alignment and evolution, and Stan's lecture had a title something like "Mathematics and Biology." As I said above, one never really knew what he had in mind. The acting mathematics chair at that time was not impressed with me which he had made evident. Stan began his lecture by saying he had a cold, but the audience was not to worry, Mike Waterman was in the audience and could take over anytime his voice gave out. My stock with the chair rose immediately, something I thought to be silly. But it was a marvel to sit in a room with Mark Kac and Stan Ulam, two great European mathematicians who now considered themselves Americans, and think "I actually know these guys!"

The first RECOMB (Research in Computational Biology) conference was held in Santa Fe, New Mexico in January 1997. It became a preeminent annual international conference in computational biology which Sorin Istrail, Pavel Pevzner and I started with much help from Ron Shamir. Sorin and I created an annual Ulam Lecture, and Eric Lander came to Santa Fe, Stan's hometown, to give his usual inspiring brilliant lecture. Here is some of my introduction to that lecture.

I was fortunate to have my first choice to deliver the first Ulam Lecture: Eric Lander. Some of you know what a furious schedule he has and appreciate our good fortune to have him here. People speak of "Lander sightings," and somewhere there may be someone whose job it is to keep a database of these occurrences. I must admit I had my moments until he appeared this afternoon. The Poisson distribution was invented to characterize just such rare events as these. I can hear Sam Karlin saying, "Yes, but it is an inhomogeneous stochastic process!" Whatever, we are in luck tonight.

Like Stan Ulam, Eric Lander is someone who moves very very fast, at least from the point of view of us mortals. I wonder sometimes about what Stan Ulam would have had to say about the exciting discoveries in biology. And what would he have had to say to Eric Lander about Eric's maps and genes. I very much wish to have heard that conversation, and they did not miss each other by many years. I want to be there, in a room listening to them go, watching their gestures. I am not at all sure I could have kept up, but it would have been remarkable to witness.

Alas it is too late for that conversation, but tonight we have the next best thing, a genuine Eric Lander lecture.

We had hoped to have Stan's widow Françoise Ulam at the lecture, but she was recovering from a minor operation. But their granddaughter Rebecca Ulam Weiner, a student at Harvard, was visiting her grandmother and she attended. She met Eric, and I remember him telling her that he taught introductory biology for both MIT and Harvard students and that she should take his class. Both Nick Metropolis and Bill Beyer were in the audience sitting at my table. I believe it was the last conference event that Metropolis attended. Sorin, Pavel and I went that evening to Stan's home to make some gifts of appreciation to Françoise.

Before the lecture when I met with Eric Lander, he said "So Mike, who was Ulam?" I quote this in hope that it will help us all put our lives into perspective. If a mathematician (and biologist) such as Eric Lander had not heard of a mathematician (and physicist) such as Stanislaw Ulam, then none of the rest of us can expect to be remembered for more than a few minutes, if at all. We must retire our egos and fully engage in being here to take part in science and life. Ulam may have transformed mathematics and made crucial contributions to physics which it was believed would save the world; Lander may have made advances to reveal and then understand the very text of the human genome. But each of us should cherish the days when, as my friend Uncle Stan would say, "Well, I think we have learned a little something today."

Nick the Greek

Nicholas Metropolis
1915–1999

I was invited to Los Alamos Scientific Laboratories in the fall of 1969 to present a lecture on my work. I had no serious interest in pursuing a research career, so I thought then, and gave my first presentation outside of the university where I received my PhD simply because my advisor John Kinney had a connection at Los Alamos. Bill Beyer planned to bring me to the Lab the next summer, and there I was, behind the security fence with a visitor's badge dangling from my shirt collar, giving my account of the discovery I had made to receive a doctorate. My thesis had its roots in two papers, one by C.J. Everett at Los Alamos and the other by Alfred Renyi, the renowned Hungarian mathematician.

At the close of my lecture there were a few questions, one from a short striking man. Even then Nick Metropolis had a shock of white hair, and with his slightly rumpled checkered sports coat, there was a chunk of turquoise instead of the tie some might have expected. He had already lived in New Mexico for 25 years. As soon as I could I asked Bill Beyer, "Was that C.J. Everett?"

"Oh no, C.J. never comes to public lectures!" Bill answered in surprise that I did not know such a well-known and obvious fact. "That was Nick Metropolis." (It turned out that C.J. Everett was a recluse at the Lab, and he avoided most human contact.) Then Bill introduced me to Nick, and I fell permanently under the spell of that elegant man. Nick Metropolis had style, from that lump of turquoise at his throat to his turn of phrase and quick wit, and he was one of those humans who are entirely at ease. I was never as close to him as I became with Gian-Carlo Rota or even with Stan

Ulam, but I felt his warmth and approval and knew first-hand of his lively interest in a variety of scientific topics.

Many years later, after I had been a visitor during the summers of the first half of the 1970s and then a full-time employee in the Statistics Group from 1975 until 1982, I came to Los Alamos as a member of a committee to evaluate a computational biology group there. We were more than once smugly told, “We are part of T-Division, the first Division at the Lab, and we are very proud of that.” It struck me that I had been supported by people like George Bell and Nick Metropolis when I was far from the Theoretical Division in the Laboratory, and the notion that Nick would care where I was sitting in the organizational structure rather than about the quality and importance of my work was absurd. That Lab was elitist is certain, but for the old guard, that elitism was based on scientific contributions, not organization charts.

Nick’s career contained remarkable triumphs: the war-time efforts at Los Alamos, the creation of some of the first digital computers including the MANIAC series (in 1970 the MANIAC II still had vacuum tubes), his paper with Paul Stein that first discovered the period-doubling that Mitch Feigenbaum went on to make famous, and the astonishingly wide-spread Metropolis simulation algorithm that is so useful for difficult optimization problems. Nick seamlessly combined his physics insights with mathematical elegance to make significant contributions. I do not remember where in the complex of buildings Nick had his office. The office was not brightly lighted and the ceilings were taller than in other rooms. When I visited Nick, there was always a measured calm about him and his responses were carefully thought out.

I held people like Ulam and Metropolis in high regard. They were the great ones, but as in any family when you look closely there are imperfections and conflicts under the surface. In a 1993 interview with Richard Rhodes, Nick says, “Stan Ulam was here during the war, but he didn’t do much during the war.” That’s if you count inventing Monte Carlo simulation and modern branching processes plus the work in physics as “not much.” About the Monte Carlo simulation efforts for the Manhattan Project, he says “Yeah, but that was not a very good piece of work,” the reason being “it was being done by throwing dice, random numbers.” After Ulam’s brain operation, Nick went to Los Angeles and suggested Stan resign from USC and return to Los Alamos. Nick greatly resented that Stan did not acknowledge that. My reaction is “so what,” one does that sort of thing for friendship, not public or even private credit.

Metropolis is the lead author on the paper describing the method known as the Metropolis algorithm, the other authors being married couples, the Rosenbluths and the Tellers. I heard a rumor (not at Los Alamos) that Martin Rosenbluth greatly resented the credit Nick received. I did not pursue it, knowing the painful efforts that are sometimes made to increase or diminish credit. Finally I read a 2003 interview with Rosenbluth where he said “Metropolis was boss of the computer laboratory. We never had a single scientific discussion with him.” That does not sound like the man I knew but Rosenbluth is convincing.

Newcomers to New Mexico always glory in the clear air. Once Nick told me that the air had been clear in 1945, but it was steadily getting worse. Then you could really see into the distance, he said. When I lived in Santa Fe and commuted to Los Alamos, when I topped the rise out of Santa Fe after a snowstorm, the air was totally clear. I could then see snow-covered Mt. San Antonio 70 miles toward Colorado, and once made a trip just to see that isolated landmass up close.

Due to a marriage of their relatives, Nick became acquainted with the Lebanese investment banker Jacqui Safra. Safra created an advisory board with the name Global Pursuits. I was invited to join and it was an awesome crew, including Gian-Carlo Rota, Daniel Kleitman, Danny Hillis, Robert Sokolowski, and Nick. Once a year we would meet for one day in a luxury hotel, and along with the stimulating sessions, we would eat and drink extremely well. One evening in early winter, walking down a Boston street, I told Nick of my astonishment and pleasure at the beginning of the Woody Allen film *Husbands and Wives* (1992) to hear Nick (as “TV Scientist”) giving a lecture on physics on an unwatched television set in the living room. Nick quotes Einstein as saying that “God does not play dice with the universe,” and then Woody Allen says “No, he just plays hide and seek.” It fit perfectly, and I told Nick teasingly that I was happy finally to know a movie star. “I live in Los Angeles now,” I said, “but the first person I happen to know who is in the movies is from New Mexico!” He came back with a story about his connection with Woody Allen and his recent appearance in the film *The Ox*. “I have my movie career to think of now,” he said with gentle irony and pleasure at the turns of life.

On a brief visit to Los Alamos during the late 1980s, I saw Nick in the lunchroom. He called me over and told me a story about “a friend of mine”

who had seen him and Jim Louck having lunch as they so often did. Nick did not recall my friend's name, but he vividly recalled the incident. My friend had come up and told them how surprised he was to see them. "I thought you both were dead," he said. Nick was still irritated at Temple Smith for that breach. I was surprised Nick even cared and knew that Temple had not said it to upset them.

Some years after that, Nick began to suffer from senile dementia. Not even his appointment as a permanent Emeritus of the Laboratory could save him from his slow decline. Due to a bitter divorce in 1977, all details of which I am ignorant, not even his children were in contact with him, and only old friends such as Bill Beyer and Jim Louck went to see him in the care facility. Global Pursuits met no more; I cannot imagine it without his sparkling presence. The idea of a person so elegant and dignified in appearance and thought sliding into unconsciousness is unpleasant.

One pleasure of mine was a rumor Gian-Carlo passed to me, that Nick Metropolis had dated Georgia O'Keeffe. I did not try to verify its truth because I did not want to learn it was untrue. O'Keeffe was older than Nick—about 25 years older—but this did not show the story to be false: she was famous for her fondness for younger men. And Nick liked older women! When I tried to slip the rumor into a short essay about Gian-Carlo I wrote for *Notices of the American Mathematical Society*, the editor balked, saying, "Such salacious gossip has no place in a mathematics journal." I thought it might be valuable to show that mathematicians had lives besides doing mathematics. So before making a big fuss, I decided I should finally check on the story's truth. Bill Beyer said he had only heard it from me, and his wife Ann said she was positive it was false. I gave in to my narrow-minded prudish editor and later an e-mail came from Bill. "Yes, the O'Keeffe story is true. I have a copy of Nick's own words for it. So you were right the first time."

It turns out that in an unpublished essay about his life Nick tells of spending many evenings at Abiquiu with Georgia O'Keeffe, "talking philosophy." Now Nick, I can see the twinkle in your Greek eyes as you tell me this, and you know that I will guess the truth. Philosophy! It is only proper that a child of immigrant parents from Chicago who worked to save our country during the big war and who helped bring the electronic age into being should have this, only right that with such elegance and grace and wit you should spend crisp high-altitude evenings at Abiquiu with another startlingly original American. I am certain you both had a glorious time!

Some of my own great good fortune has run out, as it must for all of us. I, a child of isolation and rain and mud of southwestern Oregon, I knew Stan Ulam, Gian-Carlo Rota, and Nick Metropolis, I stood in the same room with them, I ate at the same table, I rode in their car across the mesas. And I met totally urban Mark Kac at Los Alamos when he came to see his old friend Stan Ulam. Heavy brilliant sunlight of summer-time Los Alamos, thunderstorms gathering over the Jemez mountains. Stan went first in 1984, but not until after Mark Kac lured him back to Los Angeles, the scene of Stan's post-war illness and despair, and I drove him around the city I had become as accustomed to as I had the mesas of northern New Mexico. Not long after that Mark was gone too. Then in one year 1999 there was the shocking loss of Gian-Carlo, followed by the more expected but no less saddening exit of Nick the Greek. It was indeed the end of the century.

Nick, I shall always remember the afternoon sunlight slanted across the wide Rio Grande Valley as you drive off the mesa into huge shadows and turn north before the river, up and down across the arroyos, turn northwest again at the Rio Grande Cafe in Española, then go upstream along the Rio Chama past big cottonwoods and pastures and bean fields and adobe houses, scenes a new American painter was sculpting onto canvas, dry stony draws with stark skulls and thirsty bones and voluptuous flowers projected over them, then head up the rise to Abiquiu, check the bottle of Burgundy under the coat on the seat beside you, and then feel the cool rush of air into the open windows as you descend into the cottonwoods at the river's edge; ahead are the powerful oxbows of the Chama, and then that long run of land where the black volcanic knob of Cerro Pedernal juts out of the eroded edge of the Jemez mountains, but today you are not going that far around this ancient collapsed volcano. That's where you will always be, just about to stop the car beneath sandstone cliffs and walk through the soft early darkness on the path of small stones to that large weathered door.

Fishing Around

Before I moved to Los Alamos, New Mexico the summer of 1975, I spent three summers there, an Idaho refugee working at Los Alamos National Laboratory. And I had been up in the Jemez Mountains, a huge volcanic land-island in northern New Mexico. What Laboratory employee didn't take that twisting drive up precipitous Route 4 and gaze into the Valle Grande, one of the world's largest calderas, 15 miles in diameter in the center of the Jemez Mountains. When I lived there, it was magnificent cattle ranch known as the Baca Ranch, and now it is the Valles Caldera National Preserve. I had done more than just take a car ride, and in 1970 carrying a Camp Trials backpack, I had circled the backcountry of Bandelier National Monument before a big fire in the 1980s ravaged the large pines at the upper end of the Monument and before a dam backed the muddy Rio Grande up the canyon to create Cochiti Lake. That was my first real backpack trip where in dim morning light a fox trotting down Frijoles Canyon leaped at the sight of me. So I could claim some direct experience with the country, more than some of those who had spent years working behind the security fence at the Laboratory.

During my first summer in New Mexico in 1970, Bob Schrandt, a programmer in T-Division, found that I fished for trout, and he took me up past the Valle, then down the Jemez River, which brushes by the road to then swing away in a several-mile-long loop before coming back to cross under the highway. Bob and I would park at the highway crossing and fish upstream in the evenings, the severe brightness of the day softening, small brown trout beginning to rise, making delicate dimples on the water. Bob was a fly fisherman of the Eastern school, using small carefully cast flies. I had been catching big trout in large rough crashing Idaho rivers with spinning equipment and considered those New Mexico trips pleasant social outings. I did pick up a little fly-fishing knowledge in spite of myself. And we caught a few small fish which fit the water and the flies, although I kept my council

about that. That was almost all the fishing we had in New Mexico, so why complain about it? I did not then know of the fabulous fishing below Navajo Lake on the San Juan River, and I had not been in the Gila River headwaters far to the south.

Bob told me a nice story about fishing in the Jemez during the war. One of the famous European physicists, Enrico Fermi perhaps, asked why people went fishing as the eating of trout could not be enough reason to spend the time it apparently took to catch them. He received a long explanation about the imitation of insects by tying feathers on hooks and of the difficulty of presenting the flies to the trout in a way that convinced them to take. After the fishing enthusiast finally ran down, there was a pause. Then the great man said, "I think I see what is going on. You are trying to determine who is smarter, you or the fish." Bob and I both knew in our case the fish were almost always smarter. In Ulam's autobiography *Adventures of a Mathematician* on page 164 is Ulam's version of the story. It may be more accurate than mine. The fisherman was Emilio Sergé and Fermi said, "Oh, I see, Emilio, it is a battle of the wits."

Once we went up the North Fork of the Jemez, and it was much the same with less water. And we took most of a day and went on a longer trip into the Jemez to Fenton Lake, where we rented a boat and rowed out into heavy weeds and caught trout that came up in the channels. I am not inclined to fishing from boats, and we didn't repeat that adventure, although because the fish were a little bigger there, we would sometimes say, "Well, we *could* go back out to Fenton."

This did not exhaust all the available trout fishing; there were two little lakes, usually muddy, on the Santa Clara Indian Reservation toward Española where we could pay a fee to cast our lines. Those lakes were not worth taking any time off from work but we spent a few pleasant evenings there.

Twice we drove past Española up the Rio Grande River to the Taos Box Canyon. It was beautiful country, raw and rugged. We went to the Box on a bumpy rock-and-dirt road and parked at the bridge. A thunderstorm caught us on the road once, the sluice of huge drops overwhelming the wipers, and we had to stop, the road bank beside us eroding away with mud and rocks cascading onto the road. The sagebrush-ozone smell of late summer New Mexico air after a crashing storm. The water was never quite clear enough to catch trout, as thunderstorms were usually raging somewhere up-river and the violent rains caused the water to color. The Rio was a nice size compared to the Jemez River, and I enjoyed roll casting across the river to the water

running against the volcanic canyon wall.

The best aspect of these fishing trips was Bob Schrandt himself, a truly gentle person in awe of the great men he was working with, of Carson Mark, Stan Ulam, Paul Stein and Nick Metropolis. He puffed his pipe as he drove through the wonderful evening air and talked of computers and trout. Bob was a deeply contented man, much as my grandfathers had been. I very much liked his company.

After a few years in Idaho my intense joy of fishing moderated. I still loved going with my friend and fishing mentor Frank Lane. One of our last trips was late in the season across the desolate Fort Hall Indian Reservation to the Blackfoot River. Water from the reservoir had been drained so that not much of a stream was flowing. It was bitter cold and we walked down to the river to a pool where the downstream third of the pool was frozen over. Fish were rising in the open water, and we used fly rods—the spinning gear would not work due to the freezing cold, and the fly line had to stay at fixed length, coated with ice as it was. We'd hook a fish and then try to bounce out up over the lip of the ice to bring it in. Often the fish would dart under the ice and escape.

The next summer I went out with Frank. We were so close that when one of us said, I've got a good one, the other would reel in and watch the fish being played. By this time I was as good with spinning gear as I wanted to be, and I'd find some willows, behind which I'd nap. Frank Lane was the best fishing partner I ever had, but I was pretty much fished out by this time. Then I moved to New Mexico in 1975, never again to live in Idaho.

After my illness I thought I'd never be able to go backpacking again, but slowly I regained some of those pleasures. Several times I went from California to New Mexico to walk in the Gila Wilderness, country I love deeply. I'd carry a light pack the four miles from the Willow Creek Campground to Iron Creek, a stream that is home to one of the two isolated subspecies of Gila trout. I have a favorite campsite there. The next two paragraphs are taken from my journal of a 1995 trip.

.... Then I spent the afternoon fishing upstream from my camp. The creek is small, and there are few pools to support the small trout. The creek swings back and forth across the narrow valley,

creating uprooted trees and open gravel banks and sandbars. It is doing its job of valley building. I want it to grow trout, but rivers are not concerned with anything other than gravity. I find and keep a turkey feather from one of the famous Gila wild turkeys. They are so elusive that I am happy to see even a turkey track.

The day is brilliant. Sunlight, clear air, blue sky, the cleanest water. The occasional fish sometimes takes a fly before darting for cover. They are located at certain places in these pools—beside a rock, under a submerged tree trunk—and they are gone at any motion or vibration. I can make long casts with a fly line that is heavy for my six-piece five-foot-long fly rod. The line swings back behind me over the strata of sand, gravel and logs, and then the little rod powers it forward, sometimes even dropping the fly where I intend. It is just watching the water; I feel my arms and legs and feet that make these unplanned casts. I wade in sandals so the water is cold on my feet and ankles; the sun is on my back; time has gone off somewhere so that there is no such thing as hurry or tomorrow. Or yesterday. The water runs to me, the fish are always just ahead. I have not enjoyed an afternoon outdoors so much for years and years. The right place, the right time; they come seldom enough.

Falling Off Mountains

Early June of 1978 I had leave from Los Alamos to work a few weeks with Temple Smith at Northern Michigan University in Marquette Michigan. My daughter had just arrived in New Mexico and was accompanying me on the trip. When she left New Mexico, she was 9 years old and now at 11 the stress of her life with my ex-wife and her next husband were showing. My ex had married a truck driver who resented my daughter and made her life miserable. It was a chance for Tracey and me to be together.

Jeff Dodd lived in my home in Casa Alegre then, and he kept things pleasantly humming with the stir of his friends and activities. I had come down with the flu, perhaps a severe cold virus, but it seemed to be normal and I was anxious to get going on my summer trip. So I set out in my little Honda, still feeling ill. A travel tape I had made came to the wonderful Bob Wills' song "When you leave Amarillo please turn out the lights" just as we passed Amarillo Texas on the freeway, and I felt like we were off to a good start. We made 600 miles to Oklahoma City that first day, and I was not feeling better. In a few days we were in the northern peninsula of Michigan, moving into an elegant old house with a widow's walk (for wives of seagoing captains to stroll while waiting for their men to return from perilous seas). Temple seemed acutely aware of the current resident, a woman who was away for a few weeks and renting her home to me. At the end of my stay, he and I met with her, and Temple seemed to think I should have been aggressively pursuing her—which was not my style but more to the point I believe she was not interested in men which did not occur to my friend.

Temple and I had a decent month finishing a paper about computational methods for comparing how close two evolutionary trees were. We had failed to find a satisfactory solution and were writing in hope someone else could solve the problem. The techniques I wrote were even more flawed than I thought then, but the problem was difficult as others who followed us found.

The highlight of the summer was when Temple returned from a Gordon Conference in New England to report that introns had been discovered in 1977. Genes encoding proteins in bacteria were known to proceed from start codon to stop codon, spelling out the amino acids one after another, and no one guessed that in other more complex organisms the DNA encoding a gene was broken into pieces (exons) interrupted by other pieces (introns), which were eventually snipped (spliced) out and discarded. This was shocking, almost unbelievable! How could that be? Why? We knew instantly that the sequence alignment methods we had been using would not properly align two related gene regions that were interrupted by introns. How to solve this new problem became in the next year or two our main focus. Exactly what the mathematical statement should be was unclear. That it was important and needed solving was evident to us both. Work in biology was my spare-time research hobby, not my main job.

Temple was unhappy to be stuck in Michigan and he did not make a secret of it. Not everyone there appreciated his deep dissatisfaction. One of his friends was an older guy in the English Department who took a liking to me and we talked about literature. I mentioned Pirsig's book, *Zen and the Art of Motorcycle Maintenance*. Temple's friend responded, "Oh I know Pirsig. When he became wealthy from the royalties he bought a boat and planned to sail around the world. The auxiliary motor broke down on Lake Superior near here, and while the repairs were taking place, we entertained him in Marquette. He is your kind of guy, you know, at a party he drinks whiskey in the kitchen." How he guessed that I drank whiskey in the kitchen at parties, I don't know, but he had my number. I am still waiting to meet Pirsig in some kitchen.

My summer just dragged along though. I didn't feel normal, nothing critical or noteworthy, just subpar. Getting enough rest after the trip didn't seem to help. I tried jogging but that didn't pick me up at all. I kept active with Tracey and we took a road trip along Michigan's shore. At a campsite inside our tent, black flies bit Tracey whom I remember with two streams of bright red blood flowing down her face.

Driving back to New Mexico we followed a northerly route to the Black Hills. I was frustrated with the lack of open public land on which to camp, and around Rapid City I searched for a place to camp free of charge. Finally I located a spot and pitched the tent. Late that night a car of young men parked on a hill above us for an evening of drinking. They eventually commented on the tent below, and one said, "Let's shoot at that tent down there

and see what happens.” Laughter followed. I was frightened. My daughter would have complained loudly if I had tried to move her to the car and escape, and I thought it would not be wise to try. Instead I crawled out of the tent, and although there were no sticks to use as a club, I found a good rock for each hand, and in the darkness stood not far from the car, waiting for one of them to come out with a gun. I was sure that in the night I could get next to them, and, using hand-held rocks as a club, drop the first one, quite likely the second, and certainly could save my child if not myself. They left after an hour or so, and I tossed the rocks away to crawl back into my sleeping bag. There was no sleep for me, and eventually I wondered that, while with good reasons I had thought of myself to be a coward, perhaps there might be exceptions.

When we read fiction, watch a movie, or hear an account such as this one, the stories are biased, and we often can guess what is coming and wonder why the main characters do not. In life there are no such loadings of clues that are required to have connections with what follows. Why ever would there be? If I had not been facing what I came to think of as a dark abyss, I would not tell this story with any mention of the flu. I would have completely forgotten a minor health incident and even if I hadn't would never have mentioned it. But there I was, not feeling any better. The worst was to come.

My hike the previous fall along the continental divide gave me views into country I wanted to explore, and I thought a good backpack trip might help me recover. So I drove north to Alamosa Colorado, and followed the Rio Grande to a trailhead on Ute Creek. The headwaters of Ute Creek are along a part of the divide where on my 70-mile hike I lost the faint trail and descended below 11,000 feet into the Pacific drainage. So I was interested to see what I had missed. I had plans to make a high-altitude base camp and make one-day pack-free trips in the high country. At the trailhead was a fine pool I didn't fish in; instead, I went up the wilderness trail to Middle Ute Creek. My energy seemed to drain as I walked, with none of the deep reserve of strength I always depended on. This was high country where oxygen is thin and I was gaining elevation. Pitching my tent I forced myself to fish, and above a high falls, I spooked a sizable trout in the tiny creek. It rocketed away with a splash and wake. I wondered why I didn't find myself more excited at such an event. Then I spent the next two days in misery in my tent. I had a bowel movement that appeared to be green (and if my weak color vision saw it as green, then green it was). It was as if I had a bad case of the flu and I didn't carry out any of my planned excursions. Could it be

altitude sickness? I had never had altitude sickness but perhaps this was it. I had dreamed of checking this country out; I had walked about it in my imagination but all I could do was lay in a tent and feel ill.

Back in Santa Fe I continued to feel as if I had the flu: my arms and legs ached, my head hurt with sharp pain, and I had no energy for anything. I could not get enough rest. The lymph glands in my neck were swollen. There was no respite from how I was feeling, no escape. I went to doctors who gave me standard tests and told me nothing was wrong. In Santa Fe I went to one of the best physicians in the state, and as soon as tests were negative, he told me nothing was physically wrong, and I should see a psychiatrist. All of these people told me being tired was normal and I was just getting old (at 36 years of age). With my background of heavy manual labor, these people were telling me about being tired? Headaches appeared that aspirin could not touch. Physicians diagnosed this as “tension headache” that seemed to be a catchall category for headaches for which they could find no cause. The name tension headache puts weight on the patient. What if they had called it “headache we cannot diagnose”? Eventually I was prescribed Fiorinal, a blend of aspirin, a barbiturate and caffeine, and that stopped the headaches, nothing else did. I am still grateful for that cocktail! The worst aspect of all this was the deep dark hopeless state I’d fall into, no energy, no light, no hope for getting better. Physical and mental activity halted. Unrelenting exhaustion day and night without relief.

When the visits to physicians proved to be completely useless, I was quietly desperate. That fall I began to keep a record of what I did each day. Perhaps the cause of my mysterious ailment really was psychological, perhaps it was what I ate, perhaps it was what I was doing. After all I still smoked marijuana and drank alcohol. Whatever was happening to me? I recorded my emotional state, my personal stresses and upsets, and my diet including my intake of food, alcohol and marijuana. All my life after escaping the Oregon coast, I relaxed with heavy physical activity. I didn’t play sports, but instead I’d work out by running, lifting weights or carrying a pack up a mountain trail. Exercise dissipated stress and relaxed me. People talk about being bored or hating the strain of physical exercise; I liked it, enjoyed feeling my body work. I didn’t need anything to distract me from activity. As I mentioned I had tried running and hiking with this ailment to poor effect. (I still believed what I had to be an illness, however mysterious and unknowable.) As I assembled the data I kept looking for a signal correlating to how I felt. Finally I saw in my record what we sometimes call a lag

correlation. After heavy exercise, two or three days later I'd have what I came to call a collapse. After a collapse it would take a good while before I was any better. So I stopped such excess exercise which helped somewhat but not much. I still had collapses.

My mental image of a collapse was falling down a mountain. It would not be a fall to the bottom the first time, but I would land on a ledge, battered but surviving on a narrow precarious ledge. I'd hope that I could improve my situation, and then a slight bump came and I'd fall again. This occurred in darkness without any idea how far there was to fall. This happened over and over, descending painfully into some deep bottomless hole. It was hideous, hopeless, dismal. Saying this was depressing does not begin to describe my state, physically or emotionally. Usually when one is ill, there is much sympathy from others. Not with this: people would say, "Oh, everyone gets tired." And when I see photographs of me during my worst days, I look well enough. My illness and the accretion of deep despair are invisible.

My work at the Lab declined to nothing at this time. I could not even think, let alone derive any statistics or mathematics. At Los Alamos, I was a resource for the statistics group. I had some assigned projects, but when something unusual came up, I often was asked about it. I recall Dick Beckman saying he had supported hiring me, that he was not certain precisely why but thought the group could use someone like me. It seemed to have worked out well until this time when I became useless.

Mike McKay, who had an unusual and probing intelligence, came home from a trip and asked me what was so special about base 10. I had no idea what he was talking about, but eventually he showed me a puzzle problem from the TWA flight magazine. It was for base 10 numbers, and Mike not only wanted to understand the solution better, but he wanted to know why and how it did or did not work for other bases than 10. We struggled a bit and got a glimpse of the answer but I just could not keep it straight. Things got worse after that. I was finished as a researcher.

Many of my friends in Santa Fe were real estate agents and contractors. They had some idea that I was ill with no diagnosis. One day I received a call from one of them, and she excitedly told me she thought she knew what I had. I cannot remember what it was, but I looked the symptoms up and they fit. Moreover there was no cure as it was the initial stages of some dreadful form of cancer. I knew what to do, so I thought. First I told Jeff Dodd he'd have to move out. I was abrupt, and Jeff was upset as I did not give a reason. Had I told the truth he'd not have gone. After he

cleared out, I took my 30-06 (thirty-aught-six) from its case where it had been untouched for several years. I loaded the gun with two bullets, none placed in the chamber, although I worked a bullet in and then out with the bolt action. Given my intention, I don't know what I was doing with two bullets but that's what I did. One would do the job. I then stood the rifle in a quiet corner of my front room. My grandfather Waterman had committed suicide with his old 30-30 when he was terminally ill but still had control. I thought he had profound courage and wisdom, and I admired his action. Thinking slightly ahead, I had a revelation as to where he had discharged the bullet which went through his heart: on the back steps so that the family could pretend that it had been an accident and where he could use the steps to prop up the rifle against his chest. It was outside where he could hear his beloved Four Mile Creek, by the steps to hold the gun at a proper elevation. I intended to kill myself after the diagnosis was verified. Feeling so awful with things certain to get worse was intolerable. It was already intolerable, with the uncertainty and dreadful hopelessness of the illness. Perhaps I'd at least know what I had. However the diagnosis was not verified by tests, and after a few weeks I unloaded and cased the rifle while its possibility remained with me. Jeff Dodd never forgave me for rudely ejecting him from my house, and I never explained what had happened. What terrible losses we experience as we go through life.

There was no out, no ending to the story. No narrative where I could take this, do that, and then get better. No narrative where I was destined never to get better but to decline and die. There was just an amorphous hopeless undefined pit that could not be scaled or even grasped, the bottom of which was unimaginable, because every time I thought things could not get worse, they did. The only certainty was my 30-06. People often fail when shooting themselves due to an imperfect idea of where the vital parts are located in the human body. As did my grandfather I knew where my heart was and how to extinguish it. If I just had an orientation to the location of my health.

During the summer I met a striking person. Charlie Smith was a statistician and administrator at the new Energy Information Administration in Washington. Brash, confident and opinionated, Charlie had repeatedly stated that there were no qualified statisticians at Los Alamos. Eventually the new head of EIA Lincoln Moses from Stanford forced him to come to New Mexico to verify this claim. The stat group had a day-long meeting with him, with presentation after presentation. I attended some of them and saw Charlie behave brutally to one of our masters-level staff. Merle was

a young Japanese-American woman. She was passive-aggressive, which after finally understanding the passive-aggressive manipulations of my ex-wife, did not make Merle popular with me. Still I think that junior people should not get the severe treatment Charlie gave her. I went back to my office and planned my presentation at the end of the day. He held in lofty regard Princeton and John Tukey and repeatedly referred to them. The group leaders wanted to show off some of my biology work and I presented some RNA results. Charlie listened carefully to the beautiful material and afterward told me in a slightly condescending manner that it was not all new and I should check with John Tukey. I had prepared my reply. "That's strange. I presented this material at Bell Labs and at Princeton with John Tukey in the audience both times, and he never mentioned any prior work on the topic." After this episode, I moved up in Charlie Smith's estimation and he had me visit Washington to explore projects he could fund me to work on. Really, I was just trying to stick it to him for his nastiness to Merle, and instead it gave me a boost with him. I admit I can like certain smart people even when they are difficult; not always but in some cases.

However Charlie Smith got some idea of how awful I was feeling and how useless I'd be unless I got better, and he told me, "You've got to see a good physician." I told him I'd seen good physicians and it was a waste of everyone's time. "No, no, I mean a first-rate physician. You don't know what a good medical doctor is." He gave me the telephone number of John Seed who lived in Princeton New Jersey. Charlie and Princeton again!

I was willing to try it and called John Seed who had an office in the Princeton Electrical Engineering Department. But he also spent several days a week at a free clinic, the Martin Luther King Jr. Health Center in the Bronx on Bathgate Avenue. John asked me to go there to see him and gave me frightening directions for the subway. Instead I drove a rental car through streets that looked bombed out and parked my car on brick rubble from a collapsed building. It was summer, humid and hotter than hell, and fire hydrants were opened by young blacks who were sitting in the spray. In to see John Seed, he examined my body. "How long after your finger was broken did you have it set?" he asked. I've never had any broken bones, I answered. Yes you have. And all these scars on your right hand? Barbed wire, I answered, and there were 37 stitches too, I quickly added. And this one? Barbed wire too. This scar too? No that was broken glass. And this one? A knife slipped when I was working sheep, I answered. (John was used to seeing the results of street-gang violence, and he was obviously skeptical

of my explanations.) He was especially interested in a wide white scar on my leg. A knife slipped, I said. I'll bet it did. Didn't you see a physician? No, just that one time for the barbed wire.

John Seed asked me for several laboratory tests, some of them to be "after three weeks with no alcohol." Nothing showed up in the tests, and I saw John once more, this time in his Princeton office. John Seed was truly different in how he treated me. He listened to what I said and he explained his reasoning. I had been frustrated not doing any running or exercise and was trying to do what little activity I could up to that invisible barrier at which I'd fall from my precarious state of health. He encouraged me to continue to do this. It sounds trite but it was not; for the first time, I had someone hear me and support doing something about my situation. I am a determined and stubborn person, and this was an invisible turning point. Later some liver tests came in 50% above normal. My Santa Fe physician told me it was nothing; John Seed told me how many standard deviations above normal the results were and that I should have the tests done again in a few weeks. He did not diagnose my ailment, but he believed I was ill and encouraged a practical attitude and approach to my illness.

The spring of 1979 a woman named Sandie Douglas moved from Juneau Alaska to Santa Fe with two of her children. She knew George Parker, a friend from Idaho, so she had my telephone number. Originally from Texas, Sandie had vitality and energy and we hit it off. She seemed to take seriously ghosts and spirits, but that sort of thing didn't really bother me. Even in this time of my lagging strength, we became lovers and spent time together. She could tell instantly how I was feeling, and that sensitivity was very reassuring—someone could see me. Sandie was active around Santa Fe, and one night she insisted we go to a musical performance where Peter Rowan was playing bluegrass. I didn't want to go but was swept along. Peter Rowan was just fine, not great but okay to listen to. Then he finished, and a guy in bib overalls came out and said, "Hello I'm Norman Blake. Ain't that Peter Rowan just somethin'!" Well hell, I thought, I am sitting here hurting and this clown dressed like a farmer is standing up there to tell me how great the last guy was. I told Sandie it was time to leave. Then Norman Blake moved his hands across his guitar and pure American mountain music appeared; I was transported by it. Norman and Nancy Blake sang and played songs possessing a sad authentic purity, flowing like late-fall-afternoon sunlight. His music entered me and for those brief minutes took me outside my misery. What an amazing evening! I have been fortunate to see Norman

Blake perform several times since then. Other great bluegrass players appeal to me: John Hartford who brought marijuana to bluegrass, Danny Barnes who brought punk, and Gangstagrass who infused hip hop and rap, but if I had a last player to hear in my life, it would be Norman Blake in his Bluebird touring bus.

John Seed supported me in having faith in myself and my ability to cope with my illness. Sandie and Norman, each in their unique way, showed me that joy was not impossible even in my desolate state. What good fortune I had!

Everybody Does It In Hawaii

Tom Pitcher predicted disaster if I went to Idaho, and when that did not happen he was impressed. So much so that he invited me to join him at places he worked, the University of Southern California and later the University of Hawaii. A mean-spirited man would have been peeved that his predictions of failure did not come to pass. Tom was generous within the boundaries of his world of high standards in mathematics, music, and poetry. The spring of 1979 in New Mexico I could not perform even simple analytical thinking. My entire body was aching and it had no reserve for anything else. I took Tom up on his invitation to Hawaii and went there the academic year of 1979-80. He managed to obtain for me a position as Full Professor which surely helped justify the salary. I was 37 years old. For a tape of music I left for Sandie Douglas, I included 1929 Jimmie Rodgers song of the above title; Jimmie pronounced Hawaii as Haa-Y-ahhh and he brought ukuleles, popular in Hawaii, into country music. Sandie didn't appreciate the joke.

Tom and his girlfriend Theresa picked up me and my one suitcase at the Honolulu airport and hung a lei around my neck. Tom had prepared an Irish stew from a cookbook, and I recall an open copy of Yeats sitting on the dining table. The weather was incredibly humid, everything—plants, insects, mold— was growing faster than I could have imagined. Remember I was from the arid Southwest where 1000-year-old relics of native civilizations are scattered about in the open air. Taking a deep breath in New Mexico was like a hit of good gin taken straight from the freezer. In Honolulu the air was warm and heavy with moisture and spores and the odors of life and decay. Hell, I could hardly get around anyway, and I wondered if I had made a terrible mistake, if being in Hawaii would be worse for my health....

The next day Tom took me for a long drive from one place to another with the vague goal of finding me housing. “It’s not simple here,” he said without telling me what the complications were. More than housing was complicated in Hawaii, he implied, and I wondered just what he meant. Eventually we found someone who knew someone who definitely had a friend with knowledge of a room to rent. Fate, chance, and exhaustion contributed to my getting a room up the Manoa Valley past the University of Hawaii. Avocados and fruit the size of children’s basketballs hung from the trees in the yard, and just down the street were ripening papayas. The trade winds stopped blowing, making the humid heat almost impossible to bear for a couple of weeks.

As classes were about to begin, I went to registration to peer at the sign-up sheets for my two classes. A middle-aged Japanese woman came snarling at me, and I stepped back explaining that I was a visiting professor and was checking my classes. She then abruptly stopped yelling at me and introduced herself, Jessie Nakata, the head secretary of the Mathematics Department. It turned out that she was key to life in the department—she ran the office with an iron hand and every faculty member lived in fear of her. They would dash into the office if necessary and get out as soon as possible. Not me however, and to analyze why Jessie treated me with respect and kindness, suggesting restaurants I try, Island places to visit, and so on, I trace it back to this first encounter. She was in some small way in the wrong, and I had behaved civilly, apologizing for the intrusion. So she trusted me. And I believe that was all there was to it, but the rest of the department was amazed by my warm relationship with the dreaded Jessie.

In 1968, the year I was struggling with my thesis, the mathematician Paul Halmos became chair of Mathematics at the University of Hawaii. There were plans to make the department a center of mathematics research, but Halmos lasted exactly one year, and eleven years later when I was there his brief stay was still a topic of conversation. Halmos who made substantial contributions to mathematics was known to me as a master expositor. His book on measure theory is a lucid gem. Recently a friend sent me Halmos’s autobiography *I Want to Be a Mathematician* and the section “How not to be a chairman” took me back to the Manoa Campus. He begins the section with over two pages of high praise of Jessie Nakata including a 1968 picture of the young woman. On arrival Halmos was met by Jessie at the airport, not a confrontation at registration as I met her, but we agreed 100% on this lady. “Jessie Nakata is wonderful,” he wrote. “She knew almost everything trained

secretaries know, and she was extraordinarily intelligent and courageous.” I hope Jessie saw Halmos’s praise of her. I have no doubt that she knew he (and I) valued and treasured her. Halmos wrote, “Other than Jessie almost everything at the University of Hawaii was a source of worry to me.”

When the trades resumed their customary flow over the island, I made myself at home. The exotic tropics, the heavy starchy sometimes tasteless native-Hawaiian food, the flicker of soft rain and sunlight, rainbows threaded with billowing clouds, the heavy downbursts, all the riotous plant life. There was a deep calm to Hawaii, everywhere except where tourists collected. I thought New Mexico was laid back but Hawaii was of another order of calm peace. I taught my two classes, resting almost all the remainder of the time, sometimes going to the beach where I read Darwin’s most famous book while lying on a straw mat. It took a good while for someone used to reading deductive mathematics papers and books to understand Darwin’s ways of reasoning. He poses a problem and suggests a variety of potential solutions. For each of those he amasses relevant data to see how the facts fit with a solution, reluctantly rejecting each until he arrives at an explanation that agrees with the data. And sometimes he fails to get there, all of his thinking in full view. Darwin was a genius with deeply organic and integrated methods of reasoning.

It was a challenge to train myself to lay on that mat and relax—never in my life had I sat quietly doing nothing—but I eventually learned what going to the beach meant. The sun warming my body seemed to be adding to my health. I quickly adopted the unofficial uniform of the UH campus: t-shirts, shorts, and flip-flops. After an afternoon of reading on the beach, I’d roll up my straw mat, buy some take-out food sometimes with a Kirin beer and sit at a picnic table to eat while watching the sun moving toward Asia.

Medical insurance for the University of Hawaii was Kaiser. I took my test results to the hospital in Honolulu and showed them to a physician. He became concerned and consulted other doctors. They took blood to rerun the tests and said if the results did not improve they’d do a liver biopsy immediately. I was already feeling a bit better and I believed I was somewhat, somehow infinitesimally better. The tests showed that and my liver stayed undisturbed by physicians’ knives. For the next several years I completely stopped going to MDs.

I had two elementary classes to teach and after my years teaching in Idaho they required little preparation. My colleagues at the Manoa Campus of the University of Hawaii raved about the students. The girls are gorgeous,

and the classes are well-behaved with no rowdy students, they told me; the students just sit there and take notes. Politely. For me that was a problem since I had been accustomed to interactive classes. I liked classes of at least 35 students because there would be a couple of extroverts with whom I could joke without hurting their feelings or intimidating the others. I took my UH class lists, memorized the names (many of which I had no idea how to pronounce), and I thought I was ready to go. But I did not click with either class. I did my Johnny Carson style routines at the beginning of class, and they sat there wondering how to take notes, was this to be on the test? I tried sophisticated lead-ins, I tried slapstick, I stumbled and dropped my chalk, nothing worked. Mostly Japanese Americans, indeed the girls were pretty and the boys handsome, but could they think? Could they even speak? I even told them about hot-air ballooning when the international festival in Albuquerque took place, and they were indifferent. That was my best material and it flopped. What to do? I decided if I wasn't reaching them, I should at least amuse myself. So one Monday morning I told them that they all knew I was new to Hawaii and that I had spent a good deal of time to find an apartment and get settled. "But now I can look around Hawaii," I said, "so I went to the most famous beach in the world this weekend, to Waikiki." (I could see flickers of interest.) I described how amazed I was by the tourists and then went into details about the overweight men and women who would not be seen unclothed in Des Moines Iowa but on Waikiki Beach they had all that flesh hanging down over their belts. "They jiggle when they walk, and because they're in Hawaii, they think no one can see them." The boys were laughing out loud and the girls were giggling into the palms of their hands. I had them! I had taken photographs of those people and I talked about that too. The class was almost roaring now and I had discovered the secret to reach them. Just give them my honest outlander's take on things Hawaiian and they loved it. My classes became very interactive, and professors stopped in the hall, looking into my noisy class to see what was happening. Hard to believe but a math class was responding to their teacher! My teaching ratings were off scale, but the best of it was that I could reach the students and enjoy teaching again. The effort it took to raise myself from my illness and engage the classes was worth it to have happy students learning a little bit of mathematics.

The only drawback to teaching at UH was grading. I grade one problem at a time and attempt to be consistent by arranging stacks of exams around my desk or table for later reference. Air conditioning in Hawaii was the trade

winds blowing through windows. The breezes would flutter and scatter my stacks, really disturbing me. My office became home to a collection of rocks and sticks to hold the papers down, and I was always irritated by the trades when I was grading. I knew it was funny that such a triviality bugged me but there it was! Well, another negative aspect of Mathematics Department classes was Tom Pitcher himself. He was an alcoholic and would go into long slurred monologues about the physical attributes of one female student after another. He said he gave grades based on how attractive the girls were and “how much they showed him.” My reaction to this sort of talk was to ignore it and hope he’d forget it if he ever sobered up, but sobering was increasingly rare thing Tom. He made a trip to the Philippines with his bar buddies, leaving his girlfriend home to receive the stories of whores in Manilla. It was not a pretty sight. Back to University of Hawaii classes, Tom convinced a girl to take my class in the spring and he promised her a good grade. He was very angry with me when I gave her the grade she’d actually earned. Tom became Department Chair a year or two after I was there, and he took ice chests into the classroom and drank beer while teaching his classes. This was, as they put it in country songs, a sad situation.

Long-distance calls were expensive at that time and Sandie and I were contributing significantly to the profits of the Bell System. Eventually we decided that she should come to Honolulu. I bought a rusty old car and rented an apartment in Moiliili, a district of Honolulu at the foot of the valley of the Manoa campus. We furnished it with cardboard boxes and ate sitting on a straw mat using a wooden shipping pallet as a low table. Our beds were mattresses on the floor. With the warm trade winds, we seldom needed more than a sheet on the beds. Once the temperature fell to a low of 68 degrees and Honolulu thought it was entering an ice age. My students came to class huddled into coats; I was wearing my usual t-shirt and shorts. They thought I was crazy, but back in New Mexico Sandie and I wore wool socks and Birkenstocks in ice and snow.

The Island food impressed us both. We purchased cookbooks from Taiwan containing brief recipes for Chinese dishes, and we learned to prepare them. The unusual odors and flavors, the humid warm air, being a minority for the first time, it was a new world. I still had my health collapses, but I was following my instincts as to exercise. Beside our building was a Banyan tree and I regularly jogged slowly around it for a few minutes. Sandie, who could tell how I was feeling by a glance, told me she found my determination frightening. That fall however my weight dropped to 149 pounds—I am 6

foot, 3 inches tall, so that is thin. Smoking the potent Hawaiian marijuana (paca lolo) was a way to relieve discomfort and increase my appetite. And there was a Szechwan restaurant where I became friends with the owner Qwan who once had a place in Albuquerque. I was learning to cook Chinese food, and Qwan gave me useful hints, usually prefaced by “well you just,” which went straight to the essence of what I needed to do. For shopping, I went on the bus early in beautiful quiet Honolulu to the open market in the old downtown where once I bought bitter melon, pork, and shrimp. Little old Chinese ladies seemed excited when I purchased bitter melon. Later I was to find out precisely why it is called bitter melon. And I reacted just as most cooks would, by cooking the dish more which causes increased bitterness. I didn’t make that dish again, and many years later discovered how tasty Beijing chefs could make that dish. On our last night in Honolulu Qwan finally told me the secret to his superb smoked tea duck.

One of my fascinations in Honolulu was the frequency of bank and savings-and-loan robberies. Honolulu is a small place and the opportunities to escape are limited. Usually the thieves were promptly captured but they kept doing it. My favorite heist was where the guy had gotten the money in a paper bag and for his get-away he caught a public bus which were seldom on schedule. Even then he might have escaped, but on the bus he emptied his take onto a seat and was counting it. Another passenger got off the bus and police found him sitting there still counting his loot.

Once a week we went to some beach, often to Hanauma Bay where we loved snorkeling and learning to identify the amazingly colored inshore-reef fish; I even came to like the Moray eels with their jagged teeth. We had a small book for fish identification, and I’d rush back to the straw pad to look up another exotic butterflyfish, angelfish, tang or wrasse. Once out past the reef Sandie and I saw a large green sea turtle swimming below us, and we swam along the oceanside of the reef, just staying over the turtle as it made its way. For the first and only time in my life I was decent swimmer. I tried surfing, but too much effort was required, and we took up boogie boarding. Just a look at Sandy Beach convinced me that I’d be killed there. Instead we drove around the tip of the island to Waimanola and spent a couple of outings there. The waves would pick me up and slap me down onto the beach and eventually I realized it too was beyond my abilities. Then we came to the long mellow beaches at Kailua. This was perfect for me, Sandie, and the two children, and we came back often. The clear water, picnics, shave ice, the soft winds, the mellow waves all thrilled us in a subtle way, what a wonderful

place. Later a native Hawaiian told me the Hawaiian kids learned Kailua, then Waimanola and finally Sandy Beach. I tried to reverse the order.

Sandie had lived in Alaska with a man who ran TV stations. She had many stories about people like the politician Ted Stevens who was a friend. But what fascinated me were her accounts of the PTL Club (the Praise the Lord Club) run by Jim and Tammie Bakker. In spite of my shaky health, I got up at 3 a.m. to watch the PTL Club, and it was so weird! Jim and Tammy were like dolls with fluffed hair and screeching insincerity. In 2008 Senator Stevens was charged with federal corruption and lost reelection. From 1979 onward Jim and Tammy were investigated for misusing funds and unwanted sexual encounters; eventually they were found guilty of fraud and conspiracy charges. However in 2003 Jim Bakker returned with a new wife and *The Jim Bakker Show*, and there was a 2021 movie *The Eyes of Tammy Faye*.

In the apartment building at Moiliili we were almost the only haoles (whites), and the kids went to the local school where there were only a few white children. We did not have problems, but my colleagues in the Mathematics Department and their spouses often told us of the extreme prejudice against them. “They are so rude and so impolite,” I was told repeatedly. “They” meant Japanese or native Hawaiians. One day I thought about this and realized that I was under the cloak of an illness and probably wouldn’t be aware when someone was rude. So I went to our local supermarket, took a shopping cart and went up and down the aisles searching for insults and rudeness. Well, I looked up and I looked down and there was only civility around. I still have no idea how others found Island life so bent against them. It was not our experience.

One day Tom presented me with a sheet of math department stationary on which he had inscribed a genealogy. The grandfather was Joseph Doob, one of the two or three founders of the great American school of probability. The sons were Ambrose and Kinney, and the grandsons were Pitcher (descending from Ambrose) and Waterman (descending from Kinney). Somewhere I have that chart, and it contains another person we both knew. It might be Bill Root, also an Ambrose student. Tom and John were about the same age, and they had a productive collaboration. I made my entry into Los Alamos via Bill Beyer who wrote his Penn State thesis on a topic of Kinney’s. And invisible on that chart was what was yet to come, that I was later to go to the University of Southern California, where Tom had spent 1965-1969, brought

to USC by Mark Kac, another of those grand old men of probability along with Joe Doob.

John Kinney told a story about Tom and Lincoln Labs. During the Cold War there was concern that the Russians would bomb the United States. A well-placed bomb between New York and Washington, for example, would destroy essential communications. There were meetings and proposals, all in Top Secret I am sure, about how to prevent this terrible situation. Any other route for communications between two important locations could be learned by spies and then destroyed. Whatever to do? Well, a clever idea was proposed: When you wanted to send a message, the procedure would be to randomly choose a city and send the message there. At each destination the message would be checked to see if it was intended for that stop. If not, then the message was sent along to another random location. When the message finally reached the intended destination, the random routing was over. Just before actual construction was to realize this magnificent scheme, John said that Tom had enough of the nonsense and went to his office. The outcome was a short technical memorandum that showed that the expected or average length of time to send a message from one place to another was infinity! (As I read what I have written, the result as stated is wrong—apparently I have incorrectly recalled the details.) So while the scheme was invulnerable to the Russians, it would have been useless. “Think of the money that saved,” John said. “Tom earned all our salaries forever with that one.” (The unspoken joke was that it only was good until 1965 when they all had to leave Lincoln Labs.)

Sometime that spring Temple Smith called. He was very excited and said he thought he had solved our alignment problem that had been motivated by the discovery of introns. The problem came to our attention as I was getting ill, and while I had worked on it, I never was able to make a strong effort. We had a few false starts, one of which came back a few years later as a method to detect repeats within a sequence. But Temple said he hoped he’d solved the problem, employing an insight from our earlier work in establishing the duality between distance and similarity between sequences (small distance equals large similarity). Temple’s insight was to insert a zero into a similarity algorithm. Whenever the similarity became negative, it was replaced by zero. Thus the method picked up intervals between two sequences that were most similar, no matter what the rest of the sequences did. Eventually he made the idea clear to me. I worked out a crisp formulation of the problem with the proof and wrote what was nearly the final draft of the manuscript. The

formulation we gave made the algorithm and proof look easy. It was easy! In my years in research, I had made major contributions to all the papers I was co-author on; this time it felt like I was a bystander. My illness made everything else of small importance and so did this paper—or any paper—seem to be of little consequence in comparison. I told Temple I'd send him the write-up, but he should not include me on the paper. He insisted and I gave in. This work is what both he and I are best known for, with the most literature citations. The Smith-Waterman algorithm appears in textbooks. And Temple Smith put the essential zero into the algorithm.

The spring of 1980 I was feeling well enough to take up that puzzle problem Mike McKay at Los Alamos had found in a TWA Flight magazine. Mike has an unusual intelligence, and this puzzle was about an integer where from position 0 to position 9, the digit at each position i was the number of times digit i occurred in the number. The answer was 6,2,1,0,0,0,1,0,0,0. For example, there are 6 zeros so in position 0 appears 6, 2 ones so in position 1 appears 2, and so on. We called them self-descriptive numbers. Mike demanded to know if base 10 is special. If so or if not so, why? At the time he brought this up, suffering from my illness, I could not make any progress, but the spring of 1980 I was able to keep enough in my head to work out the solution. It was not deep but rather like watchmaking; it was easy to drop a tiny detail and lose the whole thing. It was a good feeling to be able think again, even to this limited extent. After I returned to Los Alamos, I wrote the article, and one journal editor said he'd be happy to take the paper but we had to delete the reference to the airline magazine. "What would be the fun in that?" I said. Then we submitted the paper to *Mathematics Magazine*. The editor did not have the paper reviewed, but she wrote a scathing rejection, saying that perhaps the work was worth trifling one's time away on an otherwise boring flight, but it was not mathematics. Mike was upset, but I told him it was priceless and we should treasure such an ignorant response. (This is second on my list of favorite rejection letters.) I wrote the editor thanking her for telling us how trivial our work was and pointed out that a certain well-known paper related to ours was even more trivial. "You may wish to similarly instruct that author," I added. Then we submitted the paper to *Mathematics Gazette* where the editor loved the paper and made it the lead article. He also allowed us to quote the airline magazine.

I did not get well in Hawaii, but I learned how to live with my condition and to wear loud Hawaiian shirts with pleasure. Without Hawaii I might have been seduced by the NYC dark-clothing style or Johnny Cash's man-

in-black. Instead I always revert to bright colors. Tom Pitcher and the University of Hawaii gave me that opportunity to mend. As I was preparing to leave Honolulu, people approached Sandie to see if I would consider staying as Chair of the Department. This must have been due to my warm friendship with Jessie, but I did not see why they did not ask me directly. Real men and their emotional fragility, go figure.

When I heard in the summer of 1996 that Tom Pitcher was seriously ill and dying of cancer, I took a flight to Portland, Oregon and made the drive up the Columbia River to his retirement home at Hood River. His directions were flawless until a certain fork in the road, and then being tired of giving details, he said, "You get the picture. I'm up the hill." There I was at the forks of the road, and I tried the most obvious "up the hill" but it was a little public park. Nobody was living there. Then up another drive and the prospects looked dim, with a tricycle in the drive. Probably not Tom's house there. The hard left just felt wrong. Maybe it was straight ahead, which led me up a hill and far down the other side, obviously that was wrong too. Looking for a place to turn around, I came to a steep driveway. It was labeled "Pitcher." Tom came out of his house, looking like a spirit. The self-deprecating irony still housed in that body proved it was Tom. We hugged on the steps.

During the evening, he referred to a call from John Kinney to whom Tom said, "Stop, John. I don't have another theorem in me." It wasn't really that he didn't have another theorem in him, he said, he just wasn't going to get it written down. We talked and drank and smoked and talked and went to bed early. There were long silences which stretched from where we sat out in all directions to somewhere far beyond my sight and experience; I did not think then to wonder what dimension that awesome set had. I was leaving to go back to Los Angeles early the next morning. "Wake me up before you go," he told me. "Be sure to wake me." That morning after my shower I went into his room, and he was sleeping so deeply that even gently shaking his shoulder did not awaken him. I did not have the heart to do anything more to bring him out of such deep sleep. I left him there in the still August morning of Hood River with his last theorem.

After Tom died, his daughter Ellen who was a lawyer in Portland asked the University of Hawaii Mathematics Department to explain what her father had been doing all those years, what did his research mean? They did not know how to proceed and asked me if I could possibly handle it. I agreed

and spent some challenging hours and days trying to give some insight into Tom's work. In 43 years of employment as professor and researcher, Tom published only 32 papers and none of them were of much length. But the work was technical and some of it quite deep. I put into my piece some of my take on Tom the human being, along with a flyover view of his work, and felt good about my charitable contribution. Censored was any reference to Tom's alcoholism or his shabby academic behavior toward students, let alone what he did in his private life. Ellen reacted by telling me that she could not understand a word of what I had written, my effort was completely useless to her. Completely. Useless. I had not expected a marching band of thanks and gratitude, but I did expect at least a polite acknowledgment of days I put into writing. Her father had published less than one paper per year and those papers were only a few pages long. If the work could be explained effortlessly to a non-mathematician, Tom would have been horrified. And his daughter apparently expected to understand the whole thing with absolutely no background and no intellectual engagement. So feeling a bit hurt, I said "I am so sorry, goodbye," and hung up. Then I thought of cynical Tom and his critical daughter and said with a slow smile, "Tom and Ellen, father and daughter. How could I have expected anything else?"

Back at Los Alamos I took over a big USGS project which supported a good fraction of the group but was in jeopardy. I managed successfully to lead the project, with much traveling for the Lab. I learned to fly somewhere, do whatever I needed to, and then go directly to my motel room to rest. I preferred anonymous motel rooms to staying with friends. Motels are not to be taken personally, and no one comments if I went straight to bed.

At UCSF in San Francisco and at USC in Los Angeles, I did much the same thing. I worked hard as I could, and after that rested as much as I could. When I'd have a collapse, I'd feel awful as ever but somewhere, sometime, I knew I'd stop falling off those ledges and crawl back to some level of activity. My personal life declined and then disappeared. At USC in Los Angeles, I kept a cot in my office. I came to work before daylight and seldom left before late in the evening. When I felt so badly that I could not go on, I'd unfold the cot and rest until I could.

There were moments when my orientation with the world would vanish. Suddenly I'd not know where I was or what was around me. This could happen in my car in the middle of an intersection and recovering from such a

momentary blackout was challenging. My very perceptions were unreliable; for example, before changing lanes, I'd check three and four times to be certain the way was clear. These events could occur anytime, but while driving they were dangerous and vividly recalled. One night arriving in Mancos Colorado, I was driving down a dirt road looking for my friend's home. I had been there many times, in this tiny place, and I couldn't recognize anything. I was completely lost with no idea what to do next. It was so frustrating and frightening that the vehicle coasted to a stop, and I helplessly wept. I have no memory of how I extricated myself from that pathetic situation.

On sabbatical at Mt Sinai Medical School in New York City the fall of 1988, I stayed in an apartment building owned by the institution. It was on Fifth Avenue at 100th Street. That may sound glamorous but it was a block or two from intense illegal drug activity. The entire city was dense with homeless who became like a vast Greek chorus; there were wretched needy people asking for handouts everywhere I went, beside every store, at every public entrance and exit. This and the famous New York incivility took its toll on me while I found the city fascinating as ever. A woman I was seeing in Los Angeles came to visit, and one night we went to the 92nd Street Y for a Trevor Pinnock performance of Bach's Brandenburg concertos played on period instruments. This is some of my favorite music and I left the hall elated. We decided to walk a block away to more easily catch a cab. There I was, glowing from the music with a lovely woman on my arm, dressed well and warmly in the frigid night, heading for a wonderful meal. Life could not be better. Then we came to a small mountain of uncollected garbage, bag after bag which in warmer weather would have made a huge stink. A homeless man was diving into the mess, with sounds of joy. He would burrow among the bags, surface to leap back in. I found the contrast between his situation and mine amazing and could hear the exaltation in his vocalizations; what variety the human condition can take! After my friend returned to Los Angeles, I had a low health spell which one of my colleagues noticed and sent me to a Mt Sinai physician who referred me to a doctor at UCLA. After tests and discussions in Los Angeles, that doctor asked me when I was applying for disability. It was shocking, and while I thought about it, I realized I was going to keep struggling until it was no longer possible.

The fall of 1994 I spent at Rutgers helping with the DIMACS (an NSF mathematics center) special year in molecular biology. The campus was isolated, and I had an apartment there, making my work but not much else

convenient. One week I visited Brown University where my friend Don Marsh was Dean of the Medical School. I stayed with Don and his wife Wendy who is a physician. Wendy had become what she told me was “the physician of last resort” in Rhode Island, largely due to her avoiding all facilities where her husband had influence. Her patients were AIDS victims or had other unusual diseases. She and Don knew of my health problems, and when she drove me to the airport, she told me that I had Chronic Fatigue Syndrome. I answered, “Wendy there is no such thing,” thinking CFS to be entirely a Yuppie invention. Then Wendy told me symptoms I had never told her, and it became clear she knew what she was talking about. I was stunned. Going through the routine of checking in and boarding the plane was difficult. I had ignored the people who suffered from CFS just as my doctors had dismissed my illness.

Did my disease actually have a name? Does naming a disease that many people believe does not exist and for which there is no treatment even matter? In 1994 the CDC gave CFS a definition as a disease, and in 2015 CFS received the name myalgic encephalomyelitis/chronic fatigue syndrome. Those with ME/CFS have been dismissed as having imagined their disease, and I who had the disease had done the same. We will never know how many committed suicide in the grips of their hopeless condition. I nearly had done that myself. When COVID-19 struck the world in 2020, we soon heard of long COVID, outwardly with the symptoms of ME/CFS. They are different diseases of course, but as I expected, there were people including MDs who arrogantly dismissed long COVID much as ME/CFS was dismissed. Perhaps as an answer to my questions at the beginning of this paragraph, having a recognized disease from which long COVID cases came and the large number of patients will keep long COVID from being ignored. Just as important perhaps is that ill people will not be isolated in their misery.

At the airport the mathematician Ron Graham was on the same flight returning to New Jersey from Brown University. When we landed, his wife Fan Chung, also a superb mathematician, picked us up, and we went to have dim sum. By this time I could carry on conversations but was still in shock. When I was back in the dreary apartment at Rutgers, I became deeply depressed as I thought of my constrained life since 1978, what I had cut out of my existence and thrown away. Wendy suggested trying a low level of one of the modern anti-depressants, and back in Los Angeles, I went to my USC physician John Brodhead. John said he didn’t believe it, but that he would let me try it. The next week he called me and said he’d read an

article and that there might be something to the suggestion. That therapy, at a lower dose than what one would take with depression, proved useful, and my life improved although there were side effects with balance, weight gain and gruesome nightmares. I believe the medication helped by allowing deep sleep. It is not that I am over ME/CFS. A few years later I went off the medication and after a strenuous backpack trip into the Sierra Nevada I had a profound collapse. I went returned to a heavier dosage and it took three years to recover. I have given up that treatment due to side effects and again struggle through days and nights. I am glad to be alive, I am fortunate to be functional at the level I am, but I regret not having lived a fuller life. But as the tautological cliché correctly has it, it is what it is.

Baghdad by the Bay

Daybreak, New Year's Day, 1982. I wake up in the little cottage beside the Bement's ranch house near Mancos Colorado. It has snowed several inches during the night and the landscape is cold and fresh. Several horses are standing in a nearby field, and while I watch a mare snorts and swings her body to lope away, the arc of her hooves marking the new snow. My house in Santa Fe is empty and up for sale, and almost everything I own is stored in the basement of a house near here. I am on leave from Los Alamos and headed for San Francisco California which makes me think of a 1928 Jimmie Rodgers song.

*I'm going to California where they sleep out every night.
I'm leaving you mama, cause you know you don't treat me right.*

...

*Got the California blues and I'm sure gonna leave you here.
I may ride the blind, I ain't got no railroad fare.*

Jimmie Rodgers knew that not everyone found California a garden of Eden, and I knew that the climate of San Francisco was damp and chilly. And I had worked in the logging woods of Oregon with dust-bowl refugees who didn't make it in California. My relationship with Sandie Douglas was over and I pledged to leave that behind me in the Southwest. My visiting appointment as Professor of Structural Biology in the Department of Biochemistry and Biophysics at the University of California in San Francisco would let me work on mathematical and computational work in biology full-time. My health was better than three years before, but often marginal and I rested as much as possible when not working. I wanted to accomplish what I could while I was still able. With my mysterious illness I thought that I'd not live past 50—I would be 40 the summer of 1982 and didn't think I had a lot

of time remaining, but I had a deep desire to explore the scientific territory that was opening up in front of me. I had no idea that my work would be as impactful as it turned out; I just wanted to follow the leads for mathematical research that I was finding in the new area of DNA and protein sequences.

I drove on icy roads to Flagstaff; it was more like skating than driving. When I reached Barstow California there was a snowstorm. I drove into the Bay Area late January 2 with forecasts of heavy rain. Greg Mann at Los Alamos had a friend Jeff Bodington who had been a consultant with our group. I was set to stay with Jeff in San Francisco and made it to his apartment just as heavy rain began. Jeff had a condominium on the edge of the Fillmore District (which was then and may remain a tough neighborhood), and after he let me in and gave me keys, Jeff went to his parent's place in Marin County. It rained and rained, records were set. In January 3-4-5, it rained 16 inches in Marin County and 25 inches in the Santa Cruz mountains. I was on the second floor safe from flooding, but I could see the water rise in the streets. Rain depresses me, especially cold rain which puts me back on the livestock ranch, hopeless on dismal winter days. Here I was inside, dry and warm, but trapped by the deluge outside. Hugo Martinez, my UCSF host, was relaxed about it all, whereas I just wanted to start work. I couldn't even get to the university.

Jeff had an interesting record collection which included Jackson Brown, Joni Mitchell and every album of the rock-and-roll singer Rickie Lee Jones. I had heard of her but had never listened to any of her songs. I sat inside the apartment, with rain, hour after hour, day after day, rain sluicing down outside, floods washing parts of Marin County into the sea, and I listened over and over to Rickie Lee Jones songs that she both wrote and performed. I didn't quickly get them as they were urban and filled with specific references. ("I and Bragger and Junior Lee/ That's the way we always thought it would be") but to be sure "something's happening there." There was nothing cloying or cute about this woman—she was strong and tough. After a few hours I tumbled into her world and became a fan. I absorbed Rickie Lee Jones; her songs scratched an itch I didn't know I had, and her sad sensibility fit my mood perfectly. Her song "Last Chance Texaco" is the equal of the best of the blues songs about sexuality using automotive images, including even Lightnin' Hopkins' "T-Model Blues." "It's her last chance/ Her timing's all wrong/ It's her last chance/ She can't idle this long." Rainy day after rainy day was filled with her music.

It finally stopped raining and it was still another week before I could go to

work. UCSF is a medical school and the campus-hospital is a maze. Hugo found a tiny office for me where I set up to start work. However I could not get going. First, I had to find a place to stay which was a challenge, and I located an apartment on 27th Avenue off Geary near the Presidio. My research stalled which was frustrating. Eventually I decided I was emotionally blocked about New Mexico, Sandie and so on. I have to get this set right, I told myself. My next step was brilliant, it now seems to me. I didn't read a self-help book, I didn't consult a shrink, I didn't even get drunk. Instead I bought a bus pass. I needed one anyway as parking at UCSF was horrible, but that's not why I did it. I took a week and just rode the San Francisco Muni system.

In the morning I'd catch a bus on Geary Street with the commuters and ride to wherever it was going. Geary downtown to the Embarcadero, over to the Mission, out to Richland, over to the Castro, and maybe back toward Candlestick Park. Nearby Clement Street was emerging as Asian and past that was the Presidio and Golden Gate Bridge. I wasn't sight-seeing; I would ride anywhere the bus went and get off at random points to sit for a while and then catch another bus. I carried my 35-mm Cannon camera in a ragged red daypack although I took no photographs; once I left it on a bus and someone leaped off to return it to me. Good fortune was with me wherever I went, despite my troubled moods. San Francisco is famously a gay destination, and a few times men tried to pick me up. I didn't even know they were gay until they approached me; as soon as I began to recognize gay men at a glance I was never approached again. I was not repulsed by their sexuality and made no conscious change of behavior, but apparently my lost innocence displayed itself. I rode the bus and thought long and hard about my relationship with Sandie and my health problems. I had been deeply in love with her and that was over and I knew we had to move on. And I must have done so, here I was in California. But these things are never simple. The busses ground on, my thoughts sanded and polished my scarred emotional state, rain came and went. I have paid the price, I thought, the rides for a whole month are now the same as free.

Hugo did not notice I had gone missing and the bus-ride-therapy sessions worked. I returned to tackle a collection of problems with new energy and determination. A computational method called dynamic programming is often used in sequence alignment and RNA structure prediction, and while

it gave the optimal or “best” answers, methods for finding solutions near the optimal were clumsy. During this time I found an elegant solution to that problem, something everyone else had missed; it was another way of thinking about the problem. The next year in Los Angeles I hoped to meet Richard Bellman who was an inventor of dynamic programming and show him that he had missed the “right” solution, the “Bellman solution,” to his problem, but he was dying of brain cancer, and this did not happen. Another matter that I struggled with for weeks was understanding the statistics of non-overlapping occurrences of a collection of words in a text. For a single word, this study is called renewal theory, and I read the intricate Chapter XIII of Feller Volume 1 over and over. I would work hard on the problem for a few days, then give up in disgust, saying to myself that it was impossible. Then after some downtime I’d be drawn back into the problem. Finally it yielded, and I wrote my first paper about it. Other related work was to come later, but this was when I began to think carefully about the intricate statistics of patterns in text where self-overlap of words greatly complicates the analysis.

I was fully engaged in the challenges I’d set, and in the brief months I spent at UCSF, I accomplished a few normal years of research. My head was buzzing, and I would forget where I was. It wasn’t safe to drive in that state of mind, and my car stayed parked for weeks. I would go out to catch the first of the buses I needed to get to UCSF and would be thinking so hard that I’d not notice when the appropriate bus came and went. I would later realize by the mysterious lapses of time that I’d missed several buses. Or I’d notice a bus pulling away when I hadn’t seen it arrive. The time I was in San Francisco was without anchor, timeless as a child’s summer vacation. It was like my years in Idaho: there was no past and no future; I was floating in a deep sea with no shore or signal buoy. But in San Francisco my dark illness never left me. In the summer of 1982 I turned 40; it seemed unlikely that I would survive another ten years and I wanted to accomplish as much as I could in that time.

I have reliable instincts for academic departments. They are extended families, and I have sat in mathematics, biology, and computer science departments. The different subjects draw different types of behaviors, and I can usually “get it” almost immediately. The great exception has been the UCSF Biochemistry and Biophysics Department. Before anyone at UCSF received a Nobel prize or became president of the National Academy of Sciences, they were seriously ambitious. The famous DNA cloning pioneer Herb Boyer had been associated with the department, but the person who drove

it into science-big-time was Bill Rutter, who in 1975-1982 added faculty who became academic stars. He said he was building “academic medicine” and that was medicine with a huge vision. Many medical schools had similar ambitions and failed. Rutter should be famous for the department he built.

Of course I was an outsider, not a regular faculty member, but that does not explain my puzzlement. The in-crowd had an informal seminar on Thursday afternoons. Someone would provide wine and cheese, and someone else from around the Bay Area was invited to speak. There were full professors in the department who were excluded. Hugo asked that I be included and after lengthy deliberation I was allowed in. The wine and cheese saved me the time it took to eat dinner, the lectures were superb, and I could hear chats in which hiring and other decisions were made. It was fascinating and more than a little frightening. Stan Prusiner was invited to speak (he was not then an insider), and that was one piece of science that was misjudged. Most of them did not believe prions were real. With the seminars I attended and these wine-and-cheese afternoons, I learned some biology at UCSF. The biology and diseases caused by retroviruses including cancer and AIDS was a topic of seminars; I realized that they are so deadly because they are in a real sense part of us and this was deeply unsettling. “Cancer is us” was not a message I wanted to hear.

In another book I wrote a chapter about my first trip outside Oregon, from Four Mile Creek all the way to South San Francisco’s stockyards. I was eight or nine years old and the City was a revelation: the amazing Golden Gate Bridge, the hilly streets our sheep-filled truck ground over, the non-white faces in the streets. Later I decided Sutro Baths built on the edge of the sea was the most bizarre and wonderful building I had even seen. It still would be but it burned in the 1960s. I lived in the East Bay the summer of 1965 when I worked at Livermore Labs and visited the City often. Before I went to my first faculty job in Idaho I drove to San Francisco to buy what I called my assistant professor jacket. I knew what I wanted and nowhere in Oregon or Idaho could I have located such a brown Harris tweed jacket. For me San Francisco was magical, and now I was living there for eight months. If I looked outside the bus window, if I walked around the block, if I took a deep breath and looked up at the sky, I had a thrill deep inside me, a satisfying sense of wonder in spite of my health. Fog rolled in and out, rains came and went, it was always wondrous. The light, the air, the fog banks

descending on selected parts of the City enchanted me. Whatever came next and however my health progressed, I was deeply in romantic love with San Francisco.

San Francisco has always been a food city, both at the highest level and at the ethnic this-is-what-we-ate-back-home joints. On my first trip to Chinatown, I talked with a few Chinese people on Grant Street and located the best large dim sum restaurant, which was located on Pacific above Stockton. A tiny Hunan restaurant on Kearney produced extremely spicy and tasty food. My favorite Asian place was Yuet Li, also known as the Coca Cola Noodle Joint, where my favorite dish was clams with black bean sauce. Once while eating this dish in the basement the owner walked by and said, "Is good, no?" "It is great!" I answered. And their chow fun was always marvelous, a mainstay of this Cantonese restaurant. During this stay in the City, I did not discover Alice Waters or Jeremiah Tower across the Bay in Berkeley but I did not require them. There was that excellent Vietnamese place just up Geary from Union Square that was situated somewhere between France and Vietnam, and nearby that was Edinburgh Castle where if you asked for ice or were going to water your single-malt whiskey, you were refused service.

The Biochemistry and Biophysics Department was interviewing a candidate, and they invited me to the recruitment dinner. It was in a posh restaurant not far from Union Square, one of those elegant, quiet and dimly lit places reeking of class and elitism. San Francisco always had an air of smug superiority, sometimes subtle but always present. Lamb chops were on the menu, and I had a crashing memory of riding into San Francisco in the sheep truck. Then and now, I thought, then and now. I did not contribute to the conversation, just ate my chops washed down with expensive California cabernet, thinking of the distance between the people sitting at that table and what it took to provide for them lamb chops with little paper dollies on the ends of the scraped rib bones. And I wondered why I had such dark memories of the cold and fog of my family ranch but found the same thing in California to be inspirational and romantic. Reasons certainly included my family but more important my former life was at a basic level, the brute labor of raising animals for slaughter. At UCSF I was paid to sit quietly and have new ideas. There was a possibility of a job and that's what Hugo had in mind. My research was not at the point where I thought that would be successful at UCSF and so I asked for a visiting position. But I instinctively knew that living permanently in a location that I almost worshiped would be a mistake.

Even when it turned out that I could have stayed at UCSF, I did not try to bring that off. Many years later I did not take a professorship across the bay at the University of California at Berkeley. Now I visit San Francisco in the 21st century, and I see its rampant homeless population, its shameless high-tech millionaires, and its terrifying real estate prices. Where, I wonder, did those brilliant flower carts around Union Square disappear to? How did this elegant proud city, this Bagdad by the Bay, lose its very essence? Can this great American city turn from its current troubles to once again be an inspiration and joy to behold?

The dark mysterious illness that had so impacted my life was still with me, hovering in the ether, striking at will. It was not quite as devastating as it had been in New Mexico and Hawaii, but it would hit me and I'd be almost immobile in misery for days. I knew now that eventually I'd come to surface again but it was crushing: what if this was the time I'd never return? The need to do my research was the primary concern. It also impacted whatever personal life I might have had. As my relationship with Sandie settled into the fog, I was in touch with a woman I had an affair with while leaving New Mexico. And now I was in San Francisco and she was in Utah in another relationship which she was leaving. She was flying to visit and I hoped for something permanent. I was at the airport and she did not appear as scheduled. My health was low and I was in a dark mood. Why was I even trying? Why did I drive to the airport instead of resting until I could work again? Why was I wasting myself on this? When I finally got home, her son called with an excuse. My affectless response was upsetting to him, but I had crossed a barrier, perhaps a barrier to nowhere. After this I met a woman at UCSF whom I found extremely sexy, and although she was deeply troubled I could not resist her. Resist her, hell, I pursued her with what might be called an addiction. When you wake up at night and find the woman you are sleeping with huddled in a corner of the room, sobbing her heart out, you know it is trouble. Trouble you did not cause but trouble for sure. Looking back, I think I knew how damaging continuing this might be to us both. It did not end well and I suppose my disastrous marriage taught me something: dance up the edge of cliffs but do not jump off without a parachute!

During this period I didn't have much time for movies, but for some reason went to see *The Year of Living Dangerously* and thought in jest that was just what I was doing, giving up my secure DOE job to devote myself to what was not even a subject. I liked the movie with its Vietnam references, and when there was a Buster Keaton film festival, I found the brilliant innocent

physicality of Keaton stunning, what a sweet man he was. Keaton relaxed me, and those films are there with my romantic San Francisco memories. He was a genius. And then some remastered Jimmy Stewart movies were released, and I went to *Rope*, after which I determined that there was enough stress in my life without adding any more movie moments to the load.

Whenever I was on the BART and got off on Market Street, I'd go in a little bar and have a draft Anchor Steam beer. A professor in the Berkeley business school told me he took students to tour the Anchor Steam and Budweiser factories. Bud in one day makes more bottles of beer than Anchor Steam does in a year. On Market and elsewhere there were homeless people carrying on conversations, settling old scores and making points to people who were invisible. I thought that there was not much distance between any of them and myself and was overcome with ineffable sadness. Today everyone is muttering and sometimes shouting into an electronic gadget; who is mentally ill now?

Charlie Smith, whom I met when he was at DOE, had left Washington and was now running the System Development Foundation, set up to distribute all its funds (over \$100 million) in a fixed amount of time. The guidelines were that the projects had to be related to information technology. Charlie wished to fund things that would have a good effect and were unlikely to be funded in normal research channels. His office was in Palo Alto, and he sometimes had me review proposals. He got some humdingers, just off track completely. And then there were huge successes, such as funding Donald Knuth who was working to create TeX. SDF was a good break from my almost vacuum-sealed San Francisco existence. I'd shake off my mental state, get my car out of the garage, and head for Palo Alto. Once while on a stretch of being clean of all intoxicants, I became dizzy driving south on Highway 280 to Palo Alto and pulled off the road, saying to myself, "So this is life without drugs, huh?" But then I'd get to the SDF offices and enter a world of someone else's obsession. One of my reviews of a mediocre proposal was that it was not wrong, just too boring to fund. Charlie made me write that down—too boring to fund—and sign it so he could put it into the records. Someone who had UCSF connections applied to SDF, and it looked odd, so I asked around. Stan Prusiner had interacted with the guy and that's how I met Prusiner who later won the Nobel Prize for his pioneering work on prions. Despite the dismissive take of the UCSF department, I liked Stan and his

science. “There is something happening there,” I thought, and as it turned out that was an understatement.

Charlie Smith began asking me what I was doing at UCSF, and when I detected his inclination, I told him there was no way my work could be interpreted as appropriately under his SDF guidelines. He didn’t agree and convinced himself that I should apply. Those are somewhat tangled sentences but it was somewhat tangled logic. Eventually we got it straight, and with Temple Smith, I put together a proposal to SDF. I had no idea what I might be doing the next year. My fatalistic attitude about my mysterious illness and life expectancy did not make for long-range planning. As summer came, my UCSF support ran out and my apartment lease ended. For three months I slept on people’s couches and floors. It was a curious time.

Jeff Bodington had tickets to see Rickie Lee Jones in Oakland and a group attended the concert. Things started off alright, all those songs many of us knew inside-out and loved. But as the evening went along her performance declined. She sings with what is nearly a lisp, but the songs became more and more slurred. Her introductions to the numbers were rambling and off-topic. By the time it was over Rickie Lee Jones was openly swigging from a bottle of whiskey, Jack Daniels Black Label, which she banged onto the stage; by the end of the concert she could hardly stand up. It was a breakdown on full display. On her page in Wikipedia is the sentence: “Another lengthy and successful tour into 1982 followed.” Well, perhaps not completely successful, but today in a new century, she has not only survived but is carrying out challenging and novel projects. Her public collapse in 1982 was unsettling for her devoted fans who were not all on such solid ground themselves.

Town South of Bakersfield

During my childhood in southwest Oregon, my family took two vacations. In the fall, we attended the rodeo in South San Francisco's Cow Palace, and during one of these trips, we went south to Los Angeles. While I was enthralled with San Francisco, I found Los Angeles dull and boring. Were palm trees really trees? I knew well some grand trees, old-growth western red cedar and Douglas fir, and the north coast redwoods were in that category. But palms with those strange naked trunks and distant frills at the top? They contributed to what was for me a strange and abstract place. To a farm boy Los Angeles did not seem real. Even when we went to Hollywood, and I stood on the corner that I had heard announced on radio programs, "Brought to you from Hollywood and Vine," I had the same negative reaction. We went to Pasadena, where there was a family my mother knew, and Pasadena was even more dull to my eyes. This trip was around 1950, and it was not until 1970 that I was again in Los Angeles, driving through to visit an MD friend doing his residency at a hospital in San Bernardino. I had driven all night, and coming into the city I became confused in the dense morning traffic. I pulled off the freeway and soon a police car stopped to ask if they could help. Had someone said I would never return to Los Angeles that would have seemed likely. Instead I was to spend half my life living in LA.

My 1982 job interview in Los Angeles went well enough. The city was preparing for the summer Olympics of 1984 so the airport, LAX, was in 1982 having a second level built while the first level tried to remain functional. It was a hell of construction and confusion, but as I was to fly in and out of LAX for decades after this, the pain was worth it. I studied a map of LA on the flight from San Francisco and for the first time in my life memorized the layout of a city I had not lived in. There is some geography to the place: ocean to the west and mountains to the east and that helped. Streets seem to go on forever, miles and miles of a street with the same name, without it

being clear where the street began or ended, if ever it does either of those things.

In San Francisco in 1982, I decided if I had nothing else to do I could have kept up with the many cultural events that appealed to me. It would have been a full-time job but just possible. It was immediately obvious that the Los Angeles cultural landscape was denser with events I might have enjoyed, not that I had time for much of that. I located a country music scene that did not follow the pop-infected country music that I found repellent. A weekly KCRW music program called Citibilly played traditional country music, and the host René Engels promoted an album *Town South of Bakersfield* produced by Pete Anderson. Bakersfield, located in the Central Valley, is the most important city on the west coast for country music. The Bakersfield Sound came from the “Okies” who arrived from the Dust Bowl; Maddox Brothers and Rose, Merle Haggard, Jean Sheppard, Buck Owens, etc, they were the real deal. The Bakersfield Sound inspired country rock including Gram Parsons of the Byrds, the Flying Burrito Brothers, Emmylou Harris, the Grateful Dead, Chris Hillman, and Creedence Clearwater Revival.

So the movement of hard-edged country music in Los Angeles gifted the city with the title *Town South of Bakersfield*. One of these singers was Dwight Yoakam, born in Kentucky and raised in Ohio, from one of those working-class families that went north with African Americans to improve their lives. “They learned readin’, writin’, roads to the north/ To the luxury and comfort a coal miner can’t afford.” Yoakam wrote intense songs that he performed, and I became a fan, going to see him in little clubs where it became clear that he was frustrated by his lack of success, his anger was evident. He moved to LA when he was 20, four years earlier, and he was still mostly unknown. I owned a copy of his album *Guitars, Cadillacs, Etc., Etc.* that did not have the title song “Guitars, Cadillacs and Hillbilly Music.” I interpreted that as a “screw you until I am appreciated” statement.

The campus where I worked was deserted on weekends except for football games. University of Southern California home games on Saturdays had a strong following but what impressed me most were the Raiders games on Sundays. Those folks were serious fans and drinkers. It was foolish to be inside the parking structure at the end of a game. If they won, the fans were drinking and fighting to celebrate. If they lost, it was worse. I never left my building when they were around and was not sorry to see the Raiders

leave Los Angeles. Otherwise on nights and weekends the campus was almost deserted. And in those first years when summer came, I could think that the whole place belonged to me. USC was then a commuter campus.

I always thought I'd stop smoking marijuana if it held back my work. In Los Angeles it became evident that this was happening—the day after smoking I was thinking a bit more slowly. So I just stopped. What I missed was the relaxation marijuana gave me, but since 1983 I have lived without smoking. With the widespread availability and use of alcohol, it seemed weird that it was legal and marijuana was not. Thankfully that is changing now. The criminal infrastructure supported by illegal marijuana is vast, disturbing, and in my opinion unnecessary. A friend, retired from the Nevada State Police, told me he never had someone under marijuana give him any fight, let alone use a gun. If alcohol and marijuana were discovered today, and one of them were legalized after scientific studies, it would not be alcohol. After decades of jailing people for what are minor offenses laws are changing, but the incarcerations were and remain tragic.

I read *Natural History Magazine* and was a fan of a food column by Raymond Sokolov that usually featured unusual dishes from remote countries. Just before I moved to Los Angeles he did a column on LA's Grand Central Market. On Broadway and open since 1917, Grand Central Market had everything, arrays of vegetables, dried chilies, fish and meat markets, bakeries, an amazing display in neon light. Sokolov was rhapsodic about the possibility to purchase all four types of beef tripe (cow's stomach). I had to see this place, and no one I met in LA had even heard of it. So I found nearby parking and made my first visit. Astonished by the variety of shops and stands not even touched by Sokolov's article, I was hooked. Many of the people were from Mexico and Central America. On one of my visits, I asked a vendor for two pounds of tomatoes and he answered, "I do not sell small amounts." I went on Saturdays when often there were demonstrations on Broadway, marchers waving signs and chanting in Spanish. I'd buy a long-necked bottle of beer and stand on the sidewalk to take it all in. In 1984, Ira Yellin purchased Grand Central Market, the Million Dollar Theater, and the Bradbury Building, which is nearby. That was an early and crucial step in the revitalization of Downtown LA. The Bradbury was in such bad shape that Ridley Scott could afford to shoot important scenes for *Bladerunner*, that 1982 genre-defining Neo-Noir vision of LA's future. The Bradbury building,

built in 1893, is my favorite architecture in the city, and it's just across the street from Grand Central Market.

Arriving in Los Angeles from San Francisco, I found LA food a mystery. In San Francisco it was easy for me to find good restaurants, both high-class as well as cheap eats. I went to La Petit Chaya in Silver Lake, which opened in 1981. It was a revelatory fusion of French and Japanese cuisine, with Japanese chefs trained in classical French cooking. The stylistic arrangement of the food, the unexpectedly elegant flavors! Then I reluctantly went to Manhattan Beach to eat at John Sedlar's Saint Estephe. Fusion New Mexico food and expensive, I scoffed. Sedlar, who learned to cook from his grandmother in Pojoaque near Santa Fe, knew his tortillas, and to my surprise the restaurant was serving art on a plate, art you loved to eat. So I went to a few high-end places, but in Los Angeles I was lost until I discovered the *LA Weekly*. This alternative paper had a food column, a reliable guide usually describing inexpensive places in a landscape that was bizarrely difficult to navigate. Great looking restaurants could have mediocre food while someplace on the second floor in the back of an awful little strip mall could be fantastic. I came to enjoy this perverse challenge but usually depended on *LA Weekly* for clues. Then in 1986 their versatile music critic Jonathan Gold became the food editor (the Counter Intelligence column), and the level raised several clicks. This guy discovered out-of-the-way wonders, some of which didn't see many people with white faces: Koreatown noodle joints, East LA cabrito taco stands, and Shanghai dives in Monterey Park. For years with no prompting at all I ranted on and on that Gold was the best restaurant critic in America. When he was awarded the first Pulitzer Prize for food criticism in 2007 for his book *Counter Intelligence*, I was elated. The 2015 movie *City of Gold* is a love letter to Jonathan and Los Angeles. When living in mid-city, Gold started a project to eat at every restaurant on Pico Boulevard, starting with fried yucca in Downtown and ending with chili fries at Tom's Number 5 near the ocean. Jonathan Gold wanted to eat Los Angeles and thereby understand the city. He took many of us along on his journey!

Monterey Park appeared to be just another white suburb in the mishmash of LA neighborhoods. But it caught my attention when I read in the *LA Weekly* that there was a protest over the city administrators making illegal signs with Chinese characters. So I went there, and the Chinese infusion that the city government was trying to stall was evident. And there was no stopping it. While the term Chinatown in America usually triggers images

of dense neighborhoods like San Francisco's or New York's Chinatowns, and LA has one too, this was of a completely different character. These people wanted to enjoy affluence, boats and lawns and suburban homes; it was just that they were Asian. Monterey Park was the first suburban Chinatown in the USA and grew across the San Gabriel Valley. The story is far more complex, and I look forward to a book that explores this in detail and depth. And the food is amazing, Chinese people cooking for other Chinese. People asked me how to find a good Chinese restaurant, and my answer was to drive around and find a restaurant jammed with Chinese people, where no one is white. Order what everyone else is ordering, you can just point. There are many such places!

On arrival I had two ambitions for Los Angeles: to own and drive an old Cadillac with fins and watch TV on a huge screen. The price of used Cadillacs declined with age until the fins showed up, and then the prices steeply increased. Apparently I was not the only one with that nostalgic instinct, and I settled on a 1972 Cadillac Coupe DeVille. It was huge, like a small yacht, and I loved driving people around LA. The carburetor kept going out, and it was not cheap to own but what fun it was. The big-screen TV did not happen, but I purchased a set to watch in bed until I could go to sleep. Somehow I subscribed to a brilliant pay television station Z Channel that introduced me to many corners of cinema of which I had no clue. For example there would be a series of movies by director John Cassavetes and then with the actor Romy Schneider. *Das Boot*, *Black Orpheus*, *Heaven's Gate*, *The Yakuza*, the great movies kept coming until Z's demise in 1989. Nothing since has reached the level and intelligence of Z Channel.

Cal Worthington had the Ford dealership in Long Beach, and his TV commercials were a delight. He used animals in his used-car lot to dramatize the ads, known under the heading of "Cal Worthington and His Dog Spot." Cal wore a big cowboy hat and western music played while he performed his antics. Many are available on YouTube. They were a parody of himself and used-car salesmen and just good fun. The dog could be replaced by a lion, cow, elephant, tiger, goat, or any animal he could get near one of his cars. Cal's deadpan humor made his commercials famous. I remember him saying "I could sell you a car for a dollar down and a dollar a year." Then after a pause: "If I wanted to."

I was working seven days a week and not sleeping much. After the first year

Tracey went back to Oregon—her stay in LA had been a failure in many aspects, and I felt that guilt that parents assume and in my case deserve. But that just meant I could work longer and harder. Things were beginning to move along; several problems on my list were solved, although postdocs and PhD students who wished to work in this area were still rare. One Saturday I couldn't accomplish anything, and finally I just gave up for the day. This seemed radical. I drove to Japantown and ate lunch. Then without consulting a map or having a plan, I drove across the LA basin, stopping here and there. I am uninterested in sports but I sat in a bar talking football with some old guys. The enormity and diversity of LA pressed on me, and for the first time, I realized what a strange wonderful place I found myself in. That evening I went to a movie *Tender Mercies* which has a message of endurance and redemption. Over the years I searched out some of LA's diversity: Boyle Heights, Japantown, Koreatown, Thaitown, Downtown LA, the new Chinatowns which were exploding before our eyes. Los Angeles is the most diverse city in the Americas, although it is easy to miss the diversity completely. It must be sought out, but it is there in magnificent and sometimes bewildering complexity.

After my daughter returned to Oregon, I moved just outside Santa Monica, a block off of Santa Monica Boulevard in a two-story apartment building. I was on the second story and the apartment on one side was occupied by a woman who kept posters of very fit weight-lifting women on her walls. On the other side was a screenwriter-hypnotist whose wife was a nurse. She would drop by when he had a client, doing whatever it is that a hypnotist does. Directly across from my bedroom was another apartment building and sounds of people's lives echoed between the stucco buildings. You could hear fragments of conversations, cries of anger, moans of pleasure, and odors from whatever was cooking. I did not have much time to read in the 1980s, but one smoggy afternoon in a used bookstore on Santa Monica Boulevard I came onto a faded copy of *The Little Disturbances of Man* by Grace Paley. Her sentence structure and word ordering were a little unusual and her message was, well, disturbing. One of her stories contains the sentence "Fire may break out from a nasty remark." Grace Paley was immigrant 1950s New York City, but when I was asked to prepare a short appreciation of the work of USC's rising star author Aimee Bender, I found Paley's "little disturbances" had a kinship with Aimee's work. My presentation brought me a wonderful friendship with Aimee whom I had not met before.

That little bookstore was jammed with books and I prospected for new

authors. One discovery was the novels of Ross Macdonald who comes just after Chandler in California private eye fiction. The compelling stories are laced with magnificent sentences such as “Smog hung over Santa Teresa like smoke from burning money.” But culturally more significant for me was the series of Martin Beck Police Mysteries, a series beginning in 1965 of 10 novels by Sjöwall and Wahöö written to illustrate and probe the decline of life in Sweden. The flood of Scandinavian crime fiction, including Mankell’s Wallander series, comes from this beginning.

I loved Santa Monica Boulevard which Randy Newman memorializes in his song “I love LA.” Toward the 405 freeway was a theater for independent films and a street of Japanese shops from sushi bars to nurseries. In the direction of Santa Monica and the Pacific Ocean was a good hospital and a classic breakfast and hamburger joint. When my daughter left Los Angeles, she did not go back to high school, but instead she ran away to Alaska. Finally, she took a GED test for a high school degree equivalent and then showed up in Los Angeles. I met her at the coffee shop; we ate breakfast and then walked around the block while I described how dangerous the AIDS epidemic was. Eventually Tracey took some classes at Santa Monica Community College and then we got her into USC.

A Southland University

In May of 1982, the celebrated Mark Kac somehow reached me by telephone in the cubicle I occupied in the maze of the medical school at the University of California at San Francisco, and he asked me to come to the University of Southern California where he had moved after retiring from Rockefeller University. He came to Los Angeles to build up the Mathematics Department, and he joked that his job was to give USC a mathematics department that the football team would be proud of. Mark Kac, from Poland as was Stan Ulam, was skillful with English. Mark did not promise me anything but was upbeat and positive. He just said that Rota had told him I was leaving New Mexico, something which he said he was surprised to hear. “But if you really are leaving Los Alamos,” he said, “you should come to USC and see what we are doing.” Mark was famous for his work on statistical independence, the Feynman-Kac formula and many other deep results. As a student I had read his little book on probability and independence, and the clarity was dazzling. It was impossible to say no to a visit to USC.

Tom Pitcher had been on the USC faculty for a few years, so I called Tom and asked about the school and Los Angeles. Tom was cynical as always and recommended only two things about USC and Southern California: the Rose Garden that has sat in a hollow across Exposition Boulevard from USC for a century blooming about nine months every year, and Henry Antosiewicz, a USC faculty member. This intriguing list did not exhaust the possibilities of the Southland, to say the very least, but it did not contain errors.

When I came in June 1982 to give one of those job seminars during which the speaker has everything to lose, there was a reception before the talk. An older tall slim elegant man, wearing one of those banker suits all who knew him vividly recall, came over to me and introduced himself. The suit was a beautiful light grey with a thin charcoal stripe. This was Henry Antosiewicz. I told him I had recently spoken with Pitcher and he sent his best. I added

that I had spent 1979-80 teaching with Tom at the Manoa campus of the University of Hawaii. Henry then asked me how Tom was doing. I looked this serious man straight in his eyes and made a split-second decision to tell the truth instead the usual meaningless words. "He's not in good shape," I said. "He's drinking night and day, and it gets worse all the time." This is not normal coffee room conversation, but Henry had asked me and I decided he wanted to know the truth. I date our mutual respect and friendship from that instant. It could easily have gone in the opposite direction.

My interview trip to Los Angeles went well enough. Molecular biology was interested as well as mathematics, and I met several people who impressed me. David Galas, with a PhD in physics, had instead become a molecular biologist. I thought I could work with him, and if not, learn some biology from him. As it turned out both those things happened. Most memorable was Bernie Straller, a biologist who specialized in aging. Bernie, in his mid-60s, was agitated. He told me he was so excited at the prospect of my joining USC that he took tranquilizers to prepare for meeting me. It was surreal, him smelling of alcohol already at midmorning, leveled off with tranquilizers, trying to be calm enough to tell me all his theoretical biology imaginations. He couldn't talk fast enough. Whew!

The Mathematics Department had some stellar faculty. Jim Dugundji the topologist and Ted Harris the probabilist were both famous, and the thought of being in a department with Kac, Dugundji and Harris was attractive. One thing which impressed me was that the Mathematics Department asked the biologists if my work had a genuine connection with biology. That was exactly the right question to ask. They could evaluate my mathematics as mathematics, but did my work impact biology in a meaningful way? I rode to the interview dinner with Don Marsh, then Chair of Physiology at the Medical School. He did modeling work, and we hit it off, beginning a long friendship. At the dinner Mike Appleman from Biological Sciences remarked that he was glad Tuck Finch was not coming, that Finch had the propensity to order the most expensive bottle of wine on the list. This nailed Mike as parsimonious, which he certainly was, but a light went off in my brain. I knew I would either love or hate this Finch guy, and I looked forward to meeting him. It turned out that Caleb Finch became one of my closest friends at USC. He is well known for his important and pioneering research in gerontology, and with Eric Davidson at Caltech, he was in the Iron Mountain String Band since the 1960s. Their Folkways recordings impress me even more than their publications in *Science* and *Nature*. The word envy might be more accurate

than impress.

It was summer before I heard from Systems Development Foundation, and I was almost flattened when I learned the grant was approved at \$807,000. Charlie Smith, the director, insisted that he make the grant to me alone although I had written it with Temple. This was an enormous amount of money in 1982, and SDF did not pay overhead charges. More funds came in the next two years. In 2020 dollars I received a total of about \$4 million from SDF. Today funding of that magnitude is not as rare as it was then. I was frightened at the responsibility. Before this, I might say that I could have tried harder or that I was doing other things or any of a list of excuses. How was I going to handle having all this backing for what I thought would be important work? I decided that if I worked as hard as possible, given my health, and if then I failed, I could live with that sad truth. For the first time in my life, I would do my best for as many hours per day as I was awake. That's all anyone could do whether they were up to the job or not. The question of where to do it was resolving.

And as my negotiations with USC went along, I became more attractive to them due to the grant. Eventually USC offered me an appointment between Mathematics and Biological Sciences, a joint appointment based in math that had voting rights in biology. As I will comment later this was a key point. I tried my best to have Temple Smith hired too, but they wouldn't budge. One always wonders about such situations with incomplete information, but a year or two later, Mark Kac told me that USC was afraid they'd lose me because they would not hire Temple. So I assessed the situation correctly. Somehow they put my appointment through in the short time before fall semester. The SDF grant paid Temple Smith to be at USC that first year. Mark told me later that pushing my case through so rapidly had been difficult, and if I didn't do well, he'd come back and haunt me. Mark had had surgery for prostate cancer that spring, but he was always clever and upbeat. I loved the man and would welcome his specter appearing, even to harass me, but I haven't seen him yet. After he died in 1984, I felt his presence in the halls of the Mathematics Department for several years. Such men do not soon vanish.

Setting up at a new place is never easy, and to make things more challenging, my daughter Tracey came for the first year. That her mother allowed her to come live with me was a strong signal that it was going badly in Oregon. She insisted that I continue to pay child support, a small price for having Tracey with me. I rented a place at the edge of Santa Monica so that

she could attend that excellent school system and brought my possessions from Colorado. USC wouldn't pay for a mover, so I drove to Colorado in my Honda and came to LA in an old delivery van that Rob Bement purchased for the trip, towing my Honda. The vehicle only went up to 35 or 40 miles per hour on the level, and the headlights periodically failed. It was a long haul. I think Bill Harris the Mathematics Chair wouldn't pay for the move but I didn't push it. (Of all the jobs I have had, that was the only time I asked for more than offered in salary or benefits; I have asked many times for others.) I was so naive about my grant that I did not think of having the grant pay for movers. I had a lot to learn about using funds to expedite the research and shelter my time. My days at USC were filled with activity and endless details, and the situation with Tracey got steadily worse as the year went along. Eventually I realized there were only two places where I could relax: the Faculty Club at lunchtime, where a big crowd went with Mark Kac, and a health club where I exercised a bit and then rested in the jacuzzi.

Mark Kac often made memorable statements. I heard him remark dismissively that there was nothing left to learn about the gambler's ruin problem. This simple model has a person beginning with one dollar who tosses a coin to lose the dollar (tails) or win another dollar (heads). Will he go broke (ruin) before he wins N dollars? I had written a paper with Bill Beyer where we showed that the average time to gain N dollars, given you accomplish that, was symmetric in the probability of heads and one minus the probability of heads. In other words, the average time to amass \$1000, given you did, was the same for head probability 0.01 as for 0.99. I reminded Mark of our paper, and he shot back with, "Well, that was the last thing left to learn." I have always been astonished that there is so much left to learn, even about ordinary subjects such as tossing a coin in a simple gambling game or adding numbers. What a way to spend a life, learning new things that were not understood before. When Arratia and I were playing with titles for our first paper, Kac made fun of us for trying to find a catchy title. Only later did I recall that Kac had used the title "Can One Hear the Shape of a Drum?" for one of his most famous papers.

The topologist Jim Dugundji was interested in what I was doing, which at first surprised me, but then I learned of his work on the topology and geometry of chemical compounds. At one point I told him of an odd mapping problem with combinatorics that I struggled with. Later the senior faculty

met to vote on the promotion of an associate professor to full professor. It was the first time I saw Jim in action. He described the guy's research career and gave a negative assessment of its past, present and likely future. The work was in functional analysis and fixed-point theorems. I had written a couple of papers in that direction so could follow what Jim was saying. Still there was only one negative vote, of course it was Jim's. Walking together back to the department, I told him I had made progress on my problem and described it. Then I said that I'd listened carefully to what he said at the meeting. "I love what I am doing," I told him, "but the mathematical level is elementary. What you talked about today is genuine mathematics, but you seem more enthusiastic about this simpler work. How can that be?" He answered that one has to distinguish between doing something new from slightly changing the assumptions and proofs of known results. I only knew Jim for a few years—he died of liver cancer in 1985. I greatly admired his intelligence and integrity.

I moved cautiously in the Mathematics Department. My unusual research support could easily cause resentment. But it went well enough, and the department always found the room I needed for postdoctoral fellows, computer facilities and visiting faculty. It was sometimes messy but they came through. On arrival at USC, I purchased a cot on which when ill or exhausted I could bring out to rest until I could go on. I'd wake up early in the morning and often get to the office by 3 or 4 a.m. Research came in the mornings and in meetings with collaborators. Things like teaching, editing, advising students often were done in afternoons and evenings.

One attraction of USC was that the Mathematics Department was trying to build in the area of statistics, and one of their prospects was Louis Gordon. Lou had been an undergrad at Michigan State, and there I saw him present a brilliant proof of a classical analysis result using probability concepts. Then I met him when he was in Washington DC working for Charlie Smith. After a successful recruitment effort, Lou joined USC the year after I did. We became friends and collaborators. Lou taught me that certain problems in life are best solved by throwing money at them until they disappear. This was inconsistent with my do-everything-yourself ranching background. Plumbing is one area where I consistently apply the Gordon strategy.

Another important colleague at USC was Richard Arratia, a probabilist who had some difficulties with his tenure case. This happened before I ar-

rived, and the department planned to finish firing him the next year. Richard and I did some work on sequence matching that I will describe later. Our second paper was quite nice and I went to Mark Kac to push for his tenure. Mark stopped me in mid-sentence, saying that if it was Arratia I was promoting, Mark was already convinced. Doing work that was outside Richard's thesis area was what impressed Mark. Eventually, both Gordon and Arratia worked with me on the probability and statistics of sequence matching, and there were some excellent papers. Both of them are far deeper and stronger mathematically than I am; without them little of our work for sequence matching statistics would have been of that depth and quality. They had a strong mutual dislike from the beginning, and I had to negotiate settlements and soothe injured feelings. No paper with both their names was written without some pressure and arranged compromise from me, and some did not include me on the author list. They owed me, and for each of these negotiations, I spent down some of that capital. Sadly, perhaps inevitably and deservedly, it came to be the case that each of them felt as negatively toward me as they ever did toward each other. There must be an appropriate saying to cover such situations.

At Los Alamos Temple Smith had in 1981 used our algorithm to compare all pairs of known genetic sequences. That was the first all-versus-all sequence comparison study (where each genetic sequence was aligned with every other sequence), but this paper, as with much of what we wrote, was difficult to get published. The code on the CRAY (a parallel vector machine) required an innovative algorithm, but this was unmentioned in the paper we wrote. We found it almost impossible to find a journal for it, but there have been a good number of studies since following precisely our pathway. Temple claimed the scores were a function of the logarithm of the sequence length. It was a noisy plot, and I wasn't completely convinced. What was the score of the best matching pieces of two random sequences? That was the basic question, important for distinguishing biological signal from random background.

Eventually I found a paper in the USC library about the largest square of all 1's within an $n \times n$ square of random 0s and 1s. It had to do with the logarithm of n , the length of the sides, and soon I was looking at a paper about intervals unusually rich in heads for a sequence of random coin tosses. The result was called the Erdős-Rényi law and yes there was the logarithm of sequence length! (Feller's first book on probability theory contains problem 5 in chapter 7, which would have given me the clue, but in spite of the hours I had spent reading the book, I missed it!) That same day Kac stopped me

in the hall saying Paul Erdős was coming to USC two days hence, and I was to join them at lunch. Erdős and I didn't have time then to talk much, and the next week I went to the Atheneum on the Caltech campus to have another lunch with him. We then went to his room where I explained the basic problem in detail. He asked a few questions and then went to sleep. Erdős was extremely thin and frail, and there he was, slumped over onto his bed. I thought about the problem for a while and then about how neat it was to be in the same room with the famous mathematician. After a long while I decided to leave him to his rest. As I quietly stood up, Erdős shook himself, tilted back upright, and said, "I am not asleep. I am thinking." Okay, I stayed on and eventually he told me the problem was possible to solve. He didn't suggest the answer or even an approach, and surprisingly he didn't propose a joint paper which I was too shy to suggest. Still, I left feeling optimistic. In few weeks, Richard Arratia and I had found the solution, and we had a nice intuition to guess answers to this and many other questions. What we stumbled onto was closely related to David Aldous's Poisson clumping heuristic. A year later Erdős visited USC again, and I told him the answer to the question I had posed to him. He was very surprised by the result which pleased me since by this time Richard and I considered it elementary. If I had written a joint paper with Paul, my Erdős number would have decreased from 2 to 1, but his surprise at the then-intuitive result was priceless. Many wonderful stories about Paul Erdős can be found in the book *The Man Who Loved Only Numbers*.

During my first year at USC I looked for someone who was talented mathematically but also serious about genetic sequence data. Sam Karlin at Stanford more than filled this description, but he was senior and very accomplished—he'd never leave Stanford for USC. Luckily I found Simon Tavaré who was somehow both at the University of Utah and Colorado State University. I had him over for visits the fall of 1984 and we developed a good working relationship. Late in the evening we'd head out for ethnic food. I recall his saying in our favorite tiny Thai restaurant, "Michael, it is time for the dreaded pompano!" This was a fiery whole-fish dish which we both loved. Then he came fall of 1987 as a visiting professor and a year later joined USC full-time. Over the years we shared grants and postdocs; he is a wonderful colleague. Without Simon Tavaré at USC I might have left, and together we built a good program. One event in his recruiting stays with me. We needed an office for Simon, and when I suggested one, the Mathematics Chair Ron Bruck said it was impossible to put him in the office I'd located. "Why not?"

I asked. Because, I was told, it has more inches of window than other full professors and a new faculty member cannot have that. The exact number of extra inches was cited. For a moment or two, I was speechless and then came up with a response. “Just tell me exactly how many inches of window you will allow, in linear or square inches. This weekend I will come in and cover the rest of the existing window with drywall. I can frame it, drywall it, tape and sand it so as to have it painted by Monday.” I didn’t have to exercise my carpenter skills although I would have greatly relished doing so, and Simon moved into an office with those few inches of extra window.

The first papers with Arratia and Gordon on sequence matching were quite technical. Then Perci Diaconis suggested to Gordon that we look at Louis Chen’s paper on Poisson approximation. Chen when a student of Charles Stein at Stanford had taken an approach to Poisson approximation related to Stein’s method for normal approximation. The first summer when Gordon presented the Chen paper to us, it looked related but none of us understood it. The following summer Gordon attacked the paper again, and things looked clearer, even to me. Gordon and I had recruited Larry Goldstein, a new PhD from USCD, and he joined the group. Suddenly Gordon, Arratia and Goldstein had a version of Chen’s paper that was straightforward in comparison. Their resulting paper has been widely cited and used. They made Chen’s work available to mortals such as me. This powerful tool allowed us to make more progress on the statistics of sequence matching. We owe a lot to Louis Chen, Perci Diaconis and, of course, to Charles Stein.

In 1984 Charlie Smith of Systems Development Foundation sent a grant applicant to the Foundation to Los Angeles to meet me, and I was to send an evaluation of his proposal to SDF. Eric Lander, a graduate of Princeton and Rhodes Scholar with a PhD in algebraic combinatorics from Oxford University, was in the business school at MIT where Mosteller had a history of making creative and unusual appointments. Eric’s proposal was about the neurobiology of the nematode. Eric is famously articulate, and he came to my USC office where I had David Galas join us. Most of the conversation was Eric talking, and we went to Koreatown for a late lunch. Eric flew back to Boston that night with a stack of papers I had written with Arratia and Gordon. He called soon after to say how impressed he was by the work, and that, I am sure, was a surprise to him. Eric’s proposal was inspired by the fact that nematode biologists had the complete fate map of the development of that worm. There was a deterministic diagram accounting for the history of each cell from the first cell to the complete animal. Eric’s idea was that

this could be leveraged to decipher the neurobiology of the nematode, which would be a huge accomplishment. I was skeptical and consulted a few people who knew the biology. After my review, Charlie called me to say, “So! You don’t think Eric Lander is as smart as he thinks he is.” I answered, “Charlie, I didn’t say that. I said I do not think his project is feasible, but you should fund him anyway. Something good will come of it.” It turns out I was correct on both of those points.

It is unlikely I would have joined USC had I been told that since the university had missed the explosion in molecular biology it had decided not to attempt to catch up. (Sadly, USC did the much same thing with Big Data, but that may be changing.) The collection of molecular biologists at USC showed this lack of support, although to Dean Bill Wagner’s credit, he put resources into neurobiology. I was not savvy enough then to see these things. Eventually much at USC turned around, but that did not really begin until Stephen Sample was brought to campus as President in 1991. In his inaugural address Sample put forward his goals, one of which was to raise the level of the undergraduates. “Good idea but it will never happen,” I told myself and paid no attention until some years later when Sample’s bold objective came to pass. There always were some excellent undergraduates at USC, but many were not impressive. Looking back I can see definite and effective steps that were taken. USC is tuition-driven, and in the early 1990s all of Southern California was suffering from a serious economic downturn. To decrease the USC student body was not an intuitive response, which however is what Sample did. Moreover he aggressively sought out National Merit Scholars and made it advantageous for them to attend USC. He created a program for the brightest students so that they were not isolated intellectually or socially. This and his outreach into the local community eventually received national attention; USC was on an upward path.

More directly affecting me, Lloyd Armstrong became Provost in 1993. The academic leader of the university, he moved deliberately to achieve some balance between USC’s deservedly famous professional schools and the College of Letters, Arts and Sciences. Here is one example of his efforts which were not confined to the College. Armstrong realized that in hiring and tenuring faculty a university recreates itself. I served a few years on the Provost’s Committee for Academic Promotion and Tenure. For every file that involved appointment or promotion to tenure, he met with the commit-

tee for a discussion, and embarrassing to me, he often had read the file more carefully than I had. This is where the so-called rubber meets the so-called road, and Armstrong was paying close attention.

In 1994 Armstrong appointed Morton Shapiro as Dean of the College of Letters, Arts and Sciences. This transformed the College. Shapiro asked me to be on a committee to help him select his three sub-deans. While those deans were until then organized by subject areas, Shapiro organized them under task (function). Neither organization is a perfect solution, but the reorganization made the entire College rethink its connections with the Dean's office, a brilliant move. My advice would be to change it back, just to stir things up and make people forge new ways of interaction. More than that was the manner of choosing the sub-deans. The committee met several evenings to go over the file of every tenured College faculty member, considering whether they'd be a good fit in one of the positions. "Don't worry about whether they will accept," the Dean told us, "that's my job." The top choice for each job was recruited by Shapiro to fill the position. Suddenly there was a Dean's office with bright ambitious people, and for the first time, I knew they really "got it." They did not always agree with me but I knew they understood my arguments. Not everyone at USC agrees with my evaluation, but when I say that they were smart and effective, not many disagree. Faculty at universities are often self-centered, and it is almost part of the job to think that one's own subject is the most important on earth as are one's own accomplishments. Having to listen to everything that comes to the College office (or to any Dean's office at any university) is terrifying, and yet people do it every day. And to do it well in the face of a severe financial downturn as happened in southern California in the early 1990s is impressive. They made plans for when things improved, and they were ready when that happened. The quality of Shapiro's office is seen in the subsequent careers of the Dean and subdeans. Shapiro went from USC to be President of Williams College and then President of Northwestern. Joseph Aoun who was Dean of Research became USC College Dean and then President of Northeastern. Nancy Vickers who was Dean of Faculty became President of Bryn Mawr College. Maria Pellegrini who was Dean of Research became Science Program Manager of the Keck Foundation, then Vice President of Research at Brandeis University; she is now Executive Director of Programs at Keck.

As I mentioned, I came to USC with a joint appointment in Biological Sciences (BISC) with Mathematics as my home department where I held tenure. It then switched, and there is a separate department for computational biology today. How did that happen? If the BISC appointment had been without voting rights, this would not have been possible. As it was, I took votes on tenure and other matters seriously and became a trusted member of my section (BISC is a federation of sections, and I was in the Molecular Biology Section). When Simon Tavaré came, he also fit into this role easily. Simon and I recruited the evolutionary biologist Walter Fitch into BISC. Sadly Fitch left for Irvine just as he was elected to the National Academy of Sciences. We were part of the Biological Sciences Department while still sitting in mathematics. Beginning in the late 1980s we had a series of great postdoctoral appointments. Those I worked with include Gary Benson, Gary Churchill, David Chew, Vlado Dancik, Sridar Hannenhalli, Jotun Hein, Laurie Heyer, Ramana Idury, Harry Katcher, George Komatsoulis, Semyon Kruglyak, Jae Lee, Christophe LeFevre, Haixu Tang, Pavel Pevzner, Sophie Schbath, Michael Schoniger, Fengzhu Sun, Martin Vingron, Arndt von Haeseler, Betty Tang, Tandy Warnow, Momiao Xiong and Shibu Yooseph. We could easily accommodate postdocs whether or not they were mathematicians. However it became difficult when we began to add faculty within the Mathematics Department. After Pevzner went to Penn State we brought him back as Associate Professor and his strength in discrete mathematics made the appointment possible.

Meeting Pavel Pevzner came from a reprint request. In the 1980s scientists would still write asking for published research papers, often on postcards. Pevzner had written such a request and I sent a stack of published and manuscript papers. They included a paper with Bill Schmitt not yet published about multiple solutions of a restriction digest mapping problem. I did not see it as biologically important, but it addressed the combinatorics of restriction mapping, a fascination of mine. In 1989 or 1990 Pevzner wrote me a letter in imperfect English, communicating that he had understood the somewhat abstract paper and had utilized it to greatly speed up a program to compute restriction maps. This was a surprise on both counts and I arranged for him to fly from Moscow to Los Angeles in 1990. His visit convinced me I could work with him and he joined us as a postdoc. Pevzner is one of the strongest and most creative computer scientists working in genomics. His theorem about bi-colored Eulerian graphs inspired by my paper with Schmitt was one foundation of his amazing work on genome arrangements.

I respect traditional science departments. If our chemistry department says someone is an excellent inorganic chemist or our physics department says another person is a superb low-energy physicist, I believe them. There is a long-standing culture of making these judgments with agreed-upon standards. In a new subject such as computational biology or bioinformatics, who is to say? And what does it mean when they say it? Some bioinformatics programs produce PhDs who know little about anything. At USC in our computational biology program, our students learn something about something. There is another PhD program in biological sciences where the students essentially take one graduate course that largely amounts to each laboratory advertising their research area to attract students. Their good students do well, but it is difficult for me to believe that there is not something more for their students to learn while in graduate school. Instead they are used as hands-in-the-lab as soon and as long as possible.

The computational biology faculty struggled to fit into the Mathematics Department. This included one structural change, dividing the Mathematics Department into sections, which was imposed on the Department and caused resentment. I am grateful for the remarkable patience and accommodation the Department showed over the years. A transition point came with the appointment of Ting Chen, who was from mainland China with a PhD in computer science from Stony Brook University and knew from the beginning exactly what he wanted to do. He had an impressive postdoc with George Church at Harvard and I hired him as assistant professor. When recruiting him, I promised that we'd move to BISC. Ting suffered for two years teaching mathematics until we accomplished the move. We could have created a separate section, but we four faculty joined the molecular biology section where we had a long relationship. While that had the advantage of putting us close to molecular biologists, we remained separate from the other sections of BISC. That turned out to be a serious error that took years and much pain to recover from.

There are many places to locate computational biology: applied mathematics, statistics, various branches of biological sciences including evolutionary biology, bioengineering and computer science. Each of those choices has both positive and negative features. A liberal and strong administration needs to see that such ventures as deserve it are healthy and remain so. That requires resources, judgment and courage. USC provided such an environment at the time we moved from mathematics. Later we split off from Molecular Biology into a separate computational biology section, and

the College administration created a toxic environment where bitterness, immaturity and acrimony flourished. In contrast with Shapiro and Aoun, that Dean's office made excuses and did not think ahead except in platitudinous proclamations. I told the science dean, "Sometimes leadership needs to lead." A weak passive-aggressive administration creates lasting damage. I debated whether to include the grubby details, which I have obliquely referred to, and decided against it. But eventually a separate Department of Quantitative and Computational Biology was established.

While I expected to keep Simon Tavaré for a few years, he stayed much longer. I believe he had an agreement with his wife Jane to stay put until their children were out of the house. When that happened Simon was looking at both Oxford and Cambridge. Considering his desire to keep a base in the USA, we let it be known that our group might be movable. University of California at Berkeley became the likely possibility, and at some point, Simon had implicit and explicit offers from all three places. However every time I spoke with Berkeley their plan for us changed, and in the end, it was less attractive than I had hoped. USC's great President Steven Sample, to keep our computational biology group from moving to Berkeley, went to the Trustees and got the go-ahead to put up the building now called Ray Irani Hall. I vividly recall sitting in the President's office with Sample and Provost Lloyd Armstrong. I considered asking for a building for applied mathematical sciences but knowing the dismal state of the molecular biology laboratories, I went with that. Sample loved to tell that story and he did that at the building's dedication. He had two endings to the story: one that he told in public and another in private. In public he'd say that people often said I don't ask for much for myself, then he'd pause. "Not much," he'd say. "Just a building." In private he would quote the salary he would have given to keep me. "When you did not ask for yourself, it told me what your values are." And that statement told me about Sample's values as well. All of us in Computational Biology owe Steven Sample a great deal, and I greatly miss his vision and his integrity.

The new building gave the molecular biologists new laboratories, and the addition of computational biology caused more resources and recognition to come to them. Almost none of those resources except office space came to computational biology, but we did carefully add faculty positions. The molecular biologists constructed an image that took credit for computational

biology using false advertising, recruiting faculty by implying that computational assistance was eagerly waiting them, as if we were to be their servants. They recruited PhD students who assumed they would also be educated in computer science and statistics. It sounded great when they described the situation to outsiders who had no clue it was a Potemkin village. It is an irony that when we finally left the section they were bitter and obstructive. While I expected no one ever to thank me for the facilities I managed to have established for them, also I did not expect the nasty situation that came to pass. I have criticized the logic of the political right which asserts that whenever the government does something for people it becomes one of their undeserved “rights” that they will never give up. What happened to computational and molecular biology at USC is a sad academic version of that phenomenon. The problems were exacerbated by a passive-aggressive Dean’s office which instead of stepping up and engaging, handled conflict by requiring “consensus” from those involved.

USC has designations of Distinguished Professor and University Professor. Receiving the title of University Professor is based on “multi-disciplinary interests and significant accomplishments in several disciplines,” and I was named University Professor in 1998. The group of University Professors was small then and included Kevin Starr, the eminent historian of California who also joined in 1998. Kevin was amazing, a large man with a booming articulate impressive voice. He persuaded the Provost to pay for monthly lunches during the academic year and a yearly black-tie banquet at the California Club in Downtown Los Angeles where he was a member. Kevin was the spark of our gatherings and interactions, and he made the University Professors a community. Kevin had a slight air of pomposity tempered by self-mockery and wit and intelligence, which made interactions with him very pleasant. We were called on to give impromptu speeches and it was privilege to be in the room. At the banquets, he went on about the tradition of double consommé and sherry (with hazelnuts on the side), which was our first course. I thought it bland but Kevin was always interesting. After a few years, the consommé with sherry disappeared from the menu and to my surprise I missed it! Kevin died in January 2017, and many of us deeply miss his transforming presence. The Society of University Professors has continued but for me it is lacking some of what made Kevin’s leadership so charming and effective. While the COVID 19 crisis ended the lunches and banquets which have begun again,

without Kevin I do not expect again to be very active.

Through the University Professor connection, I came to know Kevin and his wife Shelia. They were working to create a residential life experience along the lines of Harvard's Residential Colleges. They encouraged me to become involved. Parkside International Residential College with over 600 students opened in 2001, and Kevin and Shelia moved into the apartment for the Faculty Master. Unfortunately due to a family situation they had to withdraw after the fall semester, and the Master position was vacant for a semester. The Starrs encouraged me to apply, and as I was returning from a sabbatical, I put my name in. My interview was in the Faculty Master apartment, and I was keenly aware that I had no idea what the job was or how residential colleges worked. Stephen Toulmin was a distinguished philosopher who began his career at Oxford University. He was understandably skeptical about my qualifications, although others such as Florence Clark and Ellie Nezami were more supportive. I met with the staff whom I came to greatly admire, and it was clear to both sides that I knew nothing. The meeting with the undergraduates went very well. To my mild surprise, I was offered the job and moved in the next fall. There were three other residential faculty living a Parkside with their families, graduate students serving as residential councilors, and undergraduates to watch over each floor of undergraduates. There were frequent activities and meetings which I attended as often as I could. During semester I felt peripheral to the operation, and during winter break, I decided that unless something clicked, I should let someone more effective take over at the end of the academic year.

The next spring I became close to the residential faculty, their families which included several children, the staff, and the more engaged students. I began to feel that I was part of a real community. Parkside had over 600 students, so just becoming known to a fraction of them took time. I ate in the dining hall, I went to meetings, and I tried to be present and visible. Okay, I asked myself, if I am going to be here what do I want to accomplish? Amazingly there was no Faculty Master job description, no list of duties or goals. The title Master is a hold-over from British universities and Harvard; I had no desire to be master of anyone, and as the position had no power in any dimension, I was safe from that. I engaged in the various programs set up by the floor organizations and started a weekly Master's event where interesting people to presented their specialties. I invited authors (novels, plays, poetry), historians (Asia, the constitution, California), university presidents and provosts, musicians (jazz, classical, new music),

architects, political scientists, scientists (earthquakes, climate change, bacteria, elementary particles), engineers (robotics, surveillance), We had one evening on low-rider culture (which is big in Japan as well as the San Fernando Valley in case you didn't know that) and another on what a baby hears in the womb. After the presentations we had dessert in my apartment. About twice a week there were gatherings of from 10 to 60 students there. Sometimes there were events in my apartment when I was traveling, and I expected to lose a few books and CDs—that never happened!

Also I started a weekly dinner in my apartment which had a dining large table donated by Kevin Starr. I recruited students from different parts of the residential facilities, students who did not know one another. To begin the conversation, I talked about my situation going to university, revealing a bit about myself being a first-generation student at a land-grant university, and then we went around the room. Each of them was to tell why they came to a university, not rah-rah USC-Trojan-Family, but why were they at university and what did they hope to achieve with their education. This brought out family stories and some emotional moments. One Hispanic woman, as she was describing her immigrant mother's sacrifices to provide her opportunity, broke into tears. We passed by her, and later another student said, "Let's go back," and the young lady finished her emotional story.

There are two ways to develop a residential life program. One is along the lines of the Harvard operation where the Faculty Master is in charge. The other approach is for things to be run by professionals trained in Residential Life Programs in Schools of Education. At USC Kevin Starr's hopes for a Harvard-style organization did not come to pass. Here is a quote from the current webpage: "The Office for Residential Education fosters the holistic development of members within the USC residential community." Resident faculty are featured in the material but have little authority and are more for advertisement than content. As I began to understand the situation, I increasingly found myself contesting the Residential Life administrators. The person at the top though was Michael Jackson who was a tough and skilled administrator and without him I might not have survived a full term.

I am thankful for my five-year appointment at Parkside Faculty. Without Kevin and Shelia Starr pushing me into it it would never have happened. Without the residential faculty and their families, without the hard-working staff, without the diverse students, without my assistants Sarah Duman and then Jeanette Yarnan, the experience would not have been so rewarding and engaging. During my first 15 or 20 years at USC, I would not have had

time from my research to spend 20 hours a week in student and residential activities, but Parkside came at the right time for me.

It may appear as if I knew what I was doing, where everything was going. I did not. Indeed I was fortunate to have John Kinney introduce me to discrete dynamical systems before it became an industry and then at Los Alamos to find biological sequences. That was the setting in which I discovered wonderful problems to solve, some of which had an impact on biological as well as mathematical science. To recognize a potential mathematical problem concealed in a plethora of experimental details is not something I know how to teach except by example. There is a huge component of chance, success is partly random. Original work can be overlooked or someone famous comes after you, and your contribution is ignored. Even with something so obviously “the right answer” as the local algorithm with Smith took years of promotion and writing more papers to establish its utility. Smith moved to other topics, but I kept local alignment as my side industry until finally it was recognized as being central. Teaching, writing code, writing papers, and applying for grants all require a serious effort. Without what is famously called *sitzfleisch*, or sitting while endlessly working, nothing much happens. Many of my younger colleagues have standing desks but the principle is identical. Perhaps they will use the word *stehenfleisch*. It is key that I work on something I am genuinely interested in, for unless I honestly care it is difficult to carry out challenging work. I tell my students that our goal is to do research and write a paper that we ourselves would have found interesting when we were learning about the area. This is a far higher standard than just writing something that is publishable in a good journal.

From my ancestor Robert Waterman who landed in Plymouth Colony in the 1630s to my great-grandparents and grandparents in the mountain west to myself on an isolated livestock ranch, all those lives were transformed into something radically different or at least new. I think few of us wish to return to the realities of those earlier lives, no matter how romantic they might appear on a page or in a film. We are here for the duration until we are done; let’s take chances and not follow safe comfortable routes. So long as we are alive, we should make no other choice.

Two Weeks in the Bob

When I went to California, I spent the first half of 1982 at the Medical School of the University of California, San Francisco, followed by a permanent job at the University of Southern California in Los Angeles. I had signed myself onto a big task and kept to it for two years, working seven days a week, twelve to fourteen hours a day. Either I was working or stretched out on a cot trying to feel well enough to work. I felt as if I were in a tunnel, and I did not have a sense that I would ever emerge, or at least that I would ever emerge intact, able to lead a normal existence. It was a strange and absorbing time.

Then it was 1984, and the summer Olympics was coming to Los Angeles. The Olympics had been a financially losing proposition since the 1930s when they last were in LA, the palm-lined streets invented as part of Los Angeles's *identity*. Horror stories in 1984 were national news: the future prices of hotels and parking, and traffic, another California nightmare everyone said. Louis Gordon, my friend and colleague at USC, recounted a story of similar predictions of gridlock and disaster at another location, predictions which failed perhaps from their own weight. I took his anecdote as insight and did not take the end-of-the-city scenarios seriously, but I did use them as an excuse.

The projected traffic jams and lack of parking on the USC campus due to Olympic attendees propelled me north. North to Santa Cruz where Harry Noller kept his labs at the University of California. It is a famous school of alternative education, once well-known as a no-work school. When Harry arrived, he fell in love with the redwoods and then sent in an NIH application. The reviews came back: this all sounds fine but you can't do research at Santa Cruz. Period, that's it, no support. Harry pulled together enough cash for experimental materials and went ahead with it. After he began publishing from UCSC, he was never again refused funding. Today he is a member of

the National Academy of Sciences and was awarded the Breakthrough Prize, for work done at Santa Cruz. That summer of 1984 I visited his labs.

I was out of Los Angeles. Excuse: the Olympics. Real reason: the need to see if I were still human. In Santa Cruz I stayed at the home of Tom Byers and his wife Genine. I helped Tom with his thesis when he was finishing at UC Berkeley and I was at UCSF. Tom intuited that the subject I was developing must be a rich source of computer applications, and somehow he found me holed up in my remote and tiny office at UCSF. I gave him his thesis topic from my recent discovery of a solution to an algorithmic problem. Genine was from the logging part of Northern California, and she and I had that working-class background in common. In 1984, living in Santa Cruz, Tom was employed in a high-tech startup, and came home at night very wired up, full of tension.

But each morning Genine and I walked out along the shore, and I tried running on the firm sand next to the waves. I worked up to close to a mile at a slow jog, the wind full of a sharp iodine kelp smell, the sea calm and elongated against a heavy fog bank, and Genine a pleasant companion. Then I walked four miles to Harry's laboratory where I sat at a lab bench and thought about computational biology for the rest of the day. I proposed a simple conditional-entropy method that is well-known today for one of their sequence analysis projects, but it was so mindless that I did not attach my name. I recall the calm laboratory and walks to lunch underneath the high redwood canopy. Gradually my flywheel ran down.

I am not sure how I decided that Sandie's son Andrew Curgus should come from New Mexico and join me for my first time off in years. Helping raise a person gives you a stake in their life, and I remembered his shout to me when he caught his first trout in a wilderness fork of the San Juan River, hooking the fish off a rock in the holding water I taught him to recognize. And I was planning on going fishing again, all the way to Montana, my dream state of mind. In an old fishing encyclopedia, A.J. McClane wrote that the best cutthroat trout fishing in the lower forty-eight was in the Bob Marshall Wilderness on the South Fork of the Flathead River. Living in Idaho before I knew Andrew or his mother, twice I had set off to hike the Bob Marshall but was sidetracked both times. One of those diverted adventures snagged onto the Continental Divide between Idaho and Montana, west of the Highway 15 crossing, a wonderful trip. Idaho just was too wild and beckoning in 1972 for me to resist. I was in love with that place and that time. But in California in 1984 I was standing on a different landscape and had a different view.

I left Santa Cruz, picked Andrew up at the San Francisco airport and drove into San Francisco to stay in a wonderful old hotel up Geary Street from Union Square. The Hotel Cortez had once been high-class and was in 1984 just short of derelict. You could get a big room with two or three beds for a reasonable amount. Later a Japanese firm bought the Hotel Cortez, changed its name, tarted it up, and charged an inflated amount for a room. Ah, for the good old days. I owned an old Cadillac and had its tires replaced. We purchased a frying pan that would fit into my Kelty hard-frame backpack and started thinking of the resonant campfire embers and the smell of crisply frying trout. We walked about the City which I knew very well from my recent eight months of living there. I recall being irritated with Andrew, who wanted to be cool so walked just in front or behind me. I had not gone that far to be with someone who did not want to be seen with me, even if he was fourteen years old.

We drove on new tires up Highway 101 to Oregon, to the coastal ranch where I was raised and where my family still lives. There I caught up with my relatives, and one morning I organized the dried food and supplies into stuffsacks that would fit into our backpacks. My nephew Franklin, my brother Charlie's son, saw that and had the revelation that we would be out in the woods without a woman.

"Why who is going to cook, Uncle Mike?" he shouted. When I answered that we would, of course, he came out with a loud and nauseous "Ugggggh! Ick! Phewwww!"

Neither my father nor my brother could even make toast, and apparently my nephew thought that the ability to make eatable food is sex-linked, that *inability to cook* is spelled out on our poor male chromosome.

In keeping with the food preparations, my mother recommended a restaurant on the Columbia Gorge where we could get a "good feed." Just stop there at Biggs, she said. We drove over the Coast Range, down into and up the Willamette Valley to Portland, then up the Columbia Gorge, past Hood River and the Dalles. At Biggs is a fork in the road where Oregonians often head south along the east side of the Cascades following the Deschutes River to Bend. We were bound north across the Columbia River into Washington State and stopped to eat at the much-praised Biggs. The single restaurant was a dreary greasy place with almost nothing to recommend it besides its location. My family has always had its own special definition of good food.

Andrew and I crossed the desolate open range to Yakima where I located a motel. Down and across the two-lane blacktop road was a fruit stand where

I bought peaches and strawberries. The sun was bright and strong, even that late in the day, and the air was dry. We had escaped the foggy dew of the coast. The next morning we drove across Eastern Washington past Moses Lake and Spokane into Idaho. My great-grandfather Waterman ended up his life working in a shingle mill on the outlet of Priest Lake, but we passed into Idaho lower down, by Coeur D'Alene and its lake. Then came the old mining towns of Kellogg and Wallace, in rugged country. My friend Tom Pitcher spent time in Wallace, and I had from him an image of hard-scrabble miners and whores. Instead Wallace struck me like a few years later the remodeled Hotel Cortez in San Francisco would, just an old place that was getting gentrified coatings for the new generations who would occupy the premises without any sense of the rough hard-living grind it took to make this country. Perhaps it's best left that way.

Entering Montana's piney mountains we soon took a smaller road north-east. The urge to go fishing and hiking was becoming stronger and stronger, having talked and dreamed about fishing day-after-day, mile-after-mile, curve-after-curve, finally there we were in the magic state itself. At the first possibility, we stopped to buy fishing licenses in a log-cabin style building that was a combination roadhouse, gas station, grocery store, and *yes*, fishing counter. After becoming legal to catch fish, we made it a full mile down the road when we careened into the woods to emerge at a small stream in which we caught a couple of trout. Today this seems fortunate, but we looked at the trout as our just due. *Hell, we have come all this way to Montana, and here we are in Montana, and the streams have trout in them, don't they?* It was down the road a bit more, and we made a campfire to cook the fish. I recall sleeping on a slope in my bag, the first time I had slept outdoors in three years. The bag slid down the grade during the night, but I slept anyway.

Day 1. We woke and rolled the sleeping bags up. I have no memory what we did for breakfast, maybe it was simply excitement and anticipation, but soon we headed for the Bob. Midmorning we found ourselves in one of those marvelous Montana valleys where at times I expected to spend the remainder of this life. It was called Paradise Valley, and at the small village of Paradise Andrew called his mother who was not at home. He left a message: "It's Andrew. I am OK. We are calling you from Montana, paradise. It's Paradise, Montana." God, yes. We are lucky to be alive.

From Paradise we drove to the largest city in the region, Kalispell, which

like so many American towns showed what the author David Berlinski calls “such magnificent empty promise.” I couldn’t locate a sporting goods store in Kalispell. Kalispell Lake was magnificent, a contrast to the all-American modern-day town. But to our good fortune, there was a discount sporting shop as the road left Kalispell toward Hungry Horse Reservoir and Glacier National Park. We went inside. An acre of boots, rifles, bullets, rods, reels, and lures. This is my environment, from early years of visiting Luke Henry’s Hardware Store in Langlois Oregon, I have been schooled in this now out-of-date and politically incorrect world of find-em-and-kill-em. I asked about the Bob and was referred to a certain clerk.

“Yes, my family runs a guide service into the Bob Marshall, has for years,” he said. Andrew and I planned to walk and not pay anyone, so he had nothing to gain from our business but the few-cents profit on a few cheap trout flies. But he was straight as anything you can expect to find in the West (or anywhere on this earth), and he gave me useful information. I asked about the water, was Giardia a problem? He said that in the drainage of the Flathead it was not, untreated water was safe. That was great news. And the fishing? He was enthusiastic, especially about the Dolly Varden that swim up out of Hungry Horse Reservoir to spawn in the South Fork of the Flathead where we were headed. He mentioned Gordon Creek as especially good, although usually later in the year. “Keep your eye out for the Dolly Varden,” he said. All right, I was *ready*. I bought a box of inexpensive trout flies recommended by our new friend, and we were off in high spirits.

Finally we came to the foot of the mountain range at Holland Lake. The concept of our hike had been spawned many years earlier with a map of the Bob Marshall Wilderness Area in the basement room I built in an old house in Pocatello, Idaho, days in which I ran my hiking trips straight to the objective, whatever stood in the way. So we were going in from Holland Lake in the Swan Valley drainage, straight up the mountain which after crossing we would head down Big Salmon River that drained into Big Salmon Lake, which itself drained into the South Fork of the Flathead River where all those big cutthroats and Dolly Varden were waiting for us. Then up the South Fork, after that heading up Gordon Creek for another ascent over the mountains, finally closing our loop at Holland Lake. It was 70 miles of walking with about a quarter mile of duplicated trail. The only catch was the enormous physical effort it would take to make this little loop, carrying food and gear for two weeks.

We packed up, excited. I was not confident that we would make it. I took

a photo of the two of us at the trailhead. My posture and expression showed that. Andrew on the other hand was cocky and ready to go, thinking of the fish he was going to catch. It makes an interesting comparison. We went up through a pine forest with views of the lake, not working too hard yet. Then we started up. It was 3:15 p.m.

The mountain ridge was about 3500 feet above us, and Necklace Lakes was on the trail sign, 4 miles ahead. I told Andrew that on reasonable hikes a mile-an-hour is a conservative expectation. As we headed into the steep trail, Andrew slowed to a crawl. I was worried about this trip. *Am I strong enough to make the trip? Will I have a collapse as I have had in recent years and have to be carried out on a horse? Have I brought enough for a growing healthy 14-year-old to eat?* Andrew went even more slowly, and we took breaks with increasing frequency. A horseman passed us with tales of the Bob including grizzlies which are one of the deterrents of the place, bears that will stalk and kill a man. (I depended on it being hunting country to keep the bears wary and on putting the food far from the sleeping bags.) His stories added to the weary tension of the hike up the steep winding trail.

Andrew was hardly moving, and thunderstorms raged across the Swan Valley. We were committed, rain or not, but I hoped the storms would not reach us. At one long rest, we were perched under a pine, and three women came down the trail. Obviously they were grandmother, daughter, and granddaughter, from 70 to 15, and as they didn't see us, I said something so that we would not appear to be snooping. They had conquered the mountain we so foolishly and optimistically started up in mid-afternoon, and they wanted to know where we were going.

"Necklace Lakes," I said. The grandmother looked hard at us, and then said, "Well, do you think you are going to make it?" I answered saying, "I don't know, but we are not going back." I had the impression that she was unconvinced.

They briskly strode off down the mountain, and we slogged a few more steps up. Later I realized the spry grandmother thought we had been struggling uphill all day, but she had asked a good question nonetheless. Andrew kept asking the time of day and then how far we were. I eventually deduced that he thought that every hour should tally up another mile, just like I told him. I had counted on the hiker to do some hiking during those hours. I tried to disabuse him of his idea, but things were beginning to get a bit strained.

We hauled the packs higher, the end of the day was coming, and we then saw a ravine with trail going into the mountain instead of straight up. We

were again optimistic but the trail still tilted up. The air had a chill then; the sky was a soft darkening grey. We emerged upslope and we met a horseman, who regaled us with the fact he had seen a griz.

“Wonderful, just wonderful,” Andrew exclaimed, “That’s all we need, a griz.” “Well it was only a small one that was headed the other way,” the mountain man quickly interjected to calm him.

But Andrew was off in that exaggerated way he has when at his funniest, but he was also very serious.

“Oh well then, only a small one! And if he’s going the other way: what’s that the other way from?”

This episode gave us a little adrenaline and cheer, and we had no choice but to continue into the darkening mountains.

At last there was a little down-slope, and we were over the divide and into the Flathead River drainage at last. Water here was pure, could be drunk without treatment, but where was the water? There were no Necklace Lakes in sight, and daylight was going fast. I left Andrew and the packs and headed downhill, failing to find anything wet. We could not spend the night without water, not after the awful pull we had just made. Locating a trail we struggled along, mostly up and then along a seemingly endless ridge in the dark. Then we heard water slopping at the edge of a nearby lake and knew that we had made it. Necklace Lakes. It was 8:30 p.m. and we had hiked for over 5 hours.

After enormous relief and some long drinks of water, we set up camp using our small flashlights. Good wood was not easy to locate in the dark, but we got a small fire going, and for dinner had some Top Ramen which needed only a cup of boiling water to prepare. I had carried in some popcorn and decided to reward us for our survival of the mountain and the little griz that Andrew had made into a cartoon. I put the popcorn on the embers. There is a picture of us in the gloom, waiting for the popcorn to pop, lonely and unsure of where we were and what we were doing up on that unknown mountain. I remembered the woman’s question: “Think you are going to make it?” Well, I thought, if I can get us down Big Salmon River, we will survive, so we are started at least. But it did remain an excellent question.

Day 2. We woke up to an incredible world. The sunlight was brilliant in a sky that did not seem ever to have experienced clouds, the bright light on our bags and the ridge we were camped on, and in front of us was a magnificent lake, its blue brilliance competing with the sky with the steep

rough backbone of the mountain's ridge-top behind it. We were atop the world in a marvelous parkland, and it was downhill today.

In keeping with the struggle it took to reach this spot and the long walk ahead, I made a real breakfast. In daylight wood was easy to find, and soon the fire blazed away. First we had hot apple cider, then hot cereal followed by cornbread made in the frying pan. Life was good, the small griz and its monstrous relatives had not yet eaten us, we lacked only trout.

The first mile was among the Necklace of Lakes, leaping about small streams to pass along the trail. It would be a nice place to spend a mountaineering and scrambling holiday, but we were there to fish. It was down the trail, crunching the granite gravel, wondering what the country had to offer us. We were descending Smoky Creek which runs down into the Big Salmon River.

Mainly I remember walking, mile after mile. I was worried about making it physically, but Andrew seemed to drag. He was not having fun, not even headed downhill. Planning the trip, I had thought I would not be able to keep up with him. This was not the issue, and we became tense and irritable.

Midway we came onto a nice stream, the first real view of Big Salmon River, which was not a river yet. Fish do not live above a falls far ahead of us, Barrier Falls, I was told by the man in the sports shop, but at one slanted outcrop with the stream running along its rocky tilted V before crashing further down, I saw a fine trout, the first of the wilderness, a trout finning in mid-water. I could hardly refrain from heading down to cast to it. But we had miles ahead, and as I had refuted the no-trout-above-the-falls theory, I could wait to fish.

About seven miles and late in the day, we came to a stark opening where the trail forked to go up Albino Creek. The ground was densely covered with small boulders of exactly the size that makes a night of sleep impossible to come by. We searched about in exhausted confusion and made the mistake of going on to find a better place.

The trail improved with soft earth underfoot and dense conifers overhead. Day came to its end, our energy long since spent, and we gave up. There was a slight leveling of the ground's slope, so we talked optimistically of the excellent sleep we would get. It was nearly pitch-black as we made a fire and got some macaroni cooked. Well, partly cooked at least. The thought of bears was with us both, huddling there in the dark cool evening. The sky had thickened with clouds and we also had rain to worry about. The slope and our imaginations kept us from getting a good sleep, but we were so tired

after 8 1/2 miles that not much other than a bear or a heavy rain would have kept us from getting some rest.

Day 3. We woke up, stuffed our sleeping bags and started down the dark trail, crunching on granola bars. Sun came slanting into the deep woods in narrow shafts, angled and brief. But it was morning and a new day, and in a half-mile we came out into bright sunlight. Ancient avalanche chutes ran down steep slopes, and it was broken aspens and scrub and grass. The long-since-seen stream appeared to the right in an opening with a developed campsite and a fire circle. We went without words or pause down to the camp and dumped the packs to earth. Whew, let's rest at least a day!

Which we did: pulled the sleeping bags out of stuff sacks open to the sun, tilted the still heavy packs against lodgepole pines, and let out a sigh. We were relieved at a pause in our adventure. It had sounded exciting, but the sweaty slog up those 3500 vertical feet, the unknown and invisible man-eating grizzlies and the somewhat bleak nights had taken their toll.

I sat with my back against a pine tree. It was a long way from LA, and instead of making my way among the hazards of scientific computation, I was thinking non-stop about being eaten by bears and where would I sleep the night. Now I let it go, for the first time in at least three years. Andrew would or would not get enough to eat, the bears would or would not eat *us*, we would or would not catch fish. It was off the mark, the block kicked out from behind the tire, gravity was in charge. You can control only so much in life, and sometimes the trick is knowing when to let go. This was one of those times. I dozed against a pine that morning.

Around noon, I stirred and noticed a long string of pack horses and tourists heading up the trail. They were far enough away that I could just hear the squeak of the saddle leather and the guides' commands. Some dry wood made a fire, and I made minestrone soup; we were getting located in the Bob.

Andrew was carrying his fish pole that morning and lost his reel handle. He complained and complained. With good cause: without a reel, he was severely handicapped in the endeavor we had come all this way for. We had made camp in the bright opening right by the stream. I checked the pools and runs, and despite of the contradictory trout I saw in that slot of a pool far upstream, I did not locate any fish. This surprised me, but I did not obsess or even go downstream. Relieved to have made it that far, I was hoping I would not have one of my health crashes. But if I did, at least I

was in sunlight and pines for the duration. After lunch I went back to sleep, dozing in the marvelous Montana light.

I mentioned to Andrew that we could have pineapple upside-down cake. “Is that possible?” he asked. Later on, a deer wandered calmly by me in camp, feeding without regard to its major enemy, and then an elk grazed below the packer’s trail. It was a good country for wildlife, no question. Mid-afternoon, we located a heap of firewood in a nearby packer’s camp and lugged a batch to our camp. Andrew and I debated the morality of that act, without a satisfactory conclusion, except for a great heap of firewood we enjoyed beyond expectation. I suppose the skimpy fires we had endured the previous two days contributed. I dozed, then woke to tend the fire and fix a biscuit mix with sugar, nuts and dried fruit. Upside-down “cake” was indeed possible: cooked on coals, sugar caramelized with the dough and dried fruit, a success. For dinner I made spaghetti with fresh garlic and canned tomato paste. It was good food, in sunlight that was prying up out of the narrow valley of the Big Salmon River. Even without one trout the trip had taken an upturn.

After dinner, filled with calories I walked up the trail on dark earth cut by the hooves of the pack train. To my surprise I located Andrew’s reel handle, which was not plowed under. I returned it to him with a bit of heat, saying that contrary to what he thought, neither his mother nor I were magic, and he had better get ready to find his own lost reel handles in the future.

“Nobody will give you their gear out here, so take care of your own stuff!”

Then I took a long walk in my kung-fu slippers up a quiet vertical trail onto a high ridge with big Ponderosa pines, marvelous game country. I was alone, feeling connected with the country for the first time on the trip. A relationship I had been missing for a few years, a relief to locate it again.

Back in camp we had a marvelous bright fire with the stolen wood. Then came a great sleep on level ground, interrupted by a horseman at 3 a.m. who was looking for lost pack animals. I had a good talk with him there in the blackness, him leaning on his saddle horn, me propped up from my sleeping bag. You cannot learn too much about the country you are walking through, and while I prefer to learn most of it by myself as I go along, certain opportunities should not be passed up.

Day 4. The day came out bright, and on the coals, we made tea and oatmeal. We packed up and headed down the trail.

Just a bit along the trail (and time passes so much faster when you are

not watching the speedometer), we came out above the stream, and there like an ad in a sporting goods magazine, was a pool with rising trout. *If I ever doubted you A.J. McClane, please forgive me!* We dumped packs and dug our fishing gear out. It was perfect for dry-fly fishing, and I tied on a renegade pattern to instantly hook a 14 incher, not bad for the first cast in the Bob! Andrew had a little luck but flies were far more effective than his spinning gear (which I had thought would far and away be the best and most reliable tackle to bring into the mountains). He used my fly rod to catch one.

Then we went down farther and came to the head of Big Salmon Lake that stretched 5-6 miles in length ahead of us. We fought the thick brush and then the mud to reach the inlet. People were heard and not seen, and there was a beautiful pool we could not reach, and we had hellish brush to fight through to get back to the trail and our packs.

We hiked along this amazing lake of which I would love to understand the geology and dreamed of having a rubber boat so we could rig up a sail and troll for those big Dolly Varden and cutthroat that must live in those deep waters. Midway along the lake, we walked along a steep slope off-trail to the shore, into complete isolation from the world where I made a fire and fried our trout while Andrew cast repeatedly. He became obsessed, and several times almost caught what he called a “blue fish.” It still swims out there in those lonely waters and must be big as an ox by now. I left a big spoon there on a rock. It probably has rusted by this time, and I recommend making the trip in anticipation of fish alone, not abandoned trade goods.

After eating and resting, we hiked on to the lake’s outlet. I bathed there in those calm waters, the warmest water we encountered. There was a good view of the country above the lake, the heavy water gathering into a big run spilling out of the lake. I fished the run and did well. Dry flies worked there, but it was a real effort, casting just past the limit of my ability to float the fly drag-free along a magic strip of water before it was pulled down and away from any respectable trout’s attention. I was in that heaven of mindful concentration on specific details of the arc of hard-cast fly-line, the drift in complex currents, and the entire life history necessary to produce a trout that might take the lure. Later Andrew complained that he did not have the proper gear for catching fish, that the trip had been a waste. Our dinner was three baked trout, rice, and chocolate. A beautiful deer, entirely unconscious of us, wandered through our camp.

After dinner I took Andrew and his spinning pole down to the big run. I told him how the pool was made and how the fish come as the lure turns

against the current. Persist, I told him. Against his natural disbelief, I made him stand and watch as I turned the spinner systematically against the run and raised some fish with my persistence.

“It is not an easy thing with the fly like it was this morning,” I told him.

Knowledge and regular work will do it; that counts much more than your rigging. It made the right impression, but I was wondering what I was doing, out there in the middle of the Bob, straining, pushing and pulling on my companion. This was supposed to be a rest, relaxation. And it was. The stars shone brilliantly, the strong waters were silent as they came out of the wonderful lake, then gravity pulled them into a tight stretch, and the waters sounded out as they made their way into the unseen gorge ahead of us. I was a long way from Los Angeles and slept well on the sandy soil at the outlet of Big Salmon Lake.

Day 5. We had a quick breakfast without a fire and were off down the trail. There was now a powerful stream deserving of the name Big Salmon River. I was excited to be there, and we ground the sandy dirt under our boots as we pushed ahead. Soon we were drawn by the pools below us and headed down the small cliff to cast into white water. I left my knife on a rock, so perhaps we caught a fish. Later on when the stream had leveled and our blood had cooled, I hurried back uphill to rescue my lost hardware. It is hard to go to the store and put it on a charge card when you are a few tens of miles and a few thousand of vertical feet from a car.

The trail became softer and more level, and we heard the main river ahead, the South Fork of the Flathead River. We dumped the packs at a cable-hung swinging bridge across the Big Salmon and headed with fishing rods ready to the confluence. There was a long rip of white water and wide gravel bars opposite. On our side it was steep rocky banks. We scrambled down and then I cast flies out onto rushing waters which were rapidly swept aside. What to do?

Eventually I calmed down, sat on a rough ledge of rock that was sharp into my rear and thought it over. I remembered Charlie Brooks, who had lived in West Yellowstone and wrote books I had discovered in the public library in Pocatello Idaho. He understood the waters of the West, and he understood them in basic direct terms. It is great zen or applied science or just common sense no one else had bothered to gather up. Take your pick, call it what you will, I learned a few things from him, and with those tactile books, he made me into however much of a fly fisherman I became. Well,

sitting there below the crashing confluence of the Big Salmon into the South Fork of the Flathead with sharp rocks poking my ass, I asked a key question: “What would Charlie Brooks do?”

In a few minutes I recalled the basic idea: Fish a heavy bushy nymph and *fish it deep where the fish are!* I wrapped all the weight I could get onto a big woolly worm fly, studied the currents, and heaved the fly into the river.

Well that did it. Soon I had my first trout on the South Fork, a nice cutthroat. My Fenwick rod bent and my spirits soared. This marvelous river flowed straight out of god’s country, ceaselessly flowed, and I was on a fish, and there was no end to it. Time and river were without dimension or finish, and they were delicious. My Charlie Brooks’ trout was released back into its home.

Andrew and I headed back to the trail, across the bridge and upriver. The trail was now a well-traveled throughway, the earth chewed up and gouged out by countless horse hooves. A few backpackers used the trail, but mostly it was horses, string after string of horses, packed with pilgrims and the gear the wranglers needed to keep them happy. In fall this is a hunter’s destination; elk hunting in the Bob is known worldwide, and for something to do in the off seasons, the guides ferry an endless stream of paying tourists upriver. It was not a pretty sight to us.

After a mile or two, the trail left the river, and we continued upstream to fish and explore. In this stretch the White River comes into the Flathead, and in the headwaters of the White is a long granite cliff called the Chinese Wall running along a divide. I wanted to see the Wall and the expanse of the Sun River Game Preserve beyond the Wall, but it was not the trip for that. We set up camp in a wide and open place where flood waters had cleared out the willows, above a series of deep strong runs and pools. Lunch was ramen noodles. We fished and relished the open country and clear weather. I fished a long string of riffles, catching just enough cutthroats to keep me happy. Andrew slept beside the packs while I fished. That night we hung the packs high up in a ponderosa pine, me losing a bet about whether Andrew could get a line over a limb high above us. (He did.) The trick then is to balance the weight of the packs by a rock or stick and by counterbalancing, get the whole deal hung far overhead.

This was the first time we heard a deep distinctive sound: “Umpa, umpa,” it went. We never decoded this message sent to us but spent pleasant evenings listening to it in the twilight. “Umpa, umpa, umpa.” For dinner we had a sour-cream-and-chives flavored potato mix. While I was lying in my bag,

resting before going to sleep, I realized I was strong and would not have one of my collapses. I lay there in the evening, my heartbeat echoing in my abdomen, feeling healthy, strong, and ready for anything tomorrow would bring. Thinking back on what I had done the previous few days, I was amazed. If I had done that much physical activity in LA with the efforts of research, I would have been down for weeks. Instead I was ready for morning and more hiking and fishing.

Day 6. We got up and headed back to the trail away from the river up and around a big hill. At one point we met a big pack-string heading back from delivering steaks and tourists, and one of the young guides pulled up by us. I struck up a conversation about summer and fall packing duties.

“And do you ever get any hunting in for yourself?”

“Well, not in the Bob, but after, with the snow deep after the last guided hunters are out of the wilderness.”

“And how about mule deer?”

“Well they are good, but usually nobody hunts them in the Bob.” After, on the slopes south of Hungry Horse, he went up in four-wheel drive vehicles and found good deer, 32" spreads, at the very end of season up to his ass in snow. I thought the young man a charming conversationalist and wished to find myself struggling up those slopes in deep snow at the icy end of deer season. I learned to love such things when I lived in southeast Idaho.

Walking along the trail we came onto some pine grouse, the fool-hen of the Rockies. I have embarrassed adults doing what I did next. At one time I paced back and shot their heads off with a 30-06, then felt it rather unsporting for what was such good meat, and I invented the activity I describe next. I found a three-foot limb and set out after the birds, a hen and grown chicks. I maintain it is an art, stalking a bird that can easily fly away but just isn't always quite smart enough to do that. They skittered up a little gulch, and I swung the limb and killed the hen. This is illegal, but that was not why Andrew looked around in apprehension that we would be seen and that he would be associated with so ridiculous a spectacle! I cleaned the bird and stuffed the skinned body into a plastic bag. We proceeded down the trail. When later we came onto another covey of grouse with a rooster, I went after fool-hens again, but this time they proved they were smarter than me.

We came down to the river, and Andrew fished and then slept under cottonwoods while I fished a marvelous heavy run downstream. We each

caught two trout. It was a great day. In the afternoon we saw the first guided float-boat of trout fishermen.

That night we made camp in a tight site near the river, and I made a magnificent curry, frying the grouse in oil and curry powder with cashew nuts and raisins we separated from the nut mix. With the Japanese rice, it was a grand meal. Andrew kept asking, "Has Mom ever done this? Has Mom ever eaten like this?" We were feeling pretty good about ourselves, walking along more or less level terrain and eating great food.

Day 7. The next morning we ate some granola bars and set off upstream. We often were somewhat lost and that morning was no exception. The trails were unmarked and traveled mostly by horses. The sun came in great bundles through the pines and aspens, and we wandered up and down the slopes, keeping generally upriver.

We came to what our map seemed to hint was Bartlett Creek. On a steep gravel slope 150 feet above the river, I put my pack down, saying, "This looks like a good place to fish, doesn't it?" Andrew answered quickly with impatient disgust, "Look: you are going to climb down there and fish. Don't pretend to debate it, just go do it. As for me, I'm going to take a rest." He slung off his pack and collapsed against it.

As for me, I realized he was right. I pulled my fly rod out of its container, geared up, then jumped and slid my way down a nearby location where the slope was less brutal. The river was nice there and made a good pool. At the head near where the run came into the depths of the pool, there were some trout in the shallows taking food off the surface of the water, and I began to cast across the run to them. It was a bit tricky as the run carried well-cast lines away from their position. I was standing on a good-sized boulder, and just as I hooked a trout and started to bring it across the current, I lost my balance. I let the line go slack as I waved the pole and my arms mid-air, regaining my balance. Unconsciously I noticed that the pool flickered as if sunlight had danced through a cloud for an instant, but it was momentary and then gone. After I was firm footed again, I raised the pole to find it firmly anchored to a dead weight with just the elasticity that distinguishes a salmon from a log. I raised the pole high overhead to the extent of my arm, and when a huge trout moved, I shouted. That flicker of light had been a fine trout taking his prey. I had that Dolly Varden on for 20 minutes and brought him to the shore. Andrew eventually came straight off the gravel cliff, and he was there at the end. The Dolly Varden was 28 1/2 inches long,

an amazing fish. It is with good reason that Dolly Varden are known as bull trout.

What do you do when you catch such a fish so far from anything? You cross to the east side of the river and make camp. We pulled our jeans off and made our first South Fork crossing in our jockey shorts, the rushing water thigh deep. We made the crossing to sunlight-warm river-smooth boulders. Later leaning against an old log, we had miso soup for lunch at a grassy campsite under big Ponderosa pines. "This is living," we told ourselves.

Andrew went to sleep after lunch, and I puttered around making camp and fishing some more. I saw no more Dolly Vardens, which were deep in the pools, but I now had a healthy regard for those green and sunlight-yellowed depths. What we walk right by and miss seeing as we go about this world! Above our pool was a long heavy crashing run against a few hundred yards of gravel cliff, and I fished that location several times. Sometimes I did well with my Charlie Brook's nymph techniques, and sometimes times nothing worked. Downstream were some marvelous pools in which I raised nothing. All these years afterward I have thought of that stretch of the South Fork, and someday I will fish it again. From Bartlett Creek down to the confluence with the White River, that water will be new to me.

Mid-afternoon another float boat came by, with two clients and one guide. One of the clients was overweight and having a tantrum as the boat swung down the rapids into the pool where I caught the big fish. The fat client was berating the guide for poor fishing and poor guiding. Then they saw me and, when asked how we were doing, I said, "OK. Nothing special." The guide let them cast a couple of times into the pool and then took it on downriver. It is a hard way to make a living, out in the woods with anyone with the money for the trip.

For dinner, I fried fish and made pudding for our celebration. We remained tired, and soon after dark we were in our bags out in the open grass so we could see the stars. In the night lightning and thunder came with lashing rain. We drug the bags to the big trees where I had stretched our tarp. It took some work to get the tarp right as the rain was coming down heavy and steady. The packs were not hoisted to tree-top height this evening. Keeping them somewhat dry was essential. We went back to sleep with the heavy rain drumming on the tarp just over our heads.

Day 8. It was morning with the same weather. I eventually crawled out of the bag and pulled on cold clothes. My parka was stout enough to keep

me dry, and I searched the nearby woods for enough dry twigs to get a fire started. After that I made hot cereal. Andrew woke up when I shook his shoulder; he rolled over and propped up on his elbows as he ate the cereal, after which he dropped back into his bag and went to sleep. I had the packs under the tarp by this time and straightened up the camp as best I could. Then I searched the forest for firewood. It was wet, but I did find great fuel which I stock-piled. It gave me a close look at the woods nearby, and I located a trail going straight away from the river. Probably used by the guides in elk season and by elk too. Then I tried to sleep, but it was hard to do after so much time already spent asleep. I lasted until noon. For lunch I made cheese soup which Andrew rolled over to eat, after which he went to sleep again. I could not bear another minute in the sleeping bag.

Clouds were about two feet overhead, and the steady rain drizzled down. There was nothing to do about it, and I now felt fortunate that we had come so far without rain. What if this had hit us at Reflection Lakes? Bad news, that's what! We had all the wood we could use, and there was nothing more to do with the camp.

Eventually I set myself on the dry needles against the bark of a big Ponderosa overlooking the river, crossed my legs and tried to relax. At first my thoughts darted about, and then I replayed the trip. Our long climb, the endless ridge in the dark, the day after day that brought us to Bartlett Creek: the campfires, the trout, the rushing waters. I could look down on the pool where I had caught the magnificent bull trout, and although I had a vivid image of catching the fish, amazingly I seemed to be looking at an entirely different scene. The sunlit shore where I had landed the trout was one place; I was seeing quite another. I had two lasting and vivid images of the same water, and they were total strangers to one another. In our camp, we had slowed down and our perceptions had altered. Even the rock I had stood on to hook the trout was unrecognizable although I could deduce exactly which boulder it was. This singularity occupied my thoughts for some time. Then I went into what passes (with me) for meditation until about four in the afternoon when the rain started to relax a bit. Trees began to appear across the river out of the misting rain and, instead of being within the cloud, it was now just over us.

I detected motion under the tarp where Andrew had been asleep for over 30 hours if you measured from his deep sleep the previous day. I was amazed at how tired he had been, at how much this trip had pulled at his body. I had worried about bringing enough food for a growing boy and keeping up

with him. These had not turned out to be major difficulties. When he poked his head out, I just continued to stare out over the river, keeping his motions in my peripheral vision and not giving any sign I knew he was awake. He staggered out from under the tarp, and when he located me, he zigzagged over to my tree. He was full of nervous teenage energy.

“Hey Mike! Mike, Mike, what do you think? Will it ever stop raining? What will we do if it doesn’t stop?”

I waited a bit and then answered with: “Well, I guess we can just get back in our bags and sleep until it does stop.”

Fortunately stop it did, and we had a warm fire and spaghetti with fresh garlic that night. After that we had toasted nuts and cider for a snack. We needed creature comforts.

Day 9. We started the day with hot oatmeal packets and headed upriver. In a wonderful pool, I caught seven cutthroats on nymphs. The sun was streaming down through the trees and timber, the water was sparkling, and it was a terrific day. In good time we came to the Big Prairie Ranger Station which seemed to be without rangers. I took the slightly civilized location as a challenge and caught one trout under the Big Prairie Bridge, which in the style of the country was swinging from strung cables. Trout everywhere, I said. We came to a trail sign, the first we had seen since Holland Lake. We were about 30 miles from the nearest road. Then upstream the river seemed to divide into a hundred braided strands, and we never again saw anything like the strong vital stream we had encountered below.

We headed up Gordon Creek and did without lunch as we searched for a level place to camp. The trail was a muddy track through jack pine and brush, so we couldn’t avoid the deep mud trenches as we had done most of the way along the more wide-open valley of the South Fork. Up we went and eventually located a spot the horse packers used for their noon-time lunches. We set up a camp that sprawled over the available landscape to prevent commercial company. That evening we had a view of a sheer rock wall ahead of us, and we had split pea soup and date nut cake. The terrain was a bit sloped but we slept fine after the exercise.

Day 10. We had jammed up Gordon Creek which did not stretch before us with the infinity that the Big Salmon and the South Fork had. And the difficulty of locating ourselves in the thick brush and timber had sobered us, so we decided to spend the day exploring. We made hot cereal and considered

our situation. The outfitters ran people up and down the trails and stopped at campsites like ours for lunch. We stretched the big tarp out full, and a smaller tarp too, so we occupied all our space. Yesterday some fat boy sitting up on a horse said to us as he rode by: “Oh you came in the *easy way*.”

Our delayed replies were obscene and bitter, but we didn't get to them until he was long gone from view and earshot. He was the jerk we did not wish to share our campsite or trail with. The balance between fitness, money, access, and morality was at issue, as often happens in any form of outback. Who deserves what? Who indeed? We are all of us tourists just passing by.

I hiked up the trail, cut down through rough brush to the stream and fished back to our camp. There were some nice pools where the river swung against rock formations. That is always dependable for drama, water beating on rock. The fishing was fair, the brush thick and tough going.

After lunch at camp, I headed downstream to fish. Where the river swung into a good but not deep pool, I spooked a school of Dolly Varden and accepted it as a challenge to take one. I worked through my flybook, but no action. I reasoned that they eat minnows and small fish, and I should try a streamer made to emulate a minnow. It went deep, and I brought it ahead, jerking it along. Bang! A fish on. In 15 or 20 minutes I released a 22-inch Dolly Varden, fin-hooked. Unfair but unavoidable and good fun for me if not for the fish.

A group of trail riders pulled up by our camp, fumed and then went on. Andrew and I were thinking, “Take that, fat boy!” For dinner we had corn-meal-fried trout and jello.

That evening I found an old trail and hiked up through ancient mature pines to at least 1000 feet up, out there in game country all alone, suddenly realizing that the trip would end and that I would have to think again about what awaited me in a huge amorphous city. The thought passed but it had appeared.

Day 11. The next day we walked upriver to a beautiful camp at Cardinal Creek. The area was spacious, level and full of sunlight. We were in a wonderful mood, optimistic and energetic. For lunch we made a duo wonton-and-Ramen soup. We had enough food and were strong. Our strength was not being spent on marathon hikes so we were a bit giddy with the reserve. Then we repaired some worn and broken gear.

I fished that afternoon in a canyon with a deep swift pool full of vacationing Dolly Varden. Not one of those monsters took my lures. I told Andrew,

and he tried them with his spinners that afternoon too, but we did them no harm. There were trout caught however, and I made a teriyaki sauce for them. We were getting enough to eat, even though I had worried about not being able to feed Andrew. Depending on fish is not a great plan on such ventures. When trips go as well as ours had, you become confident; then, on the next outing, the gear is wrong or the water is high or you blow it. Then you go hungry. Fine for a day or two, but not for two weeks.

Day 12. For breakfast we heated the beautiful cornbread leftover from last night. We walked a few miles to a developed campsite at Shaw Creek. It had lean-tos which we found off-putting. It put us out of balance as if we had landed on some new planet where we were an unknown species. The deserted camps had no ranger at the ranger shack, and we made our camp, gathering wood. Soup for lunch.

That afternoon we went to the stream and knew it was our last trout fishing of the trip. We were sniveling and whining, if the truth be told. After some brush walking, we found a good little run and eventually caught two trout in the 12"–13" range. Parmesan trout and rice for dinner. We were sobered by that abrupt place.

Day 13. Leftover cornbread made a magnificent breakfast. We hiked up out of the Shaw Creek Developed Campground. On our steep ascent I spotted elk far away on the opposite drainage. I felt better at that wild view, felt capable again.

On an avalanche track we stepped off the trail onto a steep unmarked grade. This was our first cross-country off-trail sojourn. We were looking for a last campsite in the wilderness, not some developed place. We made hard work of the brush on game trails, heading upstream however small the water was. There were good berries which we ate thinking *bears* and located a fork of the stream where we made camp. It was wild and took away the odor of the previous day. On an exploration up the left fork, we came to bear shit, sheep and goat hair, and a lake with no fish. At the lake there were bear tracks, deer and much elk sign. We were in outback wilderness again, as wild as we had seen on our trip.

Andrew had given up bathing, and now he took a bath in the beautiful pool before our camp. I tried to catch him with my camera, and he waved threatening soap at me. The presence of the wild reached us, and after dinner we ate a load of sugar in multiple jello cups and chocolate and became hyper.

I did not sleep too well that night. Thoughts of bears may have figured into this.

Day 14. We woke up and ate granola bars. We were down in a hole or basin and walked straight up out of it. The rough game trails were mysterious, but we got onto tracks going right up the grade. We hit the trail far above where we left it and went back to the departure point for water. We were strong and hardly winded. There were elk feeding on the avalanche tracks far opposite us.

We easily climbed to the pass in alpine country, leaving the Bob Marshall Wilderness, bless Robert and his long-gone marathon-hiking days. We posed at the boundary sign, and in retrospect, the picture is a great contrast with our entry photo. I am more erect, confident, and calm; Andrew is subdued, and I believe was looking forward to the nearest hamburger stand.

We quickly reached Upper Holland Lake, which the Holland Lake sign at our trip's beginning had proclaimed to be 14 miles from the car. These were slow spacey miles for us, views out over Swan Valley. We recalled that fat boy's line from atop his horse, "You came in the easy way," as we had yet to see an easy way up those 3500 feet. When we finally hit the valley floor, we got sidetracked with a shortcut that went awry, *heck we couldn't look at a map after all this, could we?* And then we brushed out to the old yellow Cadillac by 12:30. We would have had no problem starting in again, and this time we could confidently reassure the grandmother on that steep pull up the mountain.

Yes, we damn well will make it.

Shifting in France

May 29 to June 12, 1987

I flew to Boston to give a talk at BBN (a computer company), two days before I was to arrive in France. I adjusted, almost, to the three-hour time change. Then Eric Lander from MIT and I took a night flight, leaving Boston at 3:30 p.m. and arriving in Nice at 8 or 9 a.m. The sea there is breathtaking in morning light, and the plane flew along the coast for some minutes before landing. The airplane and airport were filled with people going to and from Cannes to attend the annual film festival.

A driver met us, holding a sign with our names. He took us in a Mercedes at 140 km/hr (87 mph) to an estate named Les Treilles, about an hour-and-a-half trip. It was an extraordinary experience, watching the countryside fly by in our condition of excitement and exhaustion. The country, even near Nice, is somewhat dry. We could see the French Alps to the southeast; we went inland in a northeasterly direction.

On our arrival in the car, Madame Schlumberger-Brunner came out of her house, displaying the air that 84 years of supreme command gave her. There was no question in my mind as to who she was. She first complained that half the buildings were currently without electricity. “I find”, she said, “that these things always have a definite cause.” So there you have it. She loved the name Waterman. The pen company that bears that name is well known in France and she liked the pens. I suspect she assumed I too was moneyed, but in vain of course. Because Eric speaks French, she confused my name and Eric’s face for the entire 7 1/2 days. Where had we flown from? When had we left? Had we eaten? Well then, we must go to the Grande Maison, 3/8 of a mile distant up the hill, and eat. The driver took us, after showing us our house, called Lou Prat, in the opposite direction

along twisting, confusing roads.

The Schlumberger family seems to have been in academics for at least a hundred years; whether rich or not all that time I don't know. The visible money came from the company of the family name. Madame's grandfather, I think it was, had the idea that it is useful to make electrical resistivity measurements down boreholes into the earth. Good thinking! It turns out that oil-bearing sandstone conducts electrical current differently from water-bearing sandstone or dry sandstone. Rock types or at least their boundaries can be detected. None of this is without failure, but it has evolved into a huge business. The company owns no oil wells or properties. They make what is now a suite of complex measurements down well holes; this process is called well logging. Schlumberger logs 50% of domestic USA wells and 90% of the wells drilled in the rest of the world. Consequently the family is rich. Interestingly the family is famous in France, where significant private wealth is not always looked on with favor. A French friend remarked later in Paris about my stories of the excessive wonderfulness of Les Treilles, "We had a revolution over exactly that sort of thing, you know."

So there we were, ushered through this fantastic French kitchen at the Grande Maison, with staff working, and bread, cheese, and more placed on wooden tables. On through that room onto a patio that overlooked olive trees, tall pines, and a big wide valley. The air was clear and fresh and sweet, and there we sat, shot full of fatigue and unreality, on wicker chairs. The yard there was the only green lawn on the estate, with a modern sculpture sitting at one edge, lending to my sense of unreality. I said, "We must have died and gone to heaven, there is no other explanation!" We were served omelete with fine herbs, ham, orange juice, wonderful coffee, the most fantastic breads, and assorted fruits and cheeses to finish. Madame joined us to see that we were adequately cared for, as if it were possible there not to be.

"You are fed," she said, "now you go to your house for some sleep." We had a car (for our use, on and off the estate for the length of our stay) and a map. Eric drove and I tried to map read. Immediately we were lost, a not uncommon experience for us on the estate. Still, lost in paradise isn't too bad! During our wandering, we drove by Madame Schlumberger who was walking back to her house. She insisted on getting into our car and directing us to a road from which even dull Americans could not fail to locate Lou Prat. Eric did not have much experience with a car with a clutch, and he lugged the engine. "Shift," she exclaimed, "Shift! Shift! You see, we shift a lot here in France." This of course became a signal phrase during our stay,

with various words and concepts substituted for “shift.”

Our isolated house, Lou Prat, was made of stone with a heavy tile roof, 2'-3' thick walls and tile floors, all in earth colors, with a full bedroom and bath for each of us at opposite ends of the house. In the center was a kitchen and living area with a fireplace and nice furnishings, all in a country style. The kitchen was fully equipped with dishes, pots and pans, bread, juice, milk, coffee beans and grinder, fruit, wonderful butter, etc. The earth-tone tile on the kitchen counter was ceramic and appeared throughout the estate. It must have been done specially for the estate and even the kitchen sinks made of the same material. Each day we could take a list in a basket to the main house to get whatever we wanted to prepare and eat for breakfast. There was a view of the valley, and a yard and pines that looked almost unkempt but were carefully maintained in precisely that condition. Herbs were growing, seeming at random, in the yard and along the miles of roadsides. I went for a run in the sun and then relaxed, before and after a shower, on a sandstone bench in front of the house, among the blooming herbs and buzzing bees. Heaven, yes!

Dinner that night and consistently throughout our stay was wonderful. Dinner and lunch were several-course meals, always with salad and cheese courses and local wine, and were a burden to do justice to. Oh, the fish dishes with sauces, the meats with sauces, the assorted cheeses...! There was a leek soup, a poisson soup with saffron, a marrow in shank bone with course salt, The bread in France is generally wonderful, but that at Les Treilles was so superior that I was disappointed in the bread for the rest of the trip. And deserts inspired me as I had been trying to cook my way through the classic French pastries. I have mastered soufflés, but they served a heavier chocolate soufflé that was unlike anything I had ever tasted. I did my very best to show my appreciation by eating my share! That first night I got enough sleep, close enough to regular Provence time, so the jet lag didn't kill me. I had been adjusting my hours for the nine-hour time change and that helped.

The estate is about 750 acres in somewhat arid hills, covered with scrub pines, at about 5000'. Madame established the estate and grounds about 15 years previously. At one time I had a map of the estate. There are roads leading here and there with stone houses, rock walls, olive groves, grape fields, all blended into the scene. During my stay I continued to find new features. Modern sculptures were hidden behind pines, sandstone benches by a road or in a nook or cranny. A hut with circular benches covered by

cushions and a wool blanket; a circular brass artwork with a magnet in the center; a scythe hanging from a wire stuck to the magnet; beautiful views of the valley. I thought I was on another planet or in some movie. Unreal and wonderful.

Sunday we visited TourTour and another small French country village, quiet on a Sunday. That evening Madame, who also runs a foundation for music, sponsored a concert of Gregorian chants in a church in TourTour. She said she supports no Americans with her music foundation as there are ample opportunities in America in music. That evening's concert, not my kind of music which runs to country-and-western, rock and jazz, was very spiritual. After the concert, her kitchen staff replaced the staff of the only rated restaurant in the area (2 stars), and we ate there. After dinner the meeting was planned by the 18 or so participants.

My uncle Ben Payne was a paratrooper in World War II, and he was dropped into nearby Draguignan on August 5, 1944. I have a copy of an Army photograph of the drop. The fields of France geometrical below, stubby planes across the sky filled with dots and blobs which are the chutes of the men being dropped and puffs of cannon fire exploding among them. In a postcard, I joked to Ben that I received a hell of a lot better reception than he did, and I told every French person I met about my uncle. After this Ben fought across France and Italy and was wounded in the Battle of the Bulge in Belgium, ending his war. My image is that he walked the whole damn way. I loved the man and felt him with me there.

So, for five days, I arose at 7:30 a.m. and ran up the steep roads, showered, ate breakfast, and drove to the meeting house (Maison de Function) at the opposite end of the estate by 9 a.m. A nice pool was near there, discretely hidden from view. (We found three pools, all heated.) From 9 until 1 or 2, we gave talks and discussed them, often with heated discussions. Then down to Grande Maison to have yet another marvelous meal. Off formally (and there were usually informal discussions then) until 5, when we met until 7:30 to 8:30. Then of course dinner. There were always two or three tables, with Madame holding court at one. I didn't hear her when she explained that fifteen years ago she had no lover, was bored, and so started Les Treilles! Realize she was about 70 at that time! She did say in my presence that she thought there were not enough smart people in the world trying to understand it and to solve its problems, hence Les Treilles. I didn't tell her that, at least in my case, there are many people who are smarter—what and lose my place at the table? A tough life, keeping some balance between food

and science. It was: imagine thinking hard for twelve and more hours a day, balancing your own thoughts with those of other people, all smart with knowledge and opinions sometimes far from your own. The quiet setting and ease of life made it very different from the usual large scientific meetings.

Wednesday afternoon was free, and Wednesday night Madame had a famous concert pianist in to play for us (at Grande Maison). She made us assemble at 7 p.m. so we could observe 15 minutes of silence before the music. Some people took advantage of the free time and took a trek to see a Picasso museum, and they arrived after the “quiet time.” Madame wouldn’t let them enter the house to use the bathroom! Of course, after the music another wonderful dinner followed.

Well, I bore up under the strain of all this easy living! I had one nice research idea, strengthened a paper Eric and I were writing, and helped some people design a biology project. A few people I remembered from my first trip to France were attending, and it was great to see them, especially a German who spent a high school year in Texas, Chris Sander.

Saturday morning came, and Eric and I were off to see southern France. Well, we tried to get off. Madame queried our plans, changed them for us, then re-changed them.... She recommended expensive hotels far beyond our means and needs, and insisted we take her current Michelin guide. Air France was on strike, in what seems to be typical French fashion, in mornings, worse in some places than others. This gave Madame full range of action as we had planned to fly to Paris. During this amazing experience—she was a famous rich person and was taking all that time just to be sure our stay was wonderful—she drew up and exclaimed, “I know a lot about travel, in France and in the United States. If I wanted to I could make my living as a travel agent!” I wanted to ask her if she thought she would still afford the chef, but discretion kept my mouth closed. Only by insisting my Paris friends would care for us there and by promising to call her assistant (a lovely, competent and very patient young woman) at noon two days hence could we escape. Wow.

Chris Sander from Heidelberg stayed until Saturday, one more day. He gave me this account in Los Angeles that August. When lunch came, just Chris and Madame sat at one of the tables that accommodated all of us with room to spare. She did her usual bit of finding fault with the food, this time taking a piece of toast onto a napkin, scraping it with silverware, saying, “Toast, you call this toast?” They spoke of several things and came to Russia. She had given Chris the book she wrote about her life (in French),

and he had read it. As young woman, she traveled in Russia with her father. The family was liberal and, perhaps as a consequence of their visits, helped Russia become a major oil producer. Madame, who must have been incredibly energetic at that age, kept a diary of her trip, perhaps with a plan of publishing it at home. The guards at the border took the diary and it was lost. She tells of this in her book. When Chris asked her what she thought of the Soviet Union, she said, "They kept my notes, how could they have kept my notes?" Pain after over 60 years. She evaluated all present at the conference, and Chris was impressed at how well she did without technical knowledge. He did think her impression of our Nobelist was too high, unrealistic. Then they moved to the patio and continued the conversation. As Chris was talking, she fell asleep. He said he kept talking for a while, feeling a bit foolish. Eventually he stopped, and in fifteen or so minutes she awoke. She shook her head and said, "Enough of this." And it was over.

Reading Life's Code

It was May 1985, and I drove up narrow Highway 17 out of San Jose, over the mountains, down to the sea to turn right on the famous Route 1 and eventually take another right to the University of California at Santa Cruz campus. I drove across the open fields of the benchland and then into the redwood forested fingers of the university. I was at Santa Cruz to meet with Harry Noller, an RNA biologist with his labs in the maze of redwoods, small canyons and occasional buildings. Harry told me that, when he interviewed in 1968, he similarly became lost, and that's what decided him to join the newly formed university. Harry, with his beard and abiding love of jazz, is identical to Santa Cruz for me, but I met him in the flatlands of Illinois. UCSC was begun in 1965 to promote progressive and interdisciplinary education, and 20 years later it was building a serious scientific reputation.

One of brilliant students of Jacques Ninio, Philippe Marliere, came to San Francisco for a visit in 1982 when I was at the University of California there. He had a concept of RNA as the origin of life, and I was able to make some inroads on his simple but fascinating model of self-replicating single-stranded RNA molecules. We had some great discussions and made an illuminating visit to Christine Guthrie's lab at USCF, but for me the most important product of Phillippe's visit was that he convinced Carl Woese and Harry Noller to invite me to a private meeting of their collaborators at the University of Illinois at Urbana-Champaign.

Meeting Harry Noller at the tiny airport in Illinois in summer 1982, it was as if I had known him forever. Woese was more Delphic and just as interesting. They were in the process of revolutionizing the evolutionary history of organisms. Certain RNA sequences are highly conserved because those RNA molecules are essential components of the ribosome that translates gene sequences into proteins. By comparing 16S and 23S RNA sequences and their resulting structures, inferences could be made about the evolutionary rela-

tionships of organisms. Woese's informal research group is where the concept of Archaea originated. Archaea are single-celled organisms that were thought to be bacteria but are more closely related to humans than to the bacterium *E. coli*. Besides Marliere, Noller and Woese, this small gathering included Norm Pace, Mitch Sogin and Gary Olsen. One night while drinking beer, Pace said that a neglected question for biologists was "what's out there?" We didn't have a clue as to what organisms were in the dirt of the lawn under our feet. What an exciting observation! When I was in grade school I realized that anything one knows enough about is interesting, even those subjects that look very dull, like, I said then, dirt. Today after the genome projects and our enhanced ability to sequence DNA, we are finally becoming better informed about what is in dirt. Billions of viruses, bacteria and fungi are down there doing their business. I liked Noller, Woese and their collaborators, and while their consensus approach to sequence analysis was completely ad hoc and naive computationally, they had a big influence on me. Noller told me that he couldn't understand why I said more sequences made things more difficult since for them it made things easier. This inspired me to see why that was. Harry Noller has the best untrained mathematical mind of anyone I have met. He had no interest in doing mathematics but he would have been very good at it if he had tried.

In 1985 Robert Sinsheimer was chancellor of UC Santa Cruz (1977-1987), and he was famous for his work in isolating, purifying, and replicating synthetically the DNA of the virus $\phi X174$. Sinsheimer had the vision and courage to be the first to seriously propose sequencing the human genome, and that is why I and others were visiting Santa Cruz. With Noller, Edgar, and Ludwig from UCSC, a May 24 and 25 meeting of a dozen experts was assembled at Santa Cruz. I have a list of those attending, but I am not sure Barrell or Lerman were there. The list I have includes: Bart Barrell, Wally Gilbert, Lee Hood, George Church, David Botstein, Ron Davis, Helen Donis-Keller, John Sulston, Robert Waterston, Leonard Lerman, David Schwartz, and Michael Waterman. My inclusion as the only computational and mathematical person was surely due to Noller, and the meeting was transformational for me as well as several others attending.

I had met Noller, Gilbert and Hood before, but no one else. One of my dominant initial impressions was negative. David Botstein seemed to be constantly offering strong and outrageous opinions. I wondered how he had survived being so needlessly confrontational. By the morning of the second day, I grudgingly realized that every time he opened his mouth he

said something smart. In the end, we became friends, and I think highly of him. But if you don't want to know what he thinks about something, don't ask him. You probably have no choice if he's in the same room. At the conclusion of the meeting, he asked me about some issues with genetic mapping, and as David was at MIT and I was on the opposite coast, I strongly suggested he contact a person named Eric Lander. The rest of that story became, as they say, history.

Much of the meeting consisted of people wondering if the project was technically feasible. David Schwartz, who hadn't completed his PhD yet, told us about his revolutionary pulsed-field electrophoresis techniques for separating and mapping large DNA molecules. Gilbert had a Nobel Prize for sequencing methods, and Lee Hood and George Church were planning new and improved methods. Ron Davis knew about making clones with large inserts, and he spoke about maintaining accuracy. Davis, Schwartz and Church are among the true geniuses of biotechnology. I wondered if computational methods could store and process that much data and concluded it might be just possible. I was naive about the repeats in the human genome, although the repetitive nature of the human genome had been established by Britten and Davidson beginning in 1969. And reading the non-repeated DNA would be triumph enough. My head was spinning at a project of this size. It was not until 1995, ten years later, that the first complete genome of a free-living organism was sequenced and that was a bacterium of only 1.8 million base pairs while the human genome is 3 billion base pairs. Even with excellent data, assembly of the human genome would be very difficult.

While drinking brandy after dinner, Wally Gilbert wondered how to find the labor to do the boring repetitive tasks of sequencing. Sinsheimer wanted an institute in Santa Cruz to do the job. Gilbert proposed that we use prisoners to do the work. Give one group the Crick strand and another group the Watson strand; that will create competition and quality control, he said. In graduate school at Michigan State University I had a part-time job at the Michigan State Highway Department where I worked with inmates at Jackson Prison to do elementary data analysis. I thought that Gilbert had no idea what he was talking about. This was a big issue that everyone could see: how to do science when it became far more than single-investigator projects. We continue to struggle with that today in this era of "big science," and large multi-disciplinary projects in biology are common.

At the end of the meeting, almost everyone agreed that sequencing the human genome might be possible. Now, what would it cost? To read one base

cost around \$15 at that time, and the human genome was 3 billion letters long. And a redundancy of coverage of at least 5, probably 8, was needed. This was getting into inconceivable numbers. But someone declared that we had to be optimistic about scientific and technological progress. Let's assume that the genome can be sequenced at \$1 per base, that's only three-billion dollars. Only! This seemed outlandish and unwise. Then someone quoted what a battleship cost, and I had realized that the three-billion-dollar price tag was cheap. Considering the US military budget, a mere \$3,000,000,000 was a small price to learn our genetic identity. Later much was made out of the promoters of the genome project saying "the human genome" as if it were unique. It escaped no one's attention that there is a diverse population of humans, but you have to start somewhere, and the sequencing projects used a mosaic of DNA from multiple people.

After the main meeting the "big shots," who must have included Hood and Botstein, met with Sinsheimer and gave a negative evaluation of the project, at least for the project to be done at Santa Cruz. Ignorant of this, I was then and remained steady in my belief that this was barely possible and truly important. If there were no medical benefits, and for certain there would be, just deciphering the code that our ancestors passed down to us as our genetic heritage would be priceless. We had little knowledge of the complex details of human genetics, and this scientific project would be one of the greatest endeavors and accomplishments in the history of science. Plus we would get a glimpse of how biology worked, a more complex problem than understanding atomic physics.

Sinsheimer did not get his institute, and for some time it looked as if National Institutes of Health would pass on the controversial project. But my friend Charles Delisi had left Los Alamos to become director of biology at the Department of Energy, and with David Smith, he organized a consequential meeting the next March in Santa Fe. And Delisi managed to set up a DOE human genome project. The NIH could not let such an important project in human biology slip out of their hands, and the stage was set for the Human Genome Program. *California Magazine* later had an article about the Santa Cruz meeting. I treasure that I was referred to as a computer specialist from USC. They didn't bother to use my name, which I assume was because such a person was obviously peripheral and entirely unimportant.

In 1986 while sitting in Eric Lander's office at the Whitehead Institute in

Cambridge, I was looking at two papers on physical mapping that had just appeared. They were the first papers in this field. Olsen and colleagues had data on mapping yeast, and Sulston with his colleagues had data on mapping nematode, a worm. Both these mapping methods were based on the possible overlap between all pairs of clones (big pieces of DNA). By using this collection of potential overlaps, the experimentalists hoped to cover or pave the genome under study, thereby having accessible clones that covered the genome which could be individually sequenced. The results were not as encouraging as expected, and no one knew why. I remarked to Eric that as mathematicians we should be able to replace the simulations displayed in Sulston's paper with exact formulas. The key was to formulate a coverage problem where intervals (clones) are placed at random locations on the genome and where overlap could only be detected if there is a sufficient amount of overlapping DNA between two clones. I recalled that there had been mathematical work on coverage problems, and we went to the MIT library that night. But the prior work was not immediately applicable and we just worked it out ourselves. Fortunately I realized the formulas we derived were equally applicable to DNA sequencing projects, and our 1987 paper with its straightforward results was widely used in genome sequencing projects. We had a plot of the number of overlapping islands of sequence as the project went along, where each read is isolated in the beginning, and then islands begin to merge after which the number of islands decreases. Such a plot had a maximum called "the Lander-Waterman hump," after which the sequencers could feel they were finally getting somewhere with their enormous projects.

By June 1986 the idea of a human genome project was fiercely debated. Dedicating the funding required for such a project was a big change in how biological science was done, and clearly some people felt their current funding was threatened. It was said that only the genes were interesting and important; why spend that kind of money sequencing what was called junk DNA? Wally Gilbert weighed in with "The total human sequence is the grail of human genetics." In 1987 the National Academy of Science published a report of the upcoming project, "seeing progress." I reviewed the draft report whose authors included only one person involved in computation, Russ Doolittle who had a shallow but extremely confident understanding of the issues. My review touched on several points which were completely ignored and turned out to be critical. One matter, not initially appreciated, was the issue of whether genome sequences could be patented. I found the idea of human genes being commercial property offensive, and when I attended

sessions with lawyers talking about the issue, I would become upset. Finally patent issues have been properly sorted out, but it took a depressingly long while.

The HGP officially started in 1990 jointly by NIH and DOE and became a joint international project with many participating countries. James Watson headed the NIH HGP and David Galas the DOE project. In 1993 they were replaced by Francis Collins (NIH) and Aristides Patrino (DOE), and the first draft of the genome sequence was announced in 2000. There is a good account of that history by Galas et al (2017) “Notes from a revolution: lessons from the Human Genome Program.” There was a parallel effort from Craig Venter and his private company Celera. Venter recruited Hamilton Smith who built high-quality libraries of clones to sequence, and Eugene Myers who developed critical algorithms to assemble sequence from the whole genome (as opposed to sequencing one chromosome at time as the NIH project did). Although my paper with Eric Lander clearly implied that whole genome sequencing was as efficient as chromosome-by-chromosome sequencing, the idea of whole genome sequencing was controversial. Our results depended on the reads being sampled uniformly across the genome. I spent some time at Celera and there was a magical exciting atmosphere in Myers’ group. He brought together very capable people inspired by the project. The pressure from Celera caused a speedup of the public effort. As Celera was completing their sequence (using some of the public sequence which confused the issue of “who’s on first”), there was panic. Eric Lander called David Haussler at Santa Cruz asking for help in the assembly, and Jim Kent, who did not have his PhD yet, heroically stepped up to write his assembly program. And the rough draft of the human genome sequence was announced in 2000 jointly between the public and private projects. The DNA was not from a single person, was incomplete, and had many errors. The cost was around three billion dollars. Repetitive sequence at centromeres and telomeres (centers and ends of chromosomes) made it very difficult to close gaps in sequence. It was not until 2020 that the first chromosome (the X chromosome) was end-to-end sequenced, and in 2022 the complete human genome was sequenced.

One negative aspect of the genome projects was the fussing and fighting around 2000 between the public project and Venter’s Celera project about credit. Would there be a Nobel Prize for this accomplishment? Who would get it? Who would be written into history books and textbooks? It was vicious and ugly, an unfortunate and avoidable turn of events.

I am pretty much a naive idealist and felt the motives for the HGP were

to gain knowledge, not to increase grant funding and personal bank accounts, although that would be inevitable. An unpleasant facet of the HGP was the increasingly greedy behavior by some people. Here is an example relating to a paper I wrote with Gary Churchill. Our paper created a method to estimate how many sequencing errors were in a completed sequencing effort. One review from the journal where we submitted the paper was negative for obviously incorrect reasons, and when I heard a director of one of the centers make the same objections to a public presentation Gary gave, I confronted him. He answered that he could not allow any publication that asserted even one error was in sequenced DNA. “That will stop our funding,” he said passionately. My respect for the gentleman permanently evaporated. Ironically not too long after that the so-called 1996 Bermuda Principles set out rules for the rapid public release of DNA sequence data including requiring less than one error in ten-thousand letters. So then there needed to be methods to rigorously estimate errors in the sequences.

Eric Lander has come up several times in these chapters. Charlie Smith asked me to review Lander’s neurobiology proposal which was his first venture into biology. I recommended him to David Botstein, and their paper on genetic mapping thrust Lander into molecular biology. Our 1988 paper on physical mapping became widely used. A more sophisticated model, published with Tavaré and Arratia, appeared in 1991, and we had a 1992 paper on parametric dynamic programming. The 1988 and 1992 papers were conceived of and the proofs carried out by me, while the 1991 paper was proposed by Lander where I made minor contributions. Lander is obviously talented mathematically, and with his aggressive articulation and ambition, I expected that he would become a long-term collaborator. About this time I received a telephone call from him, and the message was “I no longer have time for you.” The delivery was more subtle but that was exactly what he meant. I have on occasion said, “I am easy to get rid of” and I was in this case. Lander went on to become a major player in the Human Genome Program, amassing huge amounts of funding from NIH and other sources. He was the founding director of the Broad Institute, and briefly served as the first cabinet level Science Advisor for President Biden where his assets of over \$45 million were the largest in Biden’s cabinet. He resigned his cabinet position after allegations of inappropriate behavior toward staff. One revealing incident was a brilliantly written and inappropriately self-serving paper Lander wrote titled “The Heroes of CRISPR.” When I read it I wondered how many would see how manipulative the article was. Many did get it, and

there was an uproar. My favorite lines came from Michael Eisen: “There is something mesmerizing about an evil genius at the height of their craft, and Eric Lander is an evil genius at the height of his craft.”

In the early 90s I had been working for 20 years in what had become an active and consequential area, and to establish it as a visible subject at the intersection of the mathematical and biological sciences, I wrote a book. What to call it? Mathematical Biology had a negative reputation with biologists due historically to the University of Chicago school so that was out. Statistical genetics was already a thing, and I came to name the field Computational Biology, leaving it general enough to accommodate an expansive future. Bioinformatics is an alternate name, often but not always associated with less rigorous but very useful content. My graduate textbook was the first in the field, and I aimed both at mathematical depth and biological motivation and relevance. The book sold around 10,000 copies with 2000 citations. Around that time, with others I started the *Journal of Computational Biology* and the conference *RECOMB*, research in computational biology. Today new books, journals and conferences seem to pop up every week, but that was the beginning.

The graduate textbook *Introduction to Computational Biology: Maps, Sequences and Genomes* was written while each year teaching a graduate class. Without that motivation and interaction with students, it would never have been written. There was an obvious list of topics including the algorithmic and statistical aspects of sequence alignment. I felt compelled to include sequence assembly, the process of taking short reads at random locations from an unknown text and overlapping them to reconstruct the unknown text (or genome). The approach, going back to the 1970s and Roger Staden, was known as overlap-layout-consensus. This means taking the set of reads (perhaps millions of reads) and computing all possible overlaps, taking the overlapped pairs and inferring islands of consistent overlaps (layout), and then finding a sequence of the genome that is consistent with the layout (consensus). While I was always interested in alignment, sequence assembly did not pull me in. I tried a learning method that did not work well but that was all. I had to include assembly so I covered the practical approaches and also more idealized mathematical aspects. One section covered the high computational complexity of even the most standard straightforward assembly approach. My coverage work with Lander gave critical insights into the

progress of a sequencing project. But most intriguing was work of Pavel Pevzner who had studied a technique called SBH, sequencing by hybridization. If the k -word content of a sequence is known, then the computational problem is to infer the underlying sequence. The naive method is computationally expensive but Pevzner observed that if the overlap between the $(k - 1)$ -prefixes and suffixes are the data, then graphs pioneered by Euler in the 19th century with ideal error-free data take linear time to deduce the sequence. I included a section on overlaps using spaces, an idea of Pevzner and Lipshutz that mysteriously (to me) was more powerful than un-spaced words. I worked this out to a point where I could get some sense of why, and others followed this lead to create a company. But having just finished my work, I was rolling across the floor in my chair when it hit me that the assembly problem would yield to Euler's graphs just as did SBH. My method took no alignment, no layout and no consensus. Deleted letters were as easy to handle as mismatched letters! I couldn't believe no one had thought of this, and even Pevzner did not immediately get the idea. My paper with Idury (a postdoc) published in 1995 was almost completely unnoticed until after the HGP concluded and rapid next-generation sequencing produced huge numbers of short reads. Overlap was impractical and Eulerian assembly (also known as de Bruijn assembly) became standard.

By the mid-1980s and through the 1990s it was clear that many more analytical people were required to study genomic DNA sequences and then the substantially more challenging problem of learning real biology from the sequences. I served on NSF and NIH committees to evaluate proposals and set policy. Often I was working from a disadvantage of not having enough deep knowledge of biological science, but just as often there was no one better qualified. It was usually possible to get a sense of whether the computational analysis was possible and then if the proposal had people associated who could handle it. I was asked to give many lectures. To mathematics departments, I emphasized statistics and computer science along with the biological motivations and realities. To statistics departments, I emphasized computer science and to computer science departments I emphasized statistics. To biology departments, I tried to show why mathematical analysis is important. Once at the Pasteur Institute in Paris I gave a talk debunking a so-called discovery and showed a biology-free simulation of random sequences. "Just look at that alignment, it looks good enough to publish

in *Nature*,” I remarked. A friend in the audience told me later, “When you showed that simulation you frightened almost everyone in the room.” My point was that just because the results of a computation look good they are not necessarily meaningful.

How to Live Peacefully

This chapter contains eulogies for two remarkable members of the Mathematics Department at the University of Southern California.

Henry Antosiewicz
1925-2004

What follows was written as a presentation to my colleagues at the University of Southern California at a memorial for my friend Dr. A, as the staff uniformly referred to Henry Antosiewicz. The week before the ceremony I spoke with Dean Joseph Aoun who knew Henry well. I said with some relief that my preparation was going well, that I had three pages. Dean Aoun reacted by saying, “Three pages?! But Mike, it’s Henry.” Some might see this reaction as some of the usual pressure deans place on faculty, but I took it as urging that we had to do right by Henry, that proud and sensitive man. Strange things happen at memorials, grade inflation I call it. Professors who despised teaching become beloved and gifted teachers; mediocre researchers become the equal of Fields medalists. So I was watched to maintain the standard of “But Mike, it’s Henry.”

Born in Austria, Henry Antosiewicz came to the United States from Europe after World War II. Until after his death, I did not learn what he did during the war but it affected him deeply. When Henry decided not to reveal something, you never heard a word about it from him. The words stern, severe, implacable, and forbidding come to mind. The cards he had face down stayed that way. One day, however, I was for some reason describing that chilling scene at the beginning of one of Dostoevsky’s novels where the hero—the author in real life—is lined up with others to be executed. The execution does not take place, but the description of anguish is unforget-

table. Henry then told me of his being captured along with another person by the Nazis during the war; his companion was shot in the head. Henry did not know why he had been spared. I had this event out of context with what he had been up to, but I was amazed. And I thought his story out-did Dostoevsky with that “why was he allowed to live” aspect. Henry and I would walk back to the Department from the Faculty Center, where this conversation took place, and take deep satisfaction in the day and our good fortune to have university positions. Deep in my own psyche is relief that I am not spending my life tagging corral after corral of muddy sheep on a cold wet Oregon day. In Henry’s case it might have been that he did not still have that gun pointed at his head.

In 2002 former Dean Bill Wagner learned more about Henry’s war experiences. At the beginning of the war Henry was hidden from the Nazis in Catholic boarding schools or orphanages. Later he somehow joined one of the intelligence services of the United States. As a spy for the U.S. he was serving with a partner behind enemy lines when they were captured, and the amazing incident he described had occurred.

Although Henry was destined to become a serious researcher in differential equations, finding a job in the U.S. after the war was difficult. However, after receiving his PhD from the University of Vienna, in 1948 he took a position in the Mathematics Department at Montana State College in Bozeman. The same U.S. intelligence service he had been working for arranged legal entry into the United States and his job in Bozeman. I spent a few years in Idaho which I would not trade for anything, and I retain a deep love for Alberta, Montana, Wyoming and Idaho: the Northern Rockies. So I know about the geography and the individuals who live there. Henry opened up about his years in Montana and his warm feelings about the job and the people. “I was like no one else in Montana and they all knew it,” he told me. The odds of even one person like Henry in pre-1950s Montana seem to me to be vanishingly small. Imagine this urbane sophisticated European dropped into that mountain valley in 1948. But the openness of the people and that vast sweeping land made it a good place for him. They made Henry welcome and accepted him for exactly what he was. His total honesty and solid sense of himself made this a given with those folks. Henry described driving an older car from Bozeman to Helena or Missoula to pick up a new automobile from the dealer, something we can all see Henry doing. The freedom from stress, that gorgeous light, the beautiful stark landscape; what a place to recover from world devastation.

Henry came to USC in 1958. He served three terms as USC's Chair of Mathematics, and he was key to the maturing and growth of the department. And after his time as Chair, Henry was a booster and worker in front of and behind the scenes. He was *the* key figure in bringing Mark Kac to spend those precious years at USC. He told me of a New Year's Eve party in Kac's New York City apartment, all the men in tuxedos. Without Mark Kac coming to Los Angeles, many of us would not have joined USC. Henry kept track of all of us in the department, and he had surprisingly accurate evaluations and judgments of the members of the Mathematics Department. I don't know where they came from; unlike Jim Dugundji he didn't go to the library and read what we were publishing. Jim made well-informed, accurate and sometimes devastating accounts of what we were doing. Henry didn't even go to many talks. But he knew about us and he cared about us all. One of our postdocs from the 1990s was amazed when I told her that Henry supported her being at USC and thought it was a big mistake when we let her go to UCLA. She didn't have a clue that he had even noticed her. It is difficult to imagine the USC Mathematics Department without Henry's dedication and service. He deeply believed in the future of USC as a great university, although he was often, to put it diplomatically, realistic about the progress we were making. Or not making. These things are easy to forget at universities where we each are worried about our own research and promotions and the latest elaborate academic plan.

There is a strange thing about Henry's CV. He stopped publishing in 1977. Until then he was a serious player in differential equations, and he had written a paper on the revolutionary work on the squid axon. He was pleased when that paper became "in" with the neurobiology boom in the 1980s. But it is a fact that in 1977 his research suddenly stopped appearing in print. My interpretation, which is just a guess, is that it simply was no longer important for him to make those marks of public credit for what he was doing. Around this time he took up financial mathematics. I expect Bill Wagner knows much more of this story than I do, but for many of us Henry and wealth were a natural match. Those banker suits, his thin gold wristwatches, and new silver Mercedes touring cars; his study of the mathematics of the accumulation and processes of money seems inevitable. But he never published his work on the subject, and I know that there were many publishable results. I would see an article about an aspect of financial mathematics and bring it to him. "Yes that's very interesting," he'd say, then rumble through old file cabinets and come out with an unpublished manuscript on the very topic which he had

written years earlier. After my speech at the memorial, an older man got up and spoke a few gruff words. Retired from Morgan Stanley, he said he knew why Henry had not published after 1977. “That’s when Henry started running money,” he said. “And he was good at it. People who run money do not make public their methods.”

Henry and I often had lunch on campus, but once or twice a semester ventured outside USC’s boundaries. I have a strong memory of him seeing enjoy his first Oaxacan food in a tiny inexpensive restaurant in a shack on the edge of a parking lot. Mole negro suited him just fine. I read an article by Jonathan Gold describing Asian fusion food and its arc through Los Angeles. C’est Fan Fan, Le Petite Chaya, Ishi’s Grill, and Cafe Lyon were touted as legendary restaurants in this theme. Early in its existence, I stumbled onto Cafe Lyon located in Honda Plaza, a strip mall adjacent to Japan Town. In this former sushi bar was a Japanese chef who in open view cooked simple tasty French food for a remarkably modest price. There really wasn’t much fusion to it except the cook was from Japan, the food was from France, the location was in the most international city in the Americas, and the customers were from just about anywhere. Henry loved this place; going there with him was like taking a mini vacation from our university lives.

In later years Henry served on the advisory committee for the Princeton Mathematics Department. And he was on the Steering Committee for Mathematical Sciences Research Institute in Berkeley. During that service he managed their endowment fund. Henry usually revealed nothing, but I did get a look at the returns from his management. Those were good times for the financial markets, but his proceeds were substantially better than the market averages. At a critical junction, I advised him to step down from that job. “Just think how you’d feel if something happened to the investments,” I told him. Whether it was my advice or not, he did just that, and I believe he was spared some sleepless nights.

I want to to return to Henry and Montana. I discovered a great painter of the Northern Rockies, Russell Chatham, and I own several lithographs and a painting by him. Henry agreed with me that Chatham catches some essence of that country, and he loved to see the art I accumulated over the years. I take long solo hikes in the mountains, one and two weeks at a time, where I carry everything and sleep on the ground, and Henry was interested in what I did out there. That’s hard to imagine from such an urban man, but he enjoyed hearing of more direct contact with that country than just seeing it from the window of a car.

I shall always remember our lunches at the Faculty Club, often with Louis Gordon. (Henry would laugh to hear that the Faculty Club has ascended now to being the University Club.) There was his delight when one of us, such as me who rarely dressed up, appeared wearing coat and tie. I recall his deep satisfaction and enjoyment at being on the inside of some hush-hush university matter, and his complaint that “Nobody tells me anything.” (Perhaps what he meant was that “Not everyone tells me everything.”) But what I hold most closely is my image of him driving to Helena Montana with his wife—his first wife of four, so far as we know—to pick up a new American-made automobile and to have dinner at the best restaurant that small city had to offer in the late 1940s. There was magic to those first vehicles off the U.S. assembly lines which had during the long war produced only weapons and tanks.

Early in 1990 I lent Henry my copy of Norman Maclean’s now famous book set in Montana which begins with the sentence “In our family there was no clear line between religion and fly fishing.” This was before the 1992 movie, after which yuppies became more numerous than trout along Montana’s rivers. Henry returned the book on March 6 with these words:

Dear Mike:

Thank you so much for lending me “A River Runs Through It.” It brought back many memories—when people in Bozeman tried to teach me fishing & bear hunting and how to live peacefully.

Thanks, Henry.

Herbert Busemann
1905–1994

In 1984 Hugo Martinez, the editor of the *Bulletin of Mathematical Biology*, asked me to assemble articles for a special issue focused on macromolecular sequence analysis. I wrote three of the fourteen articles, and one of them was titled “Line Geometries for Sequence Comparisons.” On seeing the manuscript, Paul Yang, my geometer colleague at the University of Southern California, told me I had discovered an example of Straight Spaces that Herbert Busemann had developed. Busemann had from 1947 to 1970 been on the faculty in the Mathematics Department of the University of Southern

California, and he retired in 1970. I tracked down his address and mailed him a copy of my paper with a letter explaining the circumstances. It was one of those salutes one makes to the past and I expected at most a note thanking me.

Herbert wrote back, graciously inviting me to visit him at his home. After a couple of phone calls, we arranged a date and I drove 95 miles from Los Angeles to Santa Barbara to see him and have dinner. From Santa Barbara I drove up a steep road and then along the Santa Inez Valley where many wineries produce excellent Chardonnay; it is higher and drier than nearby coastal Santa Barbara. After asking for directions at least once, I finally located the turnoff to Herbert's home. The road went up a steep ridge and I had to stop to allow a covey of quail to cross. Herbert's California-modern home sat on the narrow ridge top.

I was greeted at the door by Herbert and his wife and was even more impressed by the house as I walked through it. The house straddled the ridge and the landscape determined its footprint. There were big windows with views of the valley, bright abstract paintings, books everywhere, oriental rugs and comfortable furniture. Out of sight was the regulation-length pool that Herbert swam in each day for what seemed to me a heck of a long time for a man 80 years old. We toured the house, had coffee, and his wife went to see to dinner preparations. Herbert and I went through his painting room where large canvases of bright geometrical abstract paintings, finished and unfinished, were stacked everywhere.

Then Herbert said, "Now let's talk mathematics." He began to ask me about my paper. There is a subtlety that makes sequence alignment difficult which people not expert with the subject usually miss, and I assumed Herbert was making the same mistake. So I began to gently steer him away from that. "No! No! I understand that," he said impatiently and then dove into deeper waters. I already had high regard for this intense older man, but this bumped that to another level. I told him the Mathematics Department at USC was building in geometry with Paul Yang and Robert Brooks. I had read a couple of Brook's lighter papers which I thought were beautiful, and I could say something about them to Herbert.

If only I had a tape of our dinner conversation! The Busemanns came to USC in 1947 so they missed the brief unfortunate stay of my friend Stan Ulam. They bought a fine home in Baldwin Hills to the southwest of USC. It had a great view of the Los Angeles Basin, facing Griffith Park and the Hollywood Hills. But over the years the area became predominantly African

American and, I believe, less comfortable for them. So when he retired in 1970, they bought the property in the Santa Inez Valley, and Herbert designed and built their home.

Not long after my visit, I learned that Herbert Busemann had received the Soviet Union's Lobachevsky Prize, the first American mathematician ever to do so. In my head I sketched an article about Herbert and his award. Since I knew Lee Dembart, a Los Angeles Times science writer, I gave him my ideas and he wrote an article very much on those lines but like any good reporter he uncovered more than I knew at the time. Herbert was born in Berlin where his father, a successful businessman, retired from Krupp in 1943. Except for Herbert his family did not leave Germany. His father sent him to business school where he spent what he called two and a half lost years. Herbert joined Göttingen University in 1926 where there was a stellar collection of scientists and mathematicians including Hilbert, Noether, van der Waerden, Landau, Weyl, Runge and Born. Influenced by Minkowski's *Geometrie der Zahlen*, he took up non-Riemannian metrics and was inspired by the visitor Alexandroff. After Busemann's 1930 PhD, he stayed in Göttingen until 1933 when Hitler caused a decline in the mathematical atmosphere. Then he went to Denmark for three years. He came to the US in 1936 with an appointment at Princeton's Institute of Advanced Study where he spent another three years. Finally in 1947 Herbert Busemann joined the University of Southern California. A. Papadopoulos has prepared a collection of Busemann's selected works including a valuable biographical sketch.

Down Grand Gulch

May 1-3, 1992. On Wednesday I fly to Tucson Arizona where I am giving an invited lecture on Thursday at a scientific conference. Fortunately my performance is before Los Angeles explodes that evening. It is a strange sensation, listening to talks about computation and molecular biology, very scientific and intellectual, and then rushing upstairs to a luxury hotel room to watch Los Angeles burning on live television. The Los Angeles Riots of 1992 occurred after LAPD officers were acquitted of excessive use of force in the arrest and beating of Rodney King. The outrage, the fires, the greed, the brutality. The next day burning and looting were extensive; we all watch in fascination and horror.

I do not have my daughter Tracey's new telephone number, and as she teaches grade school in South Central Los Angeles not far from the epicenter of the violence (near USC where I teach), I worry about her safety. Finally, I think of a girlfriend of hers who does have the new number. Thankfully Tracey is safe, and just to hear her voice, I call repeatedly for the next few days. Once while on the phone with her, live TV showed a burning building just across the street from my USC office.

I have planned a hike in the Four Corners area of the Southwest and have a prepared backpack, but the situation makes me want to return to Los Angeles. Just what this would accomplish escapes my logical mind but there is an intensely strong desire to go home. Tracey checks on my house and everything is all right there, no damage in the neighborhood. My university USC escaped damage, although the little shopping center across Vermont Street from the building where I work was completely burned. Eventually, I realize that I should go on my hike and leave the smoky wounded city on its own. On Friday night I fly from Tucson to Flagstaff Arizona and rent a car.

Day 1, May 4. I wake up early in Flagstaff and try to make a motel

reservation for the day I expect to return. Fat chance, I am told, that's the date of the Northern Arizona University graduation. Well, I decide that when I return, I will stop in the reservation town of Tuba City or sleep in the pines on the slopes of the San Francisco Peaks off Highway 89.

I drive east on I-15 for a few miles, then northeast on Highway 89. Before Tuba City I turn east on Highway 160, which is down from higher country, and go into the high desert of the Southwest. No pines here: just juniper, mesquite, and sandstone. At Kayenta, the entrance to Monument Valley, I turn north on Highway 163, and at Mexican Hat, I get gas in a trading post with logs of petrified wood to demarcate the parking lot. Then north again onto Highway 261.

Through most of this drive, I am getting the Saturday National Public Radio news program, hearing about Los Angeles. Restaurants I eat at, stores I shop in, and places that have been in my life for a decade, have been destroyed. People have apparently looted and burned mostly stores, reminding me of the bank robber Willie Sutton. "Why," he was asked, "do you always rob banks?" "It's because," he answered, "that's where they keep the money." My campus did not have consumer goods that were the focus of many looters. Also USC's surprisingly good relationship with the surrounding neighborhood helped protect it. Remarkably a private university has achieved this in a neighborhood such as surrounds USC.

After a few miles, I come to the end of the pavement with a three-mile stretch of dirt road that climbs an impressive wall of sandstone, the same formation that I am about to spend four days walking up and down. In 20 miles I come to the Kane Station of the Bureau of Land Management (BLM) where I sign in with the ranger on duty. He is talking to a couple in their early thirties trying to decide which trip to take. I get the impression they plan a Kane Station to Grand Gulch out Bullet Canyon trek with a ranger shuttle, for which they are to pay \$15. Still, I am not listening closely, in my usual rush to get out of the car onto the trail which happens about 11 a.m.

A couple of hours later I descend into the Kane side canyon. The pools of water are stagnant at the top of the formation and become fresher as I drop in elevation. The trail is good, and the scenery is the usual Southwest when the view is restricted: sandstone, juniper, cottonwood, shad scale, rabbitbrush, sagebrush. I meet a couple, the man leading. He speaks to the woman who quickly pulls her halter top up over her bare breasts. She says, "I'm sorry," to which I reply, "No need to apologize to me!" Fortunately they both laugh instead of getting angry.

Then a turn of the narrow canyon and I am at Grand Gulch, a broader and deeper canyon. Cliff-dweller ruins are to the right, just up Grand Gulch. I find a nice campsite under large cottonwood trees and drop the pack. The ruins look nice and after poking about I pull the pad off the sleeping bag and set about to make myself comfortable in the heat. I put two cups of water on my little stove to boil for soup.

Then the male of the couple from the ranger station shows up. He looks around and says, "I just keep going down the canyon, correct?" and points *up* the canyon to the right. Well, he asked, and I assume he doesn't have a good map. No matter, he should know it is a left turn just by looking at a sketch. But no, he has the same 80' interval waterproof map that I bought last Thanksgiving in Tucson. So I go into teacher mode, hoping it is just the heat that has overcome his good sense and that he isn't as helpless as it appears.

"No, down the canyon is really that way," gesturing left. "This is Grand Gulch, see on your map: over there, those are the cliff dwellings that are marked. And it's easy to see what's going on, water runs down the slope so you can look at it and just follow it." "That's a great idea," he says, "just follow the water!"

Ouch, he is in over his head. We talk a bit more and I tell him there is a nice campsite just beyond the trees. As he leaves he asks if I am spending the night there. "Don't know, depends on how I feel," I tell him.

Later the woman shows up. God knows I have nothing against skinny women but she looks tired. She complains about how much her shoulders hurt, and I answer by saying mine always do when I hike and carry a pack. "Where the muscles attach to the backbone," I explain. This does nothing to cheer her up. When she mentions they are doing a 25-mile trip, I say "Well you only have 21 miles to go!" This too is not well received. I wonder later how much she is carrying; I used to take my ex-wife Vicki who on later trips carried only her sleeping bag and a shirt, maybe 4 pounds total, about 15-20 pounds too much as it always turned out. Initially, I thought she could carry something, and we hardly moved along the trail. A far cry from friend Sandie who wanted to go and pulled her share of the load. This guy is a long way from having any of this figured out. The 25 miles is consistent with a walk down Grand Gulch and out by Bullet Canyon, as I thought I heard them arrange. I hope they make it.

After soup and an hour's rest during which I almost go to sleep, I get up, assemble my pack and head down the canyon. As I walk along, something is

making noise under the bushes, a loud rattling in the dry leaves, but I don't take any time to figure out what is happening. Later I begin to get in tune with the canyon. The water in my bottle, a quart from the motel, finally runs out, and I pick the cleanest place I can find to pump. Sometimes the water runs, sometimes it vanishes entirely and the stream bed is dry. *Giardia* is everywhere I guess, thank god for the good pumps to purify water. My excellent pump is heavy and can be cleaned by brushing the ceramic filter in water. Other models require carrying separate disposable filters. I drink a half quart, fill the bottle to the top, and rest.

In a few places the canyon widens, and when the right exposure is present, there are Anasazi ruins. Humans have been visiting and living in the Gulch for at least 10,000 years with long periods of no habitation. The last group, the Anasazis, moved out about 700 years ago for unknown reasons. It could have been drought, a decaying environment, enemies; no one knows although theories abound. There are signs of their presence throughout the region, cliff houses and pottery. I have taken a few shards of pottery home in New Mexico and did not find them something that I valued later, so there is no temptation here. A tradition has developed in Grand Gulch of putting the shards onto pieces of sandstone so others can see them near their proper place. Small ears of corn are present. At first I think it is thoughtless hikers' litter, but instead it is Anasazis' litter! Imagine 4" – 5" corn cobs lasting hundreds of years ago, lying about in the open. They wouldn't survive long in coastal or damp climates.

By 5 p.m. I make it to Todie Canyon, which comes in from the same direction, left, as Kane Canyon. By this time I have the clear message that BLM primitive areas have no, absolutely zero, trail signs. It is not clear that I am at Todie, but some tracks through dry sand lead me to drop the pack and explore a little. Somewhat up Grand Gulch the water level has risen, and my small panic about whether I will ever see water again has eased. It seems that when two water tables meet like this the water in the stream is more prevalent. I walk up what does turn out to be Todie Canyon. Soon a nice stream is running in a narrow canyon, the sounds echoing about the walls. I wonder if my couple will find any of this. I thought he was hoping to get rid of me this afternoon, but now I realize he was worried and wanted help and company. I come to places like this for solitude.

I wander about and find a hidden campsite under one of those beautiful junipers with lacy leaves. I go back to the main trail and haul the pack up Todie. I pump water again, feeling good about how clean it looks, and fix

a small dinner. Then I scramble up the canyon, scaling a cliff high above the bottom. Every sound is magnified and seems strange to my tired ears. I find some dried pieces of pinion and juniper and return to make a fire at camp. Hiking alone it is difficult to stay up late—no one to talk with, no radio to listen to—but the beautiful fire keeps me awake past dark (about 7:30 west coast time). I make it all the way to 8 p.m., part of the time trying to classify a raucous sound: is it a furry animal or an insect? Eventually I decide the steep canyon's echo is causing the weirdness, but I do not recognize the strange, agonized noise. I go to sleep before it stops.

Day 2. I wake up at 6 a.m. and am on the trail by 7. It promises to be another hot day. This is early May, imagine what this place is like in July and August! It is not recommended to hike then, as much for the lack of water as heat, perhaps. The canyon narrows, and at both Kane and Todie, I didn't find the springs advertised on my fine map. They might be there but I didn't locate them. Maybe "spring" refers to wet spots in the canyon stream bed that are not obvious this time of year. Midmorning I pass a nice arch and photograph it from two sides as the trail gives both views.

Anasazi ruins are in every niche that has the proper southern view. I read in *Science* magazine during the 1970s energy crisis of the wonder some academic had over the fact that the Anasazi's homes were out of the summer sun and in the winter sun, energy efficient you see. I got a good laugh from that; the Anasazis were out in the weather, and it doesn't take much to know if you are comfortable or not to get it right. And the human brain has not much improved in a mere 1000 years of evolution, that's for sure. The scientist had not spent much time outdoors or with people who worked for a living. I get a sense of when to scramble up the slopes to look for dwellings: the canyon needs to widen for farming as well as the cliff oriented to provide exposure appropriate for homes. Often there are several levels of houses. I am surprised that at every place I find ruins, they have been looked over by many people. There must be a ruins map of the area.

After the arch, I take a break at a magical spot. I am resting under a juniper tree, drinking water and having a snack. The pool in front of me has a big sandstone boulder at its far edge. The texture of the boulder is smooth but with some small irregularities. When the water moves from the wind, the waves are reflected onto the rock which, without the water, would be in shadow, and it looks as if the rock itself is alive. A beautiful, constantly changing scene.

In recent years I carry a book when I hike. This trip I almost brought a collection of Wallace Stevens's poetry, *The Palm at the End of the World*. I like Stevens who is not an easy read. A few poems of his could keep me occupied for some time. I have worked a few out and when I do they are rewarding to revisit. One is about some carnations, pink and white I think, in a bowl of water on a winter day. After exploring their wonderfulness, he concludes by saying that they are not sufficient (for human emotions, life, soul, whatever). So the book would have enough sustenance for a long hike, probably a long life. Thankfully, I left it in the car. During my city life, it is hard to imagine the change in my sensibilities, in my priorities, when I am outdoors. Instead I have brought a translation of the Japanese poet Bashō (1644-1694), of his book *The Narrow Road to the Deep North and Other Travel Sketches*, less than 150 pages including a 50-page introduction. I think about the book while watching the shadows of the water making the living rock vibrate, and I am happy to leave it in my pack.

I am beginning to notice more of my surroundings and am now really curious about what is making that harsh noise in the dry leaves under the bushes. Is it some lizard or a bird or what? And I have noticed that the sagebrush that was the usual ankle to knee height at the top of the formation at the trail's beginning is now waist high and in the more fertile spots, obviously used by Anasazis to farm, is up to my shoulders. This must have been a good life for them.

Next I come to Pour Off Pool that sits below a sandstone formation off of which the water, when it is running, indeed must pour. Today it is dry and quiet, with the pool water a rather sickly green. A small tent is pitched in the willows and cottonwoods below the pool. I wonder about the water below if these people are camped here. Is it clean and flowing? Still, it is a scenic wonder: see there, it's on the map. I think about movies of Australia where in vast dry regions water like this is cherished. If I were a little more dry and thirsty, I'd be down there pumping. Below Pour Off Pool there is more water in the stream, and there are some impressive ruins in the most inaccessible spots on the cliffs at various levels. During months like this and in the early morning it seems like it would have been a good life. But hard.

On the map is The Thumb, and then Shiek's Canyon, followed by Bullet Canyon. I am moving down the trail and the country slides by. The Thumb is easy to spot, and the stream is now dry. I entertain thoughts of no water except at hidden springs and vow to fill up whenever I see anything wet again, no matter how it looks. A couple of hours later I walk through some willows

and locate water that is running in the stream bed. The pack goes off and I pump, drink, and pump again. These details of the country are important, and Los Angeles, with its smoke and violence, is now remote. Coming here was the right decision.

I walk past a trail I think is the left turn to Shiek's Canyon. Then the canyon opens, water still flows, and I enjoy being here. I take a lunch break by the stream, under a sandstone ledge large enough to shelter me from the sun. I make soup, eat half a candy bar, pump water. Then relaxation time, I stretch out on my pad and nap. An hour later I get going again.

While Bullet Canyon does not show itself, I keep looking, thinking I am even slower than I expected. At one spot the canyon has a big upslope, and I cannot work out where the stream has gone or where the trail is. You can lose the trail easily when it goes onto sandstone. There is no formal trail, just a bunch of people and animals walking about, sometimes in the same direction and place so that a trail forms for a while. I start down some slope in loose red dirt and have to sweat and climb back up to find a different route. A mile or so later I see a canyon going to the right, while there is no canyon on my map. Oh well, perspective is poor down in the canyon. The second such right-hand canyon makes me realize, guess, that Shiek's Canyon was really Bullet Canyon and that I am farther down Grand Gulch than I thought.

Consistent with this, I come to what I guess to be Green Canyon and drop the pack under some large cottonwoods. The weather has changed, with thunderheads, thunder and lightning in the distance. I put up my tarp and then realize that while not directly under a big hanging limb, it is much too close. They were called widowmakers in the logging woods of my youth. Today I would make no one a widow but have no desire to stand or sleep under this threat. While I cook some noodles, the weather gets more intense. The food is cooked and the rain comes, so I put the pack under the tarp and sit in the rain, eating and watching the weather. My new Gore-Tex parka is excellent. I was trapped by a snowstorm high in the Sierra Nevada Range when I decided I could afford a Gore-Tex jacket. This is the first payoff.

The storm stops and I go up the side canyon, which is a delight, green reeds in clear water, then a running fresh stream. I sit on sandstone and pump, drink, then pump some more. A cool refreshing place.

Back at the cottonwoods the "cotton" is blowing about and covering the ground. I lay the bag out in an open place, away from the hanging limb. Late in the day I decide to climb the rock bluff behind camp. In the shelter of a

cliff is an exquisite house, very well preserved. The mortar work is first rate, and it is hard to believe that some contemporary craftsman has not restored it. Walking along the formation to the south, I see what might be another ruin high above me along the base of another stratum. For someone of my skill, there is only one place to get up, and I chance it. It is always easier to climb up than down and it is rapidly getting dark. I come to an ancient ruin, with no mortar, just rocks piled up to keep some of the wind out of a dark shallow cave. And maybe it was defense against those even more hungry. I cannot imagine what it must have been like to spend a winter here 10,000 years ago, but it did not include watching football and drinking beer.

I struggle to get off the cliff but manage it. The night is long with a herd of bugs crawling inside the bag. Keeping it shut is too hot and whenever I open up, bugs ahoy! They are soft, probably the leaves are full of them. Only one bites me so that I can feel it. I develop a real fondness for the birds that make such a racket all day hopping about in these leaves. I hope they get a lot of these guys.

Day 3. Up at 5 a.m. to escape the bugs, and I take off by 6 for the appealingly named Dripping Canyon. I have Ed Abbey fantasies of a cliff of dripping water, green plants, and ferns, hanging on sandstone. After all this is Canyonlands and I will probably never return. I travel light with no load, no water, less brains.

At Step Canyon there is a camp with llamas, explaining the elk-sized droppings in the stream with odd tracks I did not recognize. It takes two hours to get to the mouth of Dripping Canyon, and I'm already thirsty. Oh well you only live once. Up Dripping Canyon there is a little pool but no sign of my desert fantasy. After all this hiking I come to the end where a stream must come dripping off the heights in February or March but is now dry as sun-bleached bone.

Frog eggs, tadpoles and grown frogs are abundant. The tadpoles tend to be in stagnate water, and I see frogs in or near the trail sitting in the dust. I am surprised there are not more coyotes and foxes eating them, but the survival rate must be low. Obviously there are abundant insects for them but don't they need water to survive the summer? Perhaps they lay eggs before they succumb to the deadly summer heat, if indeed they do. I will have to look this up when I get home. Worldwide there is concern that frogs and amphibians are dying out. Just why is a mystery. The Oregon coast of my childhood was thick with frogs, but it has been years since I saw this

many. I didn't know I had missed them.

I stretch to get back and am staggering by the time I reach my camp by 11. Walking back up the canyon, I get stuck by broken willow branches pointed downstream by spring runoff, a feature of the trail I didn't notice when walking downstream. I drink a quart of water at camp and recover. My foot is sore today and I am trying to ignore it. Then up Green Canyon where I drink some more, wash and enjoy the silence. I'm resting in the middle of the day and by 1 p.m. a thunderstorm is gathering. Well I can't waste this cool air so I start back up the Canyon.

The first people I meet inquire: "Is that Totem Pole?" I am vague at first, although I used that rock named on my map to be sure I had finally correctly located myself. I tell them maybe, and then recall it is farther down the canyon. They are puzzled: "How do you know when you see it?"

"Well," I say, "it looks like that tower over there, but it is a couple of stories higher than the usual formation at the top of the canyon." This does not seem to help them.

"But, how do we *know we have seen it?*"

They want to be sure they see everything on the map, like tourists want to see everything in the guidebook. "Just find something and decide it is Totem Rock. It really doesn't matter."

This is an alien concept, to be sure. Many rocks and features unnamed on maps are more worthy of attention than those that are named. Take responsibility for your sights; it's your trip. It is easier to do this when there are no signs or labels on things.

After getting back around red crumbled slopes where I again become confused about the trail, I run into a horse party of a few people with a guide. I hit it off with the guide and have a nice talk. He appreciates the distance I have covered this morning. It has been years since I rode a horse, and his group includes a newly married couple and an older obviously rich woman. If these people stayed home, it would be fun to ride around with the guide.

I reach Bullet Canyon, carefully checking the map so I don't screw up this time. I wonder about my young couple who couldn't tell upstream from down and hope they have come through this without harm. The trail at the beginning of the canyon is well-defined, passing by a few excellent campsites under cottonwoods that belong in some old black-and-white cowboy movie. Where sandstone bluffs mark the corner between Grand Gulch and Bullet Canyon is a cliff dwelling, high up the tower of sandstone. What a view, per-

haps it was used as a lookout to spot enemies: Apaches and Navahos. Then the canyon widens out and becomes completely dry. I have some water but am cautious about carrying enough now. The map indicates that Jailhouse Springs is 2.2 miles distant, along with Jailhouse Ruin which is less interesting to me. I read the map so I can check again to see if I am in the right canyon. In 1.5 miles the canyon narrows and I take a break. It is extremely dry. Two young women come down the trail and I ask about water. They report plenty at the springs but another two-mile stretch without water is beyond that. Water appears in the stream and people are occupying all the campsites. The spring is a series of springs. There is no water beyond them, but they create a profusion of cottonwoods, tall sage, and juniper. It is a splendid natural area. The convenient campsites are used, and maybe 15 people are camping here. The top pool of the spring has bubbling water all around and I pump water. How much do I need? Three quarts should do, four to be really safe. I have a collapsible plastic container that holds up to three gallons. I carefully wrap my hand with a cloth to prevent blisters and pump six quarts in 30 minutes. Along with that, I drink all I can; it's the same price. This puts over 13 pounds of additional weight on my pack, but the security is great. Jailhouse Ruin is in full view and has modern graffiti added to the old Indian petroglyphs. I neglect to photograph this juxtaposition but later wish I had done so.

I walk until the trail pulls out of the wash which is now entirely dry, and I go up a ridge to the base of the bluffs on the west side of the canyon. There is an old fire circle, and the ridge is dry and clear of cottonwoods and I hope of bugs. My meal is some tomato-flavored noodle dish, less wonderful than the dinners I had earlier on the trip. Too bad, I have had tomato on my mind. Still if you carry your entire habitat on your back—kitchen, food, bedroom, supplies—you can't complain about the food so long as you have something to eat. I sit on the rocks, eat and look down the canyon. Mosquitoes come out and I wonder if I am in for a bad night.

I read some more of the Bashō book. I have finished the introduction and now read the first travel piece by Bashō, "The Records of a Weather-Exposed Skeleton." He wrote one of the world's most famous poems:

Breaking the silence
Of an ancient pond,
A frog jumped into the water—
A deep resonance.

Haiku poems are to have seventeen syllables, divided into three groups, five-seven-five. The English translations cannot follow that convention, but they are short and packed with juice. Bashō brought an earlier form called hokku into artistic prominence during his lifetime. His travels were very nervy as he let go of valuable worldly possessions and went out, not expecting to return alive. No one went on the road in seventeenth-century Japan. Bashō's idea was to integrate prose accounts of his adventures with the poetry it inspired. The introduction didn't lead me to expect much from the first of the five travels described in the book but it is terrific. And I am reading it in a wonderful place where earth and sky collaborate in big dramas.

I wander around and gather dry juniper and pinion, excellent firewood. The fire smells great and wind comes up to send the mosquitoes to cover. The strange night sounds, which were more distant at the cottonwood camp, are close here and remain strange. It must be some desert insect's mating call. Stars come out with the thinnest shaving of moon. In the distance I can see the flash of someone's campfire at the Jailhouse Spring. I have a good night's sleep.

Day 4. I am up at 5:15, high on this ridge. Remarkably the ashes from the fire are undisturbed; the serenity is moving in the quiet air of the new day. In honor of Bashō I write a poem.

In spite of night winds,
Ashes of the campfire
Perfectly hold log shapes:
Ghosts of last night's firewood.

Bashō would have written a water poem. I had six quarts, and after a wet breakfast of oatmeal and tea, I still have at least three quarts. Okay, I overdid it! The trail is distinct and then is just traces occasionally appearing in the dry wash. There are no ruins so probably there has not been dependable water here for over a thousand years. Seldom on earth can the past be so easily seen as in the American Southwest. After 1.5 miles the canyon narrows to pools of water with trees and plants. Then it becomes dry again with rough hiking in the wash, not much of anything you could call a trail. Water appears, then the trail heads up the steep left-hand side of the canyon wall. I follow, hoping it is not a waste of my energy on some dead-end side move. Indeed not—I come up onto a sandstone ledge that bears no sign of a

trail, on which I walk a quarter mile, looking down into the tangle of junipers and boulders that choke the canyon below. It is worth the walk just for the free unbound feeling I have here. The tendon of my left foot is painful and I enjoy a break at the end of the ledge.

Paul Stein was a great guy at the Los Alamos Laboratory when I worked there in the 1970s. We did some nice work together on combinatorics, counting the shapes certain RNA molecules could take, and we talked about many things. He loved to smoke and drink and think. He knew several languages and even had a Japanese typewriter along with some incredible books. Paul was also a photographer and took wide-format photographs of still canyon scenes, along with naked young ladies he hired as models. His nature scenes were published in the Sierra Club calendars. I don't know what he did with the photographs of the nudes. A friend I met while hot-air ballooning had a girlfriend who posed for Paul. Paul was curious about her life when he discovered I knew her.

It was because of Paul Stein that I knew Grand Gulch existed. He was friends with the famous nature photographer Elliot Porter, and they had a dream of photographing Grand Gulch. He knew of my long heavy hikes and suggested, with some humor, that I could assist him and Elliot with a Grand Gulch trip. The plan was that I would carry the steaks and whiskey and camera equipment, and they could photograph. He wasn't entirely joking. If I had seen the map then I might have done it. The following poem is for Paul. He died a few years ago, after which the best problem we tried for and didn't get was solved by a collaborator, Bill Schmitt.

Bill kept asking me, "I see the table of data and I see the formulas and they check but *how* did you ever guess the formulas from the data?"

Paul gave me credit in some scribbled notes, "Waterman's formula," but I have no memory of it and it is possible that Paul himself or C.J. Everett deduced the unexpected relationship. The paper with Bill, dedicated to Paul's memory, inspired several other papers and became a new line of research.

And this hike is dedicated to Paul's memory. I bought a small Olympus camera with a zoom to 105mm. I hope it does a good job, the pictures are off at the developer as I write this, but in the Gulch I try to see things with my photographer's eye. Still the scenery hasn't too often reminded me of Stein's photographs. Maybe the reeds at Green Canyon and some of the more delicate masonry work on the Anasazi ruins. Then I come to the end of my hike out of Bullet Canyon, and I take a full roll of film and feel Paul with me as I am awestruck with this place.

Bullet Canyon

For Paul Stein

It starts a dry sandstone wash.
Then layers of springs,
water seeping down stairs
and chutes of strata into pools.

Had I known, one May
I would have come here,
carrying steaks, whiskey & all those cameras.
You would have had to bring yourself!

I exit at the Bullet Canyon Trailhead, two miles from the highway and nine more to the ranger. I stash the pack and hit the road. Before I go a half-mile, a Native American working for a company with a contract to grade the road comes by and gives me a lift. He gets me to the highway, but he goes right and I go left. Cars come by, and I stick my thumb at everyone but no rides. I am not too likely, a middle-aged scruffy guy with a thumb out, here on the edge of nowhere. I don't blame them but keep trying for a ride. My rate is only three miles per hour, and into the fourth mile, a couple from Vancouver, British Columbia stop for me. Wouldn't you know it, the people with compassion are not from my own country? It figures.

With my car, I go up to the station and find a ranger. He has not agreed to pick the couple up, and I tell my story about them. We have a nice time talking about the wilderness. I remember Idaho and all the friends I had like this guy, young and spending their lives in the hills because it is the best place they know. I am good enough at it and love it so much that it is still a temptation to me. I couldn't handle the pilgrims though; that is what modern sustained wilderness life almost always comes to— bottle feeding babies from cities.

I drive my car back to get the pack and am loading it in when the ranger comes in his pickup, looking for the couple. It warms my heart. Then I drive through the Ute Reservation, just north of Sleeping Ute Mountain, to Mancos Colorado. I spend a few days with the Bements in Mancos, wonderful people. Bob Bement is an expert on rangeland grasses and tells me that the early settlers chose land with 6' high sagebrush. "It is a sure sign of good land." I close this with the poem that Bashō put at the end of his account

“The Records of a Weather-Exposed Skeleton.”

Shed of everything else,
I still have some lice
I picked up on the road—
Crawling on my summer robes.

Getting Out the Good China, I

Hohhot, Inner Mongolia, June 1997

May 30 I am in Switzerland for a scientific meeting at the University of Zurich. The organizer told me no one had ever accepted an invitation to speak in Zurich because it was on the way to China. There is some confusion at the terminal when I am leaving; finding Cathy Pacific is not obvious. (Why, you go to Swiss Air, of course!) I had called ahead but now the airline does not have my re-confirmation. That is problematic as the flight now goes first to Frankfurt rather than nonstop to Hong Kong. (The Rolls-Royce engines in the Airbus planes that Cathy Pacific uses have had some instances of failure, and Hong Kong has forbidden their use.) The counter clerk panics, but soon I have an assigned seat. I wander the airport, buying some chocolates to give to my hosts, at least that is my rationalization. You must spend those solid Swiss francs!

The flight is the usual international overnight journey. Leaving at 11 a.m., I will be in the air for 12 hours, one hour to Frankfurt and then 11 to Hong Kong. I am comfortable with plenty of leg room in the upper deck, but I don't sleep. But with lots of rest I feel okay the next morning as we land in Hong Kong. The clouds hang in tightly so I only see a little of the world as we slide down to the runway. That's fine; I will return for a few days stay in a couple of weeks, making that more novel. I have a three-hour layover in Hong Kong.

My bag is checked to Hong Kong, and because China is another country my bag is stuck in Hong Kong territory. I ignorantly crossed into China without collecting and re-checking my bag. I could enter Hong Kong, which would be a hassle, and pay a \$HK50 fee to come back into the international terminal. The ritual is that you must get reconfirmed onto flights to China.

This is because their system does not link to the outside world, never mind *I bought the ticket from Air China*. When I do this, I have my first experience with Chinese lines, people ignoring all signs, and other people arriving and going to the head of the line. A woman does this when I am finally at the head of the line, and I protest with the encouragement of the Chinese men behind me. She finally acknowledges me, barking out words not understood by me. Finally at the counter, I explain my baggage situation to the clerk, and she takes my passport and tells me to wait. After an hour on the nearby bench, during which I nervously and repeatedly go to the counter to check if I can see my passport which I have reluctantly given up, with much pomp and display of identity I am escorted with others across the international border into the baggage-claim area. The Chinese lady I had challenged is among the others, and we become allies in anxiety while we eventually locate our bags. And then I take my passport back with great relief. I recheck my bag to Beijing, buy a duty-free one-liter bottle of single-malt scotch, and wait for my flight.

Finally I am underway to China on a three-hour flight. In a window seat, when the clouds of coastal Hong Kong clear, I can see China, vast and populated. My brother Charlie, who has lived all his life on the family ranch where we were born in western Oregon, was host to a tour of Chinese agricultural officials. He described telling one of the officials how to make quality grazing land.

“Burn,” he told the Chinese men. “You gotta burn, every chance you get. If you keep your land burned, then you will have good grass.”

My brother had no idea what this huge country faces, nor how varied its landscapes and weather are. In the humid hot steamy south for most of the year you couldn’t burn a square yard of land with a blowtorch, and in the grasslands of Mongolia there are sometimes fires that cover hundreds and even thousands of square miles. It is amusing to think of this while high over this country about which I am so curious, as I know hardly more than my brother about what I see below me. Clouds reappear and I doze a little, thankful for this bit of rest on my endless journey.

We land in Beijing, and as we taxi in, I see workers on the landing field digging a ditch in the concrete *by hand*, using picks and shovels and wheelbarrows. Some appear to be working hard and someone is sweeping with a broom of twigs. Two women cover their ears from the blast of our engines; the men, just as men everywhere else, are far too macho to protect themselves. I have never seen anything so primitive appearing at a major

country's airport. I find my bag at the terminal and go through customs without trouble. Then I wander through a sea of taxi drivers and guides (all trying to snag me) to find the area for domestic China flights. I have a five-hour wait, there are almost no seats and those are all over-occupied by large Chinese families. The wait seems endless—I have been on the road for 22 hours.

I find a cart and drop my bags onto it. After pushing it about the area, I find a way to sit on it without hurting my rear end too much. Roaches are scurrying over the pitted bare-concrete floor, and they dodge under my cart. I hope they are not crawling up my pants leg; I'm so tired it hurts and I just don't care enough to check. The flight scheme seems to be that the flight is announced about an hour before departure, and then folks queue up to check in. There is much crowding ahead and a little shoving. Chinese lines appear to be a vague and dynamic concept. Finally I see the flight number for Hohhot which is my destination in Inner Mongolia, and I am third in line. But the counter is broken and it takes 20 minutes to get to me. The agent looks at my ticket (which is nothing like what the other customers have) and smiles and says, "No good. Must reconfirm." I protest and ask what he means, but he is no help. "Must reconfirm." What the hell? I look around, and at the edge of the row of ticket counters are two pretty women at a counter with an English sign that says FIRST CLASS. I go to them, and a well-dressed woman tells me to exit this area and "Go to Window 21." That works, I get a seat and return to the end of the Hohhot line properly ticketed. It is possible that I could have missed my flight, because until you are entered in their system in their way, you do not have a seat. This is indeed a foreign concept to me.

Then I undergo another intricate ritual. At Gate 20 (and the numerals 20 are all I recognize) is a bi-level arrangement. I go below and find a milling crowd and a list of flights written in chalk on a board—at least they may be flights—and again I detect numerals for flight numbers. So far so good. I am now 28 hours into this without anything that could be counted as sleep other than one brief nap. As flights are announced, the people mob (or is it just another Chinese line?) out to a bus that I assume takes them to their airplane. I develop a one-flight one-bus theory. Then it seems that my flight is not called in order. I am anxious; some version of English (Chinglish for Chinese English) sometimes comes over the loudspeaker which is as low fidelity as an old 45 and would be incomprehensible to me even if I could hear what is spoken. And then the one-flight one-bus theory is clearly violated,

and I am as panicked as I have the energy and neurons for.

The wait becomes endless in my time frame, but then I seem to be on the correct bus, driven out through the humid smog in the darkness. I feel as if I am in some surrealistic film-noir drama. Where is the villain? And where is that woman who deceptively seems to be the heroine? The plane is full; fortunately I checked my bag. I am at a window seat again, do foreigners always get them? It feels like flying in the rural U.S. thirty years ago. The plane is old, and the announcement comes in Chinglish too, which is amazing as I am the only non-Chinese on the flight, and it is obviously a painful experience for the speaker. But I am too tired to listen after I hear the word I have come to think is Hohhot. (The double h's receive some guttural throat-clearing sound.) The language depends on tones that I cannot accurately hear, even when they are spoken in isolation. I wonder if my brain could ever learn even to hear Chinese. I find the Chinese language more beautiful as I go into China, now into Inner Mongolia, going on nothing but nerve and inertia.

When we come around through clouds to land, I feel insecure—no computer is landing this plane. It is bumpy but by god here we are: Hohhot, Inner Mongolia. Collecting my bag, I walk along noticing several uniformed armed Chinese soldiers. Then I am relieved to see a **ISMB97** sign with three Chinese who greet me. The International Symposium on Mathematical Biology. Whew, I made it! A girl Ali speaks English and seems to be serving as a guide. It is now 10 p.m. and 31 hours after the Swiss-French train station in Basel. Every fiber of collagen in my body aches.

We go to a car and drive through the mild night on a dusty bumpy raised roadway with a line of trees flanking each side. I might be in the Utah desert for all I can see of the countryside. There are big holes in the road and some dangerous-looking traffic; sometimes the lights of approaching traffic are on bright, and sometimes the lights are entirely off. And traffic seems randomly assigned to either side of the road. Bicycles appear, weaving along the road in and out of the headlights, and the drivers dodge them. Occasional roadside houses have lanterns with Chinese characters. We come to a paved road with more houses, and with jarring regularity, the road is bisected by a ditch just the right width to catch a tire. No wonder the cars and trucks appear to be wrecks.

The hotel is a contrast to what I have seen of the city: a uniformed guard on the street, a curved drive, and a stop before a modern-looking hotel. As I enter the lobby, walking on what must be new marble as the hotel is still

being finished; I can hear the saws whining somewhere, and there is a smell of glue and building materials. The elevator has a uniformed Chinese girl who is lift operator. We get out at the 8th floor where the registration desk is. I am handed a ISMB satchel (which of course I will never use again after the event) and a packet of information materials. I meet two young people: Steve Brenner and Ulrich Hansmann who know me although I have not met them before. They have been on the grasslands tour and have divergent opinions with Steve glowing from the experience and Ulrich depressed about it. They got back yesterday.

I am informed about breakfast, lunch and dinner. Breakfast is from 6:30 to 7:30 a.m.; I won't make it, no way, I tell them. The girl Ali ignores that but is persuaded to take me to my room on the 11th floor. It is a big room with two double beds, a modern-looking bathroom, a color television, and the smell of new carpet strong in the air. Even though I have a cold, the odors penetrate. Maybe I should be glad I am ill and can't smell too well, but I am overjoyed about ending my marathon trip. Ali supervises the arrival of a big thermos of hot water, and I pour a cup of yellow tea. Asked if I want something for a snack, I say yes and receive a loaf of white bread, sweet and good, I am told, and a few tubes of some meat substance. She leaves, and I eat some meat and try the bread which is like heavy angel-food cake, unique in my experience. Swiss chocolate and this bread are a great combination, and my hosts will not receive my "gifts" from Switzerland. Then I take a bath since I cannot determine how to work the shower. Every time I use the water in my week-plus stay, it runs an awful discharge of rust for a minute or two before clearing. They might not have all the details of modern plumbing completely worked out. And there is no control for the modern-looking TV. To bed finally, with a big splash of my single-malt whiskey in a Chinese teacup.

June 1 The telephone rings at 6:30 a.m. "No, no, I really do not want breakfast. No breakfast." Ali tries to move me to the schedule she has set, but I cannot get up, I will not get up. Very tired still, I have a sore throat too. The telephone goes off again at 11:30 when I get up, take a bath and drink some lukewarm tea from the wonderful big green thermos. Then down to the lobby for lunch. I enter a series of rooms with deep red carpet and girls dressed in classic Chinese dresses with the slit up one side. Perhaps the effect is supposed to be sexy, but the girls are innocent children and the effect is somewhere between touching and a bit sad. But I may not be typical. This

is my first glimpse of the genuine innocence that will crowd my next days.

I am seated at a big round table with the other foreigners, *the foreign guests*, as Ali refers to us. She introduces three other students to serve as our translators: Barbara, Victor, and Linda. (They have taken English names which they say is to make things easier for us.) They are pleasant and speak English very well. They are students from the Department of English Language and Culture at Inner Mongolia University. Their teacher is good, no doubt. Linda and Barbara sit with the white people. The ubiquitous tea and starters are spun around a big lazy Susan. Then comes ten courses. The food is good and there is far too much of it. Some of the dishes I cannot identify, parts of some variety (by which I mean unidentified portions of unidentified creatures).

The Chinese, sequestered at their own big circular tables, are excited about an event soon to take place live on television. A vibrant Mrs. Yang, in her 60s, integrates and enlivens our table. She explains what is happening. The Yellow River is the only local big river and is a major river in all of China. Some Chinese version of Evel Knievel will jump the river in a car. I immediately think of Knievel's famous failed attempt to jump the Snake River Canyon at Twin Falls Idaho and wonder if we are not about to see a disaster. The way the Chinese say, "Yellow River," I know it is a serious symbol in their lives. I go to my room, find the channel, and see a mundane static river scene. The car is mid-air for about 1.5 seconds and the leap is successful, if also downright dull. The channel reruns it several times; I am glad I saw it, however brief it was.

After this excitement, I join Steve Brenner and a German named Ulrich with his Chinese girlfriend to head out and explore Hohhot. Much taxi negotiation goes on in Chinese and then we travel along crowded streets barely missing oncoming traffic and scads of bicycles. There are hundreds of bicycles to every car, and chaos is universal. Eventually we arrive at the Temple of the Five Pagodas. It costs round-eyes four yuan to enter, much less for the Chinese. (We meet this dual pricing scheme throughout China: gouge the foreigners, it's the law of the land. But the amounts converted to dollars are so small that it is hard to resent the duality.) This temple was built in 1740. There are Chinese, Mongolian, and Sanskrit characters written across the front of the building. I fall permanently in visual love with the vertical Mongolian script that competes with Chinese writing in Inner Mongolian. This skyscraper writing has a long wiggly downstroke with short horizontal strikes and bumps. Visually appealing, it draws my

sympathy to this doomed culture. (For the Mongolians are now a conquered and diminished people, mostly present in token acknowledgment rather than in substantial numerical counts.) We climb up through a narrow vertical twisted tunnel never intended for someone of my height and emerge atop the five pagodas. I look down into a street lined with roadside businesses, paved, and has no cars. And into a bare-dirt backyard which I snap a photo of with piles of adobe bricks and rubble. There are a couple of signs, modest and small. It turns out that it is a hotel, but not for foreigners, as probably the people running it have not yet been trained to charge enough.

Then we walk to another temple, first along the street I was gazing at, then through narrow dirt streets among adobe and crumbling brick and rickety shacks. I am fascinated to be walking right through peoples' lives. The Chinese here are impressed to see us, white and weird as anything they have seen recently. We stare right back. There is no animosity, no anger, no resentment, just innocent and honest curiosity. It is not the feeling I have in some poorer countries, and I like it. There are vendors selling sewing beads, live fish, dead fish, meat parts of whatever critters you can imagine, fruits including some unlikely pineapples (how did they get to this dusty clime?), spices, bicycle parts just laid out on a greasy cloth, cooked foods, I have a cold, but I can smell this; some of it great and some not so nice, like what rises from buckets of human waste.

We come onto a former pagoda, the elaborately painted arch still extant, but the hubbub is not from prayer chants but from a school and a crowd of old men playing mahjong. Called the Great Mosque, alas its greatness has passed. Vendors surround the area, and the produce, spices and food sold by the hawkers is appealing. A most vital scene and I am charmed.

We pass by adobe rooms and see casual and intimate family scenes, and more often businesses, people sewing at old worn-out machines and manufacturing god-knows-what. A man on the side of the dirt street wrenches in vain at a mysterious mechanical device deeply shrouded in soot from the coal fire he has used to heat it. Signs and symbols of telephones signify that the passersby can locate a phone and use it for a fee, sometimes the only income of the occupant. One corner shop has four workers, heating and pounding metal, blacksmithing as we did in the rural U.S. over 100 years ago. There are piles of vegetables, including a heap of green chiles just like we have in New Mexico. The people in Inner Mongolia are not much into hot chiles and spicy food, and I exclaim to my companions. A Chinese choosing his chiles sees me, and even though we have not one word of language in common, he

knows just what I am saying, and he raises a handful of chiles, grins and points to them. I make suitable gestures in return. I wish I could sit him down to a chile relleno with tortillas and beans at Rancho de Chimayo in northern New Mexico. We'd wave our arms, point at that glorious peasant food, and drink from long-necked bottles of cold Mexican beer. Who needs spoken language?

In a few hundred yards we enter Xiletuzhao Temple which costs us two yuan. It has two small bell towers where for another two yuan you can ring the bell. We pass on the bell ringing. God knows how we would fare without this sweet skinny Beijing girl. Steve says the Chinese people on his tour were interested in the relationship between Ulrich and this girl. Not too hard to work that one out. They are lovers, no doubt about it.

The grounds of this temple go on and on. The place was closed during the Cultural Revolution, and the old monks did not return until 1982, the new young monks in the 1990s. Formerly over 3000 monks lived and worshiped here; today there are 19. We see the Buddhas of the Four Directions as we enter, a pretty lively lot they are. Then there are commercial shops for trinkets, more 7-11 than Walmart. I am not much of a shopper unless it is for food, wine, or paintings. And books. They aren't selling many of those things here, but you can buy enough fragments of jade or scraps of cloth to fill your suitcase. In the long courtyards are decaying fluttering prayer flags, Buddhist trappings. I take some photographs as the textures are marvelous, which for me discounts the religious meaning altogether. To stave off bad luck, our Chinese girl tells us, the people call for a strong wind to blow away bad luck. With my Oregon childhood, I should be free of bad luck for a full and long lifetime. Perhaps I was missing those prayer flags.

Walking back on larger busy streets, guessing at the direction of the hotel, which is miles away, the bicycles and motorcycles and rickety autos clogging the street honk and clang and come perilously close to collisions which all participants seem to know will not occur. Hundreds of bicycles clutter the roadside, not a kryptonite lock in sight (nor any other method of preventing theft). Children are buzzing around an entrance across the road. We get across the street with our limbs intact, but it is a pulse-quickening hop, skip and several jumps. We are at "The People's Park" on June 1, "Children's Day." The entrance fee is five yuan, which is about seventeen cents US. Inside people stir about with their children, their single child due to the one-child limit. The children are well-dressed and well-loved. We are a sight to these folks, and as has been the case all day, we are openly stared at.

Back at the hotel sitting in the lobby before we set out on our afternoon adventure, I wondered if a nearby structure that was obviously to be a fountain would be working before our week was over. When we return, water is splashing down a rock wall and the pool is filled. In the next week, it never works again. Dinner is at 6:30; some girl-children in slit dresses make sure we go into the correct room and sit at the white-folks table. We are among the first people to eat in these rooms.

June 2 I skip breakfast and sleep from 10:30 p.m. to 7:30 a.m. Maybe I'll recover from the jet lag. Even my cold appears to be better. In the lobby I find someone else attending the conference, and we head out into the roads about the hotel grounds. Eventually we come to what is labeled in English as "The Long Corridor." There are various narrow rooms off the long hallway, some filled with dusty maps, others with old sewing machines. Our meeting room is long and narrow, with a long table covered with a white tablecloth. Sitting there are big green thermos jugs and teacups. People subtly insist that I sit at the table. Surrounding the perimeter of the room are comfortable-looking chairs which I covet, but they are not meant for the likes of me. I soon learn that I am expected to do certain things, such as sitting at the table at prescribed seats, and while I am never directly told of these expectations, I will be pushed and bumped and nudged until I get the message.

The talks are all in English (or more accurately, in Chinglish). Various foreign speakers canceled including the notable Lewis Wolpert from London whom I was looking forward to meeting.

After morning talks, I am awake and prepared for another ten-course lunch, this one more parts laden than earlier, including chicken feet and pig stomach. They do vegetables very well, but often the fish is stale.

In the afternoon, I go with others by taxi to the nearby branch of the Bank of China. We are to pay the conference fees, which are healthy, to cover what they are spending to put on the conference. For a while I resent paying; usually when I am an invited speaker I pay nothing, and I expected to pay nothing while inside China. But I decide life's too short for such carrying on and recall that I came here on a whim and should enjoy myself. Still, instead of paying in cash which would have shorted my fat roll of yuan, I refuse, and they must maneuver a credit-card arrangement. As usual I relinquish my credit card and passport (for no good reason as it is returned before the trip to the bank). At the bank, people cashing traveler's checks

go with their passports in one direction. We with only credit cards go to the Charge-Card window. Our Chinese girl combats a chunky clerk who ignores her for some time. It is as if she hopes we will give up and go away. I was told a Visa card is OK, but when I see an American Express card sign on the plate-glass window, I switch to my Am-Ex card, and hand that over. After five minutes they return my Am-Ex card, saying it will not do. (And it is a gold card; I am heartbroken.) So Visa it is. There is much reading of my passport, which praise-be is new, only a few months old, and examining the credit card and my signature. It is not exactly electronic commerce. The credit card slip is in Chinese but only the top line is filled out. I object and it takes ten minutes to receive it with several % in what I know is the “tip” line, and a total at the bottom. I do not read Chinese but I do like to see all the numbers revealed. I sign, trying to recall if my signature on the Visa card has an “S,” my middle initial that does appear on my passport. They take the paper away, and again I have my credit card and passport. Whew! It is another 10 minutes and they return with more fuss:

“You must do new charge. 50 cents missing.”

“How about I give you 50 cents, cash?” I reply.

This causes some rapid and intense conversations. Then 50 cents becomes 58 yuan, twice the exchange rate. Oh well, I give up! But new negotiations with other scientists take place, and I leave with my cash intact for the present anyhow. (It is collected a couple of days later.) I am beginning to enjoy these games and might make a new career of standing in Chinese lines. “Hey you, stop crowding in front of me!” I could write an article: “The Theory and Practice of Lines in China.” In the years since I have observed changes in this activity and also regional differences, so perhaps today the article should be “The Evolution of Lines in China.”

June 3. Tonight we have a “cultural event.” After the obligatory and customary 10-course feast (and oh my god tomorrow night is the banquet), we embark on a bus, my knees jammed far into the dingy seat-back in front of me.

This afternoon I was presented with a cashmere Erdos-brand sweater, “a token” from the local conference committee. They seem to have noticed that I have come for the entire conference instead of arriving late, and I flatter myself that they like me. (“I get on with the Chinese,” I have claimed in the past. This trip is to put that presumption to the test.) These people seem so sincere and genuine that I am charmed. I was presented the sweater by a

petite young woman, Barbara, and she sat by me on the bus to the event.

“I tried the sweater on after you left,” I explained. “I was afraid to try it on when you were there, that it might be too small and then would embarrass us both—but it fits perfectly. In all of China, how could a sweater be large enough for me? How did you do it?”

“We discussed this problem much and we have estimated your size,” a bright young man to my left interjects.

Then I talk about Paul Erdős, the celebrated Hungarian mathematician who died recently. Advertise in a Western mathematics publication, I tell them, you’ll sell hundreds of sweaters. Imagine an Erdos sweater with your Erdős number displayed!

We get off the bus, somehow having parked without smashing a herd of bicycles, pass a portable blacksmith shop with an adjacent bicycle repair shop, the collection of parts displayed on greasy cloth, and walk down a dingy dirt alley. I love this place! We enter a small shabby theater and being the tallest, we are seated in the front row. Yes, this being a foreign guest is hard work, and we must sit in front, blocking the view of shorter people sitting behind us.

The mistress of ceremonies could star in a Hollywood movie. In a red slit-up-the-side brocade-trimmed dress, she is upbeat and speaks with bright tones; there is no side curtain, and I watch her during the acts: sullen, sultry, sexy, and drop-dead gorgeous! And there is nothing innocent about her, in contrast with the servers at the hotel.

The orchestra members are dressed in what I imagine to be a combination Cossack-Chinese dress, and leather boots too. (Remember with all this native-culture talk, the majority of the population in Inner Mongolia is ethnic Han Chinese.) A small wooden box (that folds up) is played by delicate sticks, and there are two stringed instruments with a wooden cylinder attached at the bottom, the bow *inside* the strings, one cello-like instrument, two mandolins with bows, and two horse-headed fiddles with manes; ten musicians altogether. Wailing rhythmic sounds, lovely and transporting.

The men’s dancing is robust, and they do one number that reminds me of the physicality of Polynesian men’s dancing. The women dancers wear tights under skirts, sexy and physical and straightforward—complete knowledge, eyes wide open.

Our own Ali translates the siren’s introductions so I get a faint idea of the song topics. One woman sings a herding song, but it sounds more like wind through tall grass than yelling at a herd of stock. And another song

is titled “Two Horses of Genghis Kahn.” I would like a copy of that song with horses running all through it. And a song to the Yellow River, a big presence in a country without much water. A woman does a dance of 10 teacups, and yes they are all balanced on her head. I would have enjoyed it just as much without the cups; they are a gimmick that catches us at the get-go and irrelevant by the dance’s finish when she dances them off one by one to conclude. The last dance is the Men’s Lion Dance. The Chinese never had lions, and knowing something of them, they improvised, coming up with marvelous creations. This is one of them.

It is a triumphant evening and not quite over. We go to the stage, and people snap photos, me standing by the announcer. Do you suppose the sexy mistress of ceremonies wants to live in Los Angeles?

June 4. This is the morning of my plenary lecture. I can almost find the Long Corridor without getting lost. I am early as usual, by which I mean I am on time. The crowd assembles and I can start. Here is my prepared introduction:

As many of you know, I live in Los Angeles. I have not always lived in a huge city. As I have remarked to some of you, I grew up on a ranch in Oregon where, riding a horse, I herded sheep and cattle. It has been many years since I did that!

So you will forgive me if my favorite talks at this symposium have been those about grasslands. Hao Dunyuan has direct experience with the species of grasses. He has held those grasses in his hands; he has smelled them out in the open air.

Last evening there were songs about the grasslands and horses. You could hear the rhythm of the horses’ gaits. In America there are certain songs known as cowboy songs. The genuine ones have the authentic beats of the horse’s feet; the others do not have that. You just can’t fake it. “Genghis Kahn’s Two Horses” had horses at various gaits running in several directions. I loved it; it is the most complex cowboy song I have ever experienced. Herding songs from the American West and Inner Mongolia share these things. I also loved the beautiful song about herding sheep, but I can tell you from experience that it was far too lovely to move the sheep. The singer sounded much more like the wind blowing over the prairie, bending and turning the grass.

It is a privilege to be here, see a little of your culture and find that I share a bit of it with you.

Well, midway through my nice little sincere speech I realize no one in the room is tracking what I am saying. After you teach enough undergraduates, you develop an instinct to recognize incomprehension. Well hell, I like what I am saying and don't let a little thing like no audience understanding throw me off-track. (Probably I am the only person in the room who has ever ridden a horse. No wonder they look blank.) I have a distinct impression that my scientific lecture is just as well-understood as my introduction, which means it is not understood. But most of the speakers are incomprehensible in English so I fit right in.

In the afternoon we make an excursion to a nearby historical site, the Tomb of Princess Zhao Jun. This remarkable woman, when 18 years-old, married a tribal chief, giving up "civilized life" to bring about peace among the nationalities. The Han Chinese admire her coming here to live in a tent with the so-called barbarians. Many stories exist of her beauty: so very beautiful that the birds stopped singing when they saw her, the birds were so amazed. I am told several of these charming cliches, and I think that my sources see them as exactly that. The grave is somewhere under a 100-foot-high hill built for this purpose. Of course, her remains are not here, but everyone pretends to believe they are. Atop this artificial hill you can look for miles over the flat surrounding countryside, which is used for agriculture and houses. I take a couple of young people on a walk around the base of the hill, and they are uneasy; no signs tell us where we are going or why. I point out that being lost is impossible here and that I want to see the nearby fields. They treat this tiny adventure as if we are greatly stretching the boundary of acceptable behavior. And perhaps we are. Back at the entrance area, a collection of calligraphy is displayed in some rooms, and my hosts attempt to explain this cryptic art. I will never really understand this, although I have seen a good deal of it before. My eye is good enough to classify some varieties, including ancient script. I recognize the symbol of man.

This evening is the Conference Banquet. I sit at a big table and then summoned to the "important people" table—I cannot refuse although I go with a foreboding sinking feeling. To combat that I put on my energetic positive aspect. It proves inadequate to the occasion. At the table is the University of Hohhot Vice President whom I immediately decide to call VP in my private thoughts, Professor Luo the conference head, the Mathematics

Chair who is a genuine Mongolian and I suspect an entirely political appointment, another man whom I think of as the Ancient (he once did something in biophysics, just what no one seems to remember), and the much younger wife of the Ancient (no, no, she must be his mistress) who sits to my right. And the ever-energetic Mrs. Yang who infiltrates the table, God bless her, not even these stuffed shirts can keep her away or stifle her good cheer.

Wine and beer is served for the first time at the conference. There is not nearly enough alcohol to dull my pain at the awkward strained social situation. Professor Luo gives a Panglossian speech: "Everything is better than the best and continues to promise a rosy future where things will constantly rocket skyward."

And such stuff. He seems to believe he has founded biomathematics. I am forced to the microphone where I mumble a few ill-chosen but intense words. If I had just known, I would have saved that heartfelt speech I wasted this morning and would have broadcast it to these uncomprehending ears. At least then I would have had something to say. Shortly after this, all the Mongolians and important Chinese are singing, one after the other, I swear to god, taking turns at the microphone, singing their hearts out. It is the first time I see this amazing trait in action, and it is not to be the last. The VP does an entire opera, a Chinese opera, belting out both the male and female parts, the latter delivered in a marvelously screechy tone like a shovel scrapping across the back of a dumpster. And apparently all Mongolians can sing and sing they do, one after the other, taking turn after turn, and then back around again. Even the poor soul who cannot carry a tune acquits himself very well. I sink further into my hard seat.

Mrs. Yang cannot contain herself; she is so moved that she leaps up and seizes the microphone. She delivers the old quote about enough water floating everything up. (In my mood, I hope for universal death by drowning.) Then she represents the Chinese people by the making a cock's crow at dawn. She is one of my favorite people at the conference, but it is easy to see that she would follow her nation down any road whatsoever and salute smartly as she marched along. She does yet another song of the Yellow River.

This banquet was unique in all my conference experiences. I am left at the table after things finally quiet down and have a chat with VP who acts interested until some certain time point known only to him is reached, and abruptly he says, "Enough," in the middle of one of my sentences. The VP gets up without another word and leaves. Probably I should have been an ambassador for George Bush; I couldn't be less of a success even if I were to

throw up on these people (as George HW Bush did in Japan).

June 5 The conference winds down at noon. Having guessed I will be asked to do everything that Wolpert would have been asked, I notice that he is to give a closing address. Well, I am a slow learner but eventually catch on, I hope. I sit down the night before with tea cups of Scotch whiskey and write a closing address. But when the time comes, Professor Luo (probably deeply disappointed that I had performed so poorly when he had called on me the night before) says: “We have three minutes to meet the bus so that we can tour the University.”

I realize all my preparation is for naught, and I leap up saying, “There is zero time, but I wish to, on behalf of those I have learned to call the foreign guests, thank the people who ran this excellent conference and for the warm welcome to your country. And a special thanks to Professor Luo.” I then lead a round of applause, much more appreciated than my moral platitudes would have been.

Then out of the Long Corridor for the last time. I enjoy doing something in this life that I can survey and, say to myself, well, *that* won't ever come by again! The Long Corridor is one of those experiences. We go to the bus and ride a few blocks in bright sunshine to Inner Mongolian (or Hohhot) University. My knees as usual are two inches into the seat-back in front of me. Hohhot U. has 6000 undergraduates and 500 graduate students, including a few PhD students. The marble facade at the entrance is imposing: *Inner Mongolian University* spelled out in English, Chinese, and of course those dashing magnificently vertical Mongolian characters. We are posed in front of the facade for publicity photographs, then, as usual, we are not allowed to walk about freely but instead are bussed by the sights of the small campus. China has designated 100 universities to take it to glory in the next century. Hohhot University is one of them; I suppose even an Autonomous Region such as Inner Mongolia must have at least one, and Hohhot is Inner Mongolia's only university. It was a done deal. The biggest and best building on campus is a classroom building. I offer the observation that in the West, especially in the States, the administration almost always occupies the best buildings. “Oh, they were in this building before they moved.” Some things are universal truths; the administration probably has the best building at the University of Mars. With my agricultural and Land Grant University background, I am pleased to see the tiny (and dingy) Animal Science Building where they even have pens for livestock.

At the hotel we eat what has become our routine 10-course lunch, and are then scheduled to make the Grasslands Tour, a two- or three-day affair, all the traveling to be done by bus. Some bags must be left with the hotel and plans for doing this are made and broken several times. I am becoming accustomed to my complete lack of control. There are at least two layers between us and the hotel. First and most pleasant are the English Language and Culture students. Then comes a group run by a crew-cut fellow who must have loved the Cultural Revolution and being a party leader when you could really boss people around. And his people include an attractive woman who dresses with a great sense of style and in more expensive clothing than any other young person I have seen here. Probably she is reaping the benefits of power, but this is beyond my abilities to find out. (Of course I make oblique inquiries.) Directions to us and our objections to them have layers that foster miscommunication and alteration of the messages. This is an interesting system which I am not well-suited for. What finally happens after re-re-renegotiation of the plans, is that we *all* go to our rooms. I wait until a member of the first layer, one of the Language Students, Victor, comes into my room with a member of the third layer, a hotel employee who takes my bag. The “left-baggage” is then tagged and entered into a book that I sign. It is typical that I do not receive a claim ticket or receipt. Those in authority retain such things. That’s what they are in authority to do.

Then we are off on our “Grasslands Tour”; I paid \$300 for this two-day journey to the lands of Genghis Kahn. I am told that we are riding in the finest bus assigned to the University of Hohhot. My knees are just against the seat in front of me: I have gained several inches advantage from the earlier busses. It is a relief as we are tightly stuffed into this box. All seats are occupied, luggage is jammed into the space overhead, and boxes of gear and bottled water are stacked in the aisles. We were told to use the facilities before we left as there will be no restroom stops on our journey. These people are used to seeing bodily needs handled on the edge of public scenes and are not shy or demure. They are just trying to be sensitive to us delicate Westerners.

And then we begin the tour. The bus (which is none too new) grinds and weaves through the busy city streets, honking on all sides, making its way through swarms of cyclists who miraculously escape being crushed, hundreds of bicycles all surviving to congest again, hauling goods and, in one amazing case, whole sheets of plate glass. The engines of this Chinese city are its citizens weaving through the streets on bicycles.

I imagine a young Chinese man riding his bicycle through these streets: his child balanced on his wife's shoulders, the child tossing a ball from hand to hand, his wife sitting perched on the handlebars with her legs tucked up, tonight's noodles and a sack of rice balanced on her knees, his parents riding behind him, adobe bricks for home repairs solidly resting on boards between the parent's shoulders, the sacks and mounds of vegetables riding atop the adobe bricks and some chickens stirring about the vegetables, everyone talking at machine-gun speed and intensity, just a typical Chinese family out for a spin.

Out of Hohhot, we head toward Baotou City, the center of the new steel industry, 135 km away. That drive from Hohhot to Baotou strips away some of my romantic notions of China. Abject stark poverty is strewn along and across the battered blacktop road. The city of Hohhot is far richer than what I am now seeing. There it is: rubble everywhere, bare dirt and garbage before the tiny dwellings and the ragged little businesses. Bicycles weave along the road, riders not seeming anxious to go anywhere in particular; motorcycles haul heavy goods and wretchedly thin animals with raw open sores pull donkey and horse carts. Decaying adobe, broken windows, abandoned buildings (and dreams, perchance?), sagging scattered heaps of sand and coal, bricks strewn about, various walls in frozen states of construction while other nearby walls erode, their brief day over.

And scattered along the road, people are standing in groups or alone. They might be holding tools, shovels and picks, and sometime somewhere someone might be working, but you could get rich betting against seeing that. It is a warm enough day, not hot, and cyclists stop to rest, sometimes leaving their bikes in the road so that the drivers swerve around them and once again sound their meaningless horns. People are out in the fields too, fields of corn or tomatoes, wheat or barley, fields sometimes ditched to carry water, although water appears to be in short supply. On our right low dry mountains run parallel to the unseen Yellow River, the Yinshan mountains, which I finally learn by map and elimination separate me permanently from the true grasslands. But right now I have hopes of huge empty ranges of waving tan grasses of summer, and those hopes are dashed by the bleak scenes that unfold endlessly before me. The people in the fields just seem to be there, not working but holding some implement that might be someday used to dig or hoe, but not today. In one field a mule-drawn plow scratches the earth. The very air smells of burned scorched smoke, and I sink into a deeper and deeper depression.

The two grand buildings between Hohhot and Baotou are Buddhist temples, one down a beautiful green lane behind elaborate gates, and the other a huge complex high up on the mountainside. Buddhism is looking less and less wonderful to me; let's feed these folks, say what! Whatever could lift up this complex of dirt and manure and hunger?

Vehicles drive wherever they want, although there is a slight rightward tendency. Alone on the highway (and seldom are vehicles here alone) with a center line (which only a few feet of roads here possess), the typical driver centers himself and perhaps drifts a bit rightward but only ever so slightly to the right. Exactly why they do this I do not know. If a driver comes up on one of these road hogs and wishes to pass, he moves to his left, honking and beeping with what I came to call the left-lane beeper. Maybe the vehicle will move right, or maybe he is thinking of tonight's noodles and stays put, cruising the center line. Soon appears an on-coming vehicle—which might be a horse-drawn wagon full of coal—and the lead vehicle will then move rightward. Then the follower has a brief chance and can pass honking and beeping all the while. It is loud raucous endless tension-filled drama. Roads at intersections or villages are clogged with bicycles to provide continuous noise and emotions, although I cannot vouch for the involvement of the participants. They just seem to go through the motions. It's a ritual perhaps and maybe they enjoy this seemingly random driving and dodging. For three days I study these phenomena and try to deduce the rules, laws, and customs of the road. I locate the only law of the road, and I offer it here free of charge, although I had to dig far and deep to extract one truth.

When meeting oncoming traffic, stay to the right, eventually, no matter what you have to run over to do that.

And the driver might move to the right onto the sidewalk, or the oncoming car might be on the sidewalk. And mind you, with non-motorized vehicles, there is NO rule whatsoever. Amazingly there are plastic, full-sized statues of traffic cops, fully as tall as I am, placed beside the road every so often to put the fear of the law into these bicycle and cart drivers. Yeah, sure, the fear of plastic men, it's surreal. The statues are universally ignored. (As with so many things in China, over the two and a half decades since this was written, driving practices have evolved from bicycle customs and have regional differences. The number of automobiles grew exponentially.)

The bus comes to a stop before Baotou, although I distinctly recall that no-stop announcement before we set off. We all get off the stuffy bus. There is an arch over the highway ahead, but that isn't what halts us. The stocky macho bus driver takes pliers and screwdriver to the rear where I can smell and see diesel leaking. I walk down the highway along a stone fence to a metal gate where some man in Communist Party dress is slowly peddling a bicycle down a gravel road away from the highway. He halts, seemingly out of energy, to stare off into space. It is not an uplifting scene in the heat of this broken-down afternoon.

My fellow passengers head in the opposite direction toward the arch, and they find cold popsicles and ice cream at a stand, but I don't catch onto this soon enough. Back in the bus I wonder what the driver has accomplished. No one seems to know. I feel dry as a bone and open a bottled water from one of the crates stacked in the bus aisle for people to struggle over. I've been happy at various times on treks in the wilderness with warm but clean water, and once or twice with water that was hot and dirty but at least wet. Hell-be-damned, as my father used to say, I wish for one of those frozen sticks of ice cream.

We head east now, a left turn in Baotou City, then grind through some rather energetic squalor, where people are milling listlessly about while others bicycle, animals draw carts into the mass of carts, cars, trucks, and bicycles that swirl endlessly around. The worn adobe is leaking away in this city, and I decide their lives have run into the open sewers with dirty water and human waste. We are now three hours from the shining metropolis of Hohhot.

Emerging from the twisted streets, we begin to meet more and more of a species of large blue truck-and-trailers piled high with boulders of coal. These are to feed the steel mills, and it is a sobering thought. What is going on here? Are they moving mountains of coal? The answer is obviously yes. We come to the much-loved and much-sung Yellow River, a symbol and lifeline of Inner Mongolia. It is not yellow, but it is darn muddy and big and slow and very obviously wet. Not Columbia River big, but a genuine river, not just a trickle down a sandy wash. The land becomes more arid, and we reach Dalad B., the site of a huge twin-towered power plant. I am convinced that the two big cooling towers signify a nuclear power plant and is not coal powered, and I sink deeper into depression, thinking of the radiation exposure the locals have from this monstrosity. There is one shiny hotel local to the plant, but this dismal un-watered city is poverty and power-plant. Not even the TV show "The Simpsons" could satirize this place; it is too real for irony. That

intensity marks the long trip, now at four hours and 6 p.m. We have miles, no it is kilometers, to go before we sleep. I learn later that the plant is coal-fired power.

The landscape is more barren. Su Guo Du from Singapore sits beside me on the inside seat, and we have an hour-long talk, for example chatting about California food and wine. He loves his glass, bless him. I have always thought Asians weighed in at a disadvantage in drinking, those weak ADH genes. He lived in the US—Arizona—and drove 3000 miles in a VW bus in one month, camping by the road sometimes. I tell him that is very American, “On the Road,” and that I liked doing that sort of thing too. He goes poetic about dining on raw oysters and white wine in a Berkeley motel room. I come back with what twenty years ago I said was the best meal in California: a Dungeness crab, sourdough French bread, and a bottle of California white. It too was a meal designed to be eaten in a motel room. We beam at each other in the fading light. I invite him to visit me in Los Angeles on his next California visit.

The bus slows on the steep grade while a stream of big blue coal trucks honk and labor by us. One is off the road, a serious accident. I imagine they go day and night and sometimes drivers just fall asleep. Then our bus is stopped on the grade, with diesel spilled onto the road behind the bus. We all get out. I should help the driver as I suspect I am the best (and only?) mechanic on board, but I have become fatalistic about this trip and China in general. How could such sunken ships be helped? (The bus or China itself, take your pick.) And I am reminded that we are aboard Hohhot University’s best luxury bus. I walk off the road down the steep gritty grade toward sand dunes. The vegetation is unlike anything I have seen in harsh dry country. There appear to be poplars planted in rows; what is this? And even the ground cover is too evenly spaced to be natural. I am later told by Linda that this area is a famous reclamation project, designed by a celebrated scientist who received a UN award for his efforts at reclamation. It looks desperate and hopeless to me, and I sink deeper into gloom even off the bus out in the open. I walk to a side road, and it appears that the whole countryside has been planted. What percentage of the plantings lived? What labor went into what I am seeing? Fertilize, and China will bloom, perhaps Mao said. Right, just add a tree with a little fertilizer. That’ll do the trick!

Across the road from the bus are two small shacks made of mud and sticks. Three small boys about ten years old appear on bicycles, schoolboys

I am told. And where does school happen? I do not see any possibility. One of the shacks is a motel. The bed is a wood pallet with a dirty cloth, and a tube under the boards that can be stuffed with coal on frigid winter nights. Dejection gathers inside my soul. Could anyone escape the fate of being born on this slag heap? And what was it like before they could rent beds to busted-down drivers of busted-down blue trucks? These are boom times for this place.

Despite our handlers, I see some genuine Chinese bathrooms on this journey. I am familiar with the slit in the floor where one squats over and does what's needed; I have seen these in Singapore too. And I was raised in a rural location, so bodily functions and their products are not news to me. Still, the rank filthy bathrooms I see here are places I hesitate to step in for fear I will have to discard my shoes to rid myself of the stench. The women have it worse.

The bus starts up and we are off again. I see adobe structures everywhere with none of the Santa Fe romance, not for me. Many are washed down to fragments of a former house, and some are occupied, although all appear run-down. Small fields dotted with stunted plants awaiting water, water that I do not believe will ever come. My god, it is early June. What will this hellhole look like in August? The few people I see are standing or sitting; no one seems to be active. Who can blame them?

Then on the top of a rise, we come to a roadblock, and we start on a detour. The driver could have returned to the main road, but instead we continue on what is obviously the old road. There is more sand, fewer adobes and fields. I snap pictures through the window that Su Guo Du kindly relinquished to me. Then after a deep sandy wash the bus stops on the lonely up-grade with another breakdown.

The country is sand, and still has a few of what I take to be planted trees. The only ones surviving are near the wash. The wasted human effort! There is sign of great water flows—thunderstorms must ravage this country, but not often enough for much plant growth. I could be in New Mexico near the Mexican border, sand and spiny plants. Several of us wonder how and when we will get out of this, and as soon as we estimate the time it would take to walk to the next town, I relax. A few hours of walking is in line with my capabilities and inclinations.

But after three-quarters of an hour we set out again. Sacks of cookie-like snacks flow from Ali and others in the front of the bus, and we are comforted by that food. Some of the Mongolians sing. But shortly the bus slides to

a stop: the road is completely washed out. We are 20 km from Dongsheng; certainly not too far to hike in three or four hours. The bus backs up slowly; the driver is not as skilled at back-up as he is at straight ahead. Then he locates a sandy unpaved detour from the blacktop. The bus slowly and dramatically makes its way down and then uphill to the paved road. Whew! Later I decide this is all an act, that the driver had made the detour before and knew exactly what was coming.

Our journey is now uneventful. We pass hopeless sandy fields. More weather-destroyed attempts at adobe buildings. Then we turn back onto the main coal-truck road. Coming into Dongsheng is a relief, but life still looks hard to me, the lives of those who live here, that is. (Not for me, I live a life as rich as Bill Gates compared to these folks.) For the first time I see the brilliant balls of light from arc-welding. There is enough electric power here. The town is obviously better off, the streets wider, the frontage buildings newer, no old adobe, no winding streets. The hotel we stop at is marble-fronted and brightly lighted. The lobby extends two floors with strings of lights and a marble pedestal supporting a bright black piano. Las Vegas in Inner Mongolia, here we are.

June 6. I go down for buffet-style breakfast at which I sit with a table of Chinese men and take my ration of salty tea (salt must be a Mongolian thing), salty milk with millet, and hard pieces of something soaked in milk to become eatable. Some bao (steamed buns) are also available. The men seem amazed and amused that I use chopsticks so well, as apparently they have assumed “the foreign guests” do not have such skills. Characteristically they never even glanced at our table.

Last evening there was an announcement: “Ladies and gentleman. We have a happy thing to tell you. At 8:30 tomorrow an opening of the department store is made especially for you. You can buy the Erdos cashmere item for your sale.”

One of these sweaters was my conference gift, and seeing they cost less than \$100, I went into the store and bought two more. A good move I think. The sweaters still smell of the animals from which the wool was clipped.

I have stowed my bags onto the bus to have both hands for shopping, but the bus is missing when I emerge to put my purchases on board. Eventually we are told the bus has gone “for repairing.” About twenty of us spend the next two-and-one-half hours waiting. I am still in my fatalistic mood and realize I could happily spend the day at this crossroads before the hotel.

Whatever. The Swiss man Jorg Stucki (I think of him as the Swiss), who gave an excellent lecture at the conference, is ironically bitter (and funny) about the delays and about China.

“They just don’t *do* anything,” he says. “They simply stand about idly. See! Look at that!”

We observe young people assigned to wash the hotel front windows. There are six, each equipped with something intended for window cleaning, cloths and whatnot. They stand, they chat, they sit, they walk, they stand, they chat,... They do just about everything except clean windows. Most of the time only one is doing anything like cleaning, taking feeble swipes at the big plate glass. The number of people cleaning once rises to two for a brief moment and then plummets back to zero. In the opposite direction, there are five men standing in what should be the hotel’s fountain. Like most fountains I saw in Inner Mongolia, it is bone dry. The five men are engaged in some fountain-related task; I cannot guess exactly what it might be. At any one time at most one man is doing anything.

I point this out to the Swiss. “My God,” he says. “There is no end to it. This country is hopeless. It will never catch up. And did you *see* those huts we drove by? Never once, absolutely nowhere, was there a sign of any care for the appearance of anything. No grass, no plants. Nothing but dirt and broken objects. And this hotel! It looks pretty but it is just a facade. This morning in the bath I grabbed the hand bar and it just pulled off the wall. It’s all just paper and paste.”

I can’t argue with much of this commentary, but when I have been slightly hungry and just a bit desperate, I never found keeping up appearances such as a yard to be of much value or interest. But the Swiss drives me deeper into my despair about China. A few days ago I found the dirt streets of Hohhot to be charming and bustling with energy. Now I see bleak hopelessness in the same material. I am coming to realize I do not understand what I am seeing. What do the people feel and think? What is the impact of the uneducated generation just younger than I am that was crushed by Mao’s programs? Some of those people can read about as many Chinese characters as I can (none), and they must burden this society greatly. And they are exhausted, a used-up burned-out generation, Cultural Revolution detritus.

On the bus trip I am assigned a room with Chris Lloyd, a statistician from Hong Kong who has one of those famous high-paying Hong Kong jobs. He has been there a year but has never taken the train to the border with the P. R. China, a ride of less than an hour. This is his first visit to the P.

R. China. He also has found the bus ride revealing and wonders what keeps those wretches out there on the sand hills.

“Why don’t they just move to a city?” he asks. “Obviously life is better here in town.”

I have read in the Berlitz guide that moving is not an option, but that guide is dated 1995/6, and the sentence could be older. So I set out to find out what the situation is. Sitting out on the marble hotel facade, I chat with Linda. She is the most interesting of our guides to me. I have queried each of them about why they are studying English and received answers ranging from a blank stare to an expression of a desire to teach English. One is in love with the plays of Eugene O’Neil and I send her a collection of his plays when I get home. Linda is the only one for whom a visit to America or England is a remote possibility. She has a slightly bigger world picture than the rest. And yes, it is true that moving to town must be approved. And approval is difficult, almost impossible to obtain. If you know a government official it is easier. But even then it is probably impossible. Then I ask how this control is managed. Linda answers another question, not the one I asked. This is frequently the Chinese manner of dealing with awkward situations. I persist, stating my query as directly as possible.

“If someone walks into Dongsheng from where the bus broke down yesterday, how is it known that he is in Dongsheng? And what happens to that person then, when this is known?” We exchange question and non-answer twice, and then she falls silent. “I cannot say,” Linda finally responds, looking away, and then I change the subject. I have learned all that I can about this.

The issue of moving and changing your circumstances strikes more at my vital nerve than does free speech. My view of China shifts this morning. The people can work themselves up by doing well in school—the time-honored Chinese method of moving up the system by good scores is again possible after the Cultural Revolution. And schools are widely available, recall the schoolboys on the slag heap. But to be born out there would be a huge handicap almost impossible to overcome.

About 10:30 the bus is announced. It appears twenty minutes later. No one seems interested in the repair. I gesture and go with the macho driver to the rear of the bus, and he opens the door to the engine compartment. He is proud of his repair—what repairman is not?—and he shows me the rubber fuel hose he has replaced. The faulty hose is lying on the platform, perhaps for future use. The job, *with a new hose*, could be done in 10 minutes.

Therein lies the difficulty.

Underway, Ali makes an announcement. “Ladies and gentleman. Our driver has fixed our vehicle. Perhaps in your country this could be done quick. But please remember. You are not in the U.S. Or your country. You are in Inner Mongolia.”

Our passage through the countryside is now unimpeded by breakdowns, and we seem to sail along. There was a booming distant thunderstorm last night, and the air is clear for once. Slowly we leave the sandy soil behind and then come to some actual grass. Amazing patches of green grass, and we are a few hours after leaving Dongsheng approaching the goal this journey (which was unknown to us), the Genghis Kahn Mausoleum at the southern end of the Eerduosi Plateau.

Some genuine Mongolians in costume “meet the guests” on small ponies and gallop the animals alongside the bus. The happiness at seeing us is a purely commercial hoax, but theirs are the first beasts of burden I noticed not covered with sores. These people care for and feed their animals. The bus circles about and finally parks in the courtyard of a collection of buildings which like the hotel was probably built yesterday. Strike the word probably. The domed buildings shine with new colorful decorations. There is to be a “wedding ceremony” performed for us. I had hoped the bus breakdown would nix that but it has not. We are told by Ali what an honor we have, and pictures of us with Mongolian women in costume are ceremoniously taken. I think about going over to the men and making horse talk. They will be amazed that I understand horses at all, and I anticipate the jokes about my size and leg length. We do not share not a word of common language, but I have no doubt of being able to make myself understood. The handling and knowledge of horses and domestic animals are universal. But my pessimism maintains itself, and I gloomily watch the picture-taking and am forced to take part in the first round of a nauseating ritual, some bowing followed by at least a sip of some vile liquor in a metal cup. Scotch whiskey this ain’t!

Eventually we go inside a round hut-like building to eat and observe the sham wedding. We sit at the ubiquitous round tables and realize that with the journey and hard labor of bus repair, we are hungry. There are some opening songs from the girls who greeted us on our arrival—once again proving the Mongolian genetic predisposition to singing. Then we begin the endless rounds of vile liquor in small metal shot glasses. The Hungarian, Mathais Sipiczki, downs them all, all afternoon, and he holds the stuff well. Beer is served and both I and Chris leap to our glasses and drain them repeatedly. I

learn later that our drinking is closely observed, but unfortunately I gain an unearned reputation: so far as I can detect the beer is non-alcoholic. And the food starts to come, the sham wedding proceeds with announcements from Ali as to what is happening, or would be happening if it were real, and when it would be happening.

“Ladies and gentleman. The next songs would go into the night and the wedding guests would arise early for food and singing.”

Or something like that. As in the reported real wedding, the damn event seems to last forever; I feel as if I have been here for days. I notice the Swiss is as nervous and irritated as I am by the proceedings. I try to avoid the stainless-steel shot glass, but the crowd, except for me and the Swiss, are into it, and they find it amusing to be sure everyone does his part. Ahhhgh!

The tea is salty, the soup is salty. I recall my first years in Idaho when I was running several miles per day. I had aches in my arms and legs which disappeared after taking salt pills. Something no one would do today, but it worked. Probably these folks found it hard to get enough salt in their traditional life in this dry climate.

At long last, the barbecued sheep comes, an entire body including head with horns. They do know how to roast an animal over an open fire, that's for sure. The mutton is delicious, and we all dive in, wrenching off hunks of meat and bones. There are continual rounds of metal shot glasses which we must stand up and sip. In due time I am full of sheep, the most straightforward food I have had in days, no guessing which parts of which animal I have been nibbling on here; this is chunks and hunks of delicious dead sheep, no question about it. Then to disconnect from the pseudo ceremony, I take my camera and photograph my companions. And some of the surroundings. Mr Zhu from Beijing is absorbed and entertained. Su Guo sits leaning into a chair back, quite taken up with the happenings. Then I begin to wonder what it is about me that finds these counterfeit realities a humiliating experience for the actors and the audience. Somehow being asked to “take part” is the key. The Swiss and I wish our realities to be authentic, whatever that means. Obviously that is not universal. Amusement parks strike me the same way. (I do not even visit Disneyland!) When this charade and the wedding fakery ends, the Mongolians sing and dance. Of course, would a Mongolian miss another chance to sing? We are now just onlookers, and I feel fine.

Responding to the cramped and stuffy bus of the day before, today I am dressed in a shirt and shorts. This has amazed and fascinated people who repeatedly ask me if I am too cold. And they ask even in warm weather.

Then we go outside, and the Mongolian children are out of school. They are beautiful with those flat oval Mongolian faces and a tendency to freckle. I take some excellent photographs, especially of three attractive and charming young girls. Their innocence is remarkable. We are in a tourist trap which is a tourist trap not often visited by tourists. This is too many dusty and twisted miles from anything. And who would come to Inner Mongolia in the first place? Why?

The grounds are rectangular with the parking and wedding hut at one end. We are given a set time, and then as usual entrance fees are handled by the organizers. The domes of the Cheng Jisihan Mausoleum are beautiful and colorful. Someday they will move Genghis Kahn's remains to this place, or at least what in ancient world tradition will be claimed to be his remains. There is a disconnect with the outside world's take on the Kahn. These folks see him as a hero and a nobleman. (I believe he was reviled during the Cultural Revolution but has been reinstated.) At home the name is a synonym with barbarian. (The joke is that the Chinese saw us as barbarians until just a few historical minutes ago, and maybe still do, we uncivilized peoples outside China.) Genghis Kahn united the Mongolian tribes in 1206, and then conquered China. His empire crumbled in 1368. One of my favorite young Chinese scientists says to me:

"Genghis Kahn. He *was* great. But now he is nothing."

Meaning, I believe, that the Kahn controlled the relevant world once, but now that world is greatly diminished. The West has won without fighting battles; we should show better manners about it. I disagree with the young man and tell him that, if the Kahn had wished to do so, he could have conquered the globe; he did not care for the outside world then, and he did not even make the attempt. (I believe this to be true when I am saying it. My ignorance has no limit.)

In this land there is a little grass and some healthy stock, and I try to imagine the tribes riding over the rolling hills and barren sandstone, crossing the wastelands. I decide that with good horses this was a great life. The big exhibit hall has one object I am transfixed by: a metal teapot with ancient Mongolian characters etched onto it. It takes my breath and imagination away; for a few minutes I squat by the coals of a small campfire on a chilly night, the open windswept heavens stretching outward and upward forever, waiting for my day's tea, the nearby horses making their nuzzling sounds of relaxation. But I doubt that even this artifact will draw enough people to pay for this lavish outlay off in these stony hinterlands.

We gather and ride away in the bus. There is a scheduled stop at the nearby tent camps where some Mongolian herders are supposed to be located. It is just another sham, and the bus does not stop, just wheels through the campsites. There is no time. No time because of what, I wonder.

Then we are cruising through a back-roads countryside, and I stare as we go along. One occupation I will gladly pass up in this lifetime and any possible future booking is that of Chinese beekeeper. The hives are dumped alongside the road, and the keepers live in shabby tents, filthy canvas thrown over sticks, right next to the road. It does not appear to be a rewarding life—for the bees to find honey in this parched country must be a feat equal to the gold-from-base-substances trick. Or gold from thin air. The horizon line is under the trees as the trunks flash by, giving three horizontal lines and a fine feeling of motion. The top layer of the trees is dead branches. The beekeepers sit motionless by their tents, the sky becomes grey with what I take to be dust but looks like fog, and winds are coming up.

As we drive along there are vehicles broken down with people sitting about. In places the breakdown is strewn across the highway, with no attempt by the people involved to gather up the fragments of their disaster, or even to sit in safety. They are usually dressed in grey cloth, although even here you see an amazing number of men wearing suit coats or sport jackets, inappropriate for doing anything. I infer that they associate the jackets with the west and so don them with the pride of being up to date.

The driver is heading onto some new roads, which confuses me as I thought we were retracing our path from visiting the future site of the Kahn's bones. The sky is darkening and I can see it might rain; it does rain a bit, driving thunderstorm-type rain. And I would have bet serious money yesterday that these sand heaps would not see rain for months. At one sandy crossroads, the driver stops and queries a man by the road.

"What did he say?" I ask. I am told the driver inquired about the flood. I respond with: What does that mean? I am soon to find out. We have been heading for a place in the sand dunes called the Singing Sands. The storm has flooded the half-mile-wide arroyo we must cross to arrive there. Mind you, I must deduce this from slivers of evidence. We are never informed of these things by the hosts, full information is just not their way. And coming to the arroyo, the driver steers out onto the wet sand and tips the bus and races his engine. I fear that we will never be able to retreat and am even more confident that we shall get nowhere headed as we are. That's correct and the driver is just being dramatic. "See, I tried!" he is letting everyone know. He

is a tyrant, and as none of these folks understand machines in the slightest, he is king of the motor bus. This is just another macho demonstration to those aboard. We then get out in the rain and I am queried repeatedly about being cold with my bare legs. Months and years later, I suspect I am still a subject of speculation in China. The dunes look dramatic and I wish to be across into their solitude. (There is no solitude in China, when will I learn?) And that we have wasted time at that stupid fake wedding ceremony.... The edges of these arroyos are planted with dying plants. This recovery-of-the-land business has gone too far. Give it up! Stop right here, this instant! You are wasting your time!

Back on the bus, the Mongolians cheer us up by singing. They burst into melodious song at the drop of a hat (although none of them wear hats, that does not stop the singing). Then we pass back to Baotou which is Linda's hometown. We learn that her father is retired from a steel mill but remains the head of the Communist Party for the 12,000 workers. This, I think, explains her worldview being slightly broader than her fellow students. If no one in your family ventures across the local fences, it is much more difficult to see over them. The hotel is in a compound and has some Communist Party literature, some in English, which I collect while checking around to be sure Linda does not see me doing it. One of them states that in a few years, China will surpass the U.S. economically. And I would love to see it, but perhaps in a hundred years, not too soon I fear. They need roads, electrical networks, infrastructure, and social and economic restructuring. Don't hold your breath. On this trip I look at the people I am with, and I think that I like them as much as I do any people on earth. Then I look at their government or what little of it on view to me, and I think that I dislike it as much as I have any government I have been exposed to. That is not a contradiction.

June 7. We get up and ride back to Hohhot. We stop to relieve ourselves, and we all, men and women alike, run in the drizzle back to a roadside ditch to do our business at various locations. This is not a problem to a boy raised in western Oregon in the 1940s and 50s, but it is another clear and obvious crack in the image our hosts are presenting on this journey.

On the outskirts of Hohhot, I ask again about a big building standing out in the flats. It was on the exit trip an "electrical college;" on return it became a "school for training people who run the electrical plants." In other words, for training bureaucrats who will run and manage the huge

coal-powered plants for producing electricity. Pretty far from the electrical engineers whom I pictured on my trip out. My picture of China has evolved similarly, not that I have even one accurate clue as to what is really going on.

I have signed up for another night at the conference hotel. My former post-doc Momiao Xiong is in the residential hotel adjoining the new and seemingly grand digs I have been staying in. I finally am signed in by my handlers and find a printed message in my room.

Ladies and gentlemen:

May I have your attention, please. Because of fixing the tupe system, the water will not be offered from 23:00 to 04:00 o'clock tonight. We are very sorry to make you in trouble. If you have any request, please dial "5". Thank you !

the front lobby June 7th 1997

Before you react, think of what you or I would write in Chinese characters. It is humbling, all the way around.

June 8. On arising at 5 a.m., the tap is devoid of water. I scurry to get into the vehicle, ready to try a different Chinese city. Professor Luo arrives on the scene; he speaks English poorly but feels responsible. He transfers me from one vehicle to another, then back to the first. There are problems starting the cars. There is negotiation regarding getting Mr Xiong, myself and several others, including a Chinese man from Davis, Yin Yeh, to the airport. Finally underway, it is fascinating to see the countryside between the hotel and the airport, all of which I rode by in darkness on arrival. Hohhot is rural in its outskirts. Inside the airport is the inevitable line and obscure procedures for boarding the plane. Even Momiao and another Chinese-speaking couple are mystified and confused. We board and are off to Beijing.

Airborne I stare out of my window seat. Whatever, I am pleased. Pleased at having seen and done all that I have in Inner Mongolia, pleased to be heading for the major city of China, pleased to be looking out at this mysterious country I increasingly feel I know less and less. I can gesture meaningfully, smile and say, "Shee-shee" (Xié xié) in gratitude. I can use chopsticks expertly and will eat almost any part of any animal the Chinese will cook. (That extravagant claim is untrue!) But I know only false things about this amalgamation of one-fifth of the world's people. Below me, the low moun-

tains are bare with some human terracing, and small villages appear here and there, even high up on desolate slopes. How do they survive on such un-bounteous land? What is daily life like down there? Did anyone in memory ever escape to a city? After an hour-and-a-half we fly over a serpentine stripe across the landscape—The Great Wall, it must be! The mountains are now more forested, and the plains, as we come out of the mountains, are densely covered with crops.

Getting Out the Good China, II

Beijing and Hong Kong, June 1997

June 8. At the Beijing airport, I am met by Dayue Chen, an associate professor in the Department of Probability and Statistics at Beijing University. He came to my office at USC when he was visiting UCLA and it was a bit awkward. Professor Minping Qian of the same university sent him to meet me; she was the first advisor of my former student and close friend, Fengzhu Sun. Unlike our meeting in Los Angeles, here he is relaxed. Some people were here to meet friends at the airport and in the crowd there was talk of me being on the plane. “You are a famous man,” my new host tells me. “Very famous.” Fame can be very local! Dayue is a great guy and a serious scholar.

An elegant toll road takes us to Loop Road Number 3. The toll road was built to qualify China for an Olympics that China did not get. We are in a hired car as few individuals in China own cars. The trip to Beijing University takes 40 minutes. The city I see out of the car window is far more prosperous than anything in Inner Mongolia. Sidewalks, sounder construction, some high-rises.

Beijing University is beautiful. It was a garden outreach of the Summer Palace with lakes and many trees. I am enchanted and it is a refuge from the life I have been observing. Assigned to the Foreign Visitors lodging, my first-floor room looks onto a pond. I have two not-new rooms, running water, a small fridge, and a desk.

Professor Qian walks me about the grounds, and she is dynamic and strong-willed as Chinese women often are. We meet her sister-in-law and both their husbands, academics all of them. We eat lunch at a dining hall, which is far and away the best food I have eaten in China. A bean-curd dish comes

with some shredded green leaf with a vibrant flavor I have not encountered before. Great! As everywhere I am asked about China: What do I think of China? What do I want to do and see? I ask about the preponderance and widespread wearing of sports coats and am told that prices are important. If it costs more it must be better. If it is from the West it is even better. Professor Qian tells me of shopping and being offered “lychee nuts from America.” “You have made a mistake,” she told the vendor. “You did not do your study. They do not grow lychee nuts in America.” I quickly come to like this woman.

My former postdoc Momiao comes to my room with his wife and a dynamic young man from the Institute of Medicine (where Momiao is trying to work a deal, the precise nature of which I never understand). Then they and Professor Qian loudly debate about where I will go and who will pay for what. Thankfully I do not speak Chinese; I’d be embarrassed, I’m sure. After this seems settled or at least a truce is reached, Momiao and company, with me in tow, head for the Summer Palace.

What an amazing tribute to excess is the Summer Palace. After the Anglo-French alliance burned it in 1860, it was re-constructed in 1888 with money the Empress Dowager Ci Xi was to spend on creation of a modern navy. It gets worse: during the Boxer Revolution in 1900 the Palace was demolished again. When Ci Xi returned to Beijing in 1903 another reconstruction took place. The navy never came into being, but instead we have the Summer Palace, complete with Kunming Lake, islands, and an astonishingly beautiful and graceful bridge, perhaps the most handsome bridge I have seen in my life, the Seventeen-Arch Bridge spans the way out to the island. This place—lake, island, hills and all—is artificial, built with that diverted money. The graceful wide paths along the lake remind me of sidewalks in Paris, and they are not jammed with people. Here, unlike Inner Mongolia, western tourists are common. I am not receiving wide-eyed open-mouthed stares.

There is a half-mile-long covered walkway decorated with paintings for the Empress to look at as she walked along on a summer’s day or eve. The paintings are of some size and painted onto curved surfaces so they must have required great skill. And artistry: many would hang in museums and here they are in open air. I walk along, looking at each side, left and right, left right, thinking I see them all, left-right-left, my neck and energy feeling the strain. Then I realize there are paintings opposite those I am looking at, so I am seeing “only” 4000 paintings. I will leave the remaining 4000

for next time I come to Beijing or perhaps the time after that. By then my stiff neck might have recovered. My hosts explain many of the historical connections. The Chinese love a certain stretch of history when the country had five kingdoms; events from that brief period are frequently depicted, so often that I begin to be able to guess some of the paintings that refer to the Five Kingdoms. Once again I have gained a tissue-paper-thin veneer of expertise.

A word about Momiao Xiong. I had more trouble understanding his spoken English than I have had with any other student. I learned from my other students that even his Mandarin is spoken with an accent. Momiao was caught at the beginning of the Cultural Revolution and spent the whole time as a laborer when he could have been productive intellectually. He is the hardest-working person I have known. Once I asked a friend Grace Yang, a professor at Georgetown University, her advice. She had met Momiao and was raised in the same region, a valley or two away. "Oh Michael," Grace said. "Even in his home dialect, his accent is quite bad!"

So on this historic walkway, Momiao explains the stories of the paintings to me, and other Chinese tourists passing by, hearing his pronunciation of various names in Chinese, under their breath mutter corrections to his Chinese words. Even I, almost deaf to the subtle Chinese tones, can hear the differences.

The strong young man with Momiao is ambitious; he has an MD and claims to be the first person in China to receive both a PhD and an MD. He bristles with energy and is keen to practice his English and impress me. Mrs. Xiong buys me a card with red guard buttons, most of them featuring Mao. (I give them to my daughter, imagining her wearing them to dance clubs in Los Angeles.)

"Mao is my God," he tells me emphatically. "I don't mean god, I mean God! You know Tyson has Mao tattooed on both shoulders. He can fight anything and win." I advise him not to put too much faith in Mike Tyson, which has no effect on his exuberance.

When we reach the double-deck marble structure just offshore that is fashioned to be a yacht, I say to myself, of course, this is exactly what they needed! Here we have it, a boat for the Empress's navy. The whole place has the effect of Versailles, of the peasants walking on the excesses of former royalty and enjoyment at rubbing it in, twisting their feet on the dead tyrants. That is the effect on me but I have no idea what Chinese people are thinking.

Back in my room that evening I dip again into my reading material which on this trip is a paperback edition of Rebecca West's great book *Black Lamb and Grey Falcon*, 1181 pages comprising *A Journey through Yugoslavia*. It was published in 1941, just as the world was shattering, and it is a complex subtle masterpiece. It describes travel and philosophy with endless historical details of peoples who have become headline news again, the Serbs and the Croats, the Slavs and the Germans; it seems almost usual. On the book's cover is a photograph of the Stari Most, the bridge spanning the Neretva River in Bosnia built in 1566. West calls it one of the most beautiful bridges in the world; in 1993 Croatian gunners destroyed it. Later in the year, I see in Tokyo displayed in an art gallery a photograph of a hand holding the picture reproduced in West's book, a hand-and-arm holding the picture of the Stari Most over the river with the destroyed bridge in the background, the river running by rough as always. In my reading this evening West and her husband are in Trogir, a city in Dalmatia on an island. They hear the story of when Trogir was almost destroyed in 1241 when the Mongolians had just conquered Russia and swept across Europe. The King of Hungary fled from the Mongolians.

...the invaders swept on towards Vienna and then swung down to Croatia, burning, looting, killing. King Bela tried to stand firm at Zagreb, and sent his Greek wife and their three children to seek safety on the coast. These were ranging in panic [...]when the King joined them frantic with fear. It is doubtful if even our own times can provide anything as hideous as the Mongol invasion, as this dispensing of horrible death by yellow people made terrible as demons by their own unfamiliarity. It is true that the establishment of the Mongol Empire was ultimately an excellent thing for the human spirit, since it made Asiatic culture available to Europe; but as Peer Gynt said, "Though god is thoughtful for His people, economical, no, that He isn't!"

The King fled to Trogir on the theory that *Yellow horsemen could not ride the sea*. This seems to me to have been optimistic.

The Mongols came down on the coast. Nothing could stop them. But at the sea they met a check. They had thought the King must be at Klish or Split, and they were repulsed at both. ...

The Mongols were used to unlimited space for their operations, and to attack fortifications from a terrain bounded by the sea or sharply broken ground presented them with a new problem. But they found their way to Trogir; and on to this bridge across the channel they sent a herald who cried out in a loud voice the minatory nonsense talked by the aggressor in any age....

After this tremendous moment, nothing happened. The herald cried out his tremendous message, the guards kept silent, and presently the Mongols went home. It is thought that they were considering whether they should ford or bridge the channel when they received news that their supreme chief, Ogodai, the son of Genghis Kahn, had died in Asia and that the succession was in dispute. They went back at a trot, just taking time to sack and kill on their way....

Once again, something I thought to be true about China and Asia turns out to be false. And this one I could have looked up in a book had I learned a bit more Chinese history. Or had I learned more European history.

June 9. I have a good rest, awoken by words outside my window that may be from a recording. And the road goes alongside my pond. At 10:30 I meet with Professor Minping Qian in her office. She shows me some of her work, really nice, elegant and down-to-earth papers on stochastic processes. I tell her it is good to see such pretty results in Markov chains (instead of abstractions in fancier settings). Minping immediately replies that much of stochastic-processes research is quite intricate and abstract and of little or no interest to anyone. Amen.

Lunch is a spring roll and a steamed sweet-and-sour fish. It costs 31 yuan or about \$4. Delicious!

In the afternoon I lecture to a full room. I open by saying my Chinese students are very happy that I have finally visited China. "About time!" they told me. The audience laughs and it is off to a good start. However, I talk too fast and probably lose almost everyone. An older woman in back likes my phase transition result (in my opinion showing excellent taste!). In answer to her question regarding a more general physical meaning of the theorem, I answer that I have searched for one, and have asked many statistical physicists without gaining any new insights. Minping tells me, all this in

front of the full audience, that the questioner is a statistical physicist, and I answer that of course I knew that from the formulation of the question. The audience laughs heartily at this exchange. I think these Chinese women are wonderful in their strong confident approach to things. I have a nice talk with my questioner as the audience leaves and show her my physical interpretation of the theorem.

I go to dinner with Minping, her husband, and Dayue Chen. We walk to a nearby and world-famous Peking duck restaurant. The meal starts with duck parts and a special dish of scrambled eggs with that amazing green leaf Minping introduced to me. That dish on an elegant plate with a dusting of black caviar would be at least twenty 1997 dollars as an appetizer in a California restaurant. Perhaps I should introduce that plant to US agriculture. Or to my backyard so I can dream up green-leaf dishes myself. There is duck's foot—no, no, I am to say duck's paw—and shredded duck wing. Very tasty!

Here is the story of the origin of Peking duck as told to me at a sidewalk table on a warm June night in 1997 in that wonderful restaurant in Beijing. An emperor visited the south of China, and a cook on the spot created a wonderful duck dish. Returning to his home base, the emperor directed his chef to recreate the marvelous duck he had eaten, and eventually, after much experimentation the chef did so. After some years the chef retired and started his own duck restaurant. Restaurants were unusual then but his was a smashing success. But then his assistant resigned and started a restaurant of his own. To give himself a competitive edge, the former assistant began serving duck parts with the meal and presented a special duck soup at the end of the meal. The soup is to be boiled for nine hours. Minping's husband said that he thought the soup we had just been served was only boiled for two hours. It was excellent in any case. Because of sanitation laws there was then only one restaurant in the US with an exemption to prepare genuine Peking duck, a restaurant in New York City's Chinatown. Yes, I say, I ate Christmas dinner in that restaurant eight years ago. I did not add that I was accompanied the then-love of my life, a Chinese woman born in Taiwan.

I learned interesting things about Minping. Thirty-five generations ago there was a king in her family. The boy was born hairy with little money. He possessed great energy and ambition and traded a store of rice for soil, just loads of dirt, which he dumped into the bay's edge and thereby created for himself new land in what is now Shanghai. These holdings propelled him into power. Few among us in the United States can trace five generations

back.

What about her experience in the Cultural Revolution? After all she was at Beijing University, how much more elitist could you be? She had a baby in 1966 and was allowed to stay at Beijing University. Her sister-in-law and husband were sent 1000 km away to the country. She worked on campus, at first “teaching politics,” and probably helping the students who hung on for a while to be at the university. There were no classes at Beijing University in mathematics or in the sciences; this was not allowed. Later she was sent to the country in the north. The peasants were good to her, she said, and she liked them. It is difficult for me to imagine anyone not getting on with this confident positive woman. On meeting the peasants, they presented her with a raw onion and were perplexed and amused when she had a hard time getting down even one bite. Then she was moved from the country to a power plant, and finally she worked with oil-exploration data, doing signal processing on the most primitive of computers (using binary coding). At the end of the Cultural Revolution she was irritated with computers, and being given her choice of what to do, she returned to Beijing University.

We also talk about Chinese students. I express my surprise at some of those arriving in the States who seem not to have integrity and will lie and cheat and steal without any second thoughts. Then there are the others whom I find to be great people. My hosts tell me there are two types of students today, and that there is a huge generation gap. I remark that, looking at the clothes worn by young people in China and thereby sensing the cultural invasion from the west, I am sure they have only seen the beginning.

As we leave the restaurant on the sidewalk is a cart loaded to overflowing with the carcass of ducks, some not yet been used for duck soup. I wonder where it is headed.

June 10. I get up at 7 a.m. and shower. In less shiny accommodations than the “luxury” hotel in Hohhot, I have hot water beginning at 7 a.m. until 10 at night. The young student Xiaoman Li who represents Professor Qian shows up at 7:40 and at 7:45 the station wagon hired by the Institute of Medicine arrives. These games of status and territory have gone on since my arrival in China and escape my remotest understanding. It is China. I am not in control of my life and don’t know what is going on. It is China, I repeat myself. There is Mr Luo with Momiao and his wife who since I had an extravagant lunch at the Xiong’s apartment in Los Angeles some years ago has learned more English. In contrast I have learned no Chinese. With

the driver we are a party of six people and set off for the Badaling Pass and the Great Wall. Exiting the city we climb into the mountains to the east. An oily haze hangs over Beijing. The first crossing of the Great Wall is the most commercialized and often visited. At the second location we park, and the five of us set out, the driver staying with the car. Here as everywhere, my hosts buy my ticket with theirs, and then at the entrance, I am stopped. My ticket should be a foreign visitor ticket which costs double and more.

This is a fine experience, spending more than an hour climbing on the 2000-year-old structure. Being a soldier must have been hell, cold-hot-lonely-brutal—and likely they were constantly hungry. The rugged little mountains are covered by scrub. The old Chinese poets spoke of the western frontier—probably this wall started as a path patrolled by some less-than-fortunate souls. The Great Wall ends far north of us, within a few hours' drive of Hohhot at the edge of the Gobi Desert. As everyone knows, Japan invaded China during WWII, and a photo display shows Chinese soldiers posed with their guns laid across a rampart of the Great Wall, supposedly fighting the Japanese (whom they still hate). I like its theatrical aspect and do not believe for a moment that China was defended like that. It makes good propaganda however.

When President Richard Nixon “opened” China with a state visit in 1972, he came out from Beijing as we have just done. Although I doubt that he ventured far up these heights, but he made a famous pronouncement. “I think you'd have to conclude—this is a great wall.” The Great Wall is a Great Wall, in other words. Ah, what elegance, what a flight of language!

Here we are, almost all ethnic Chinese this early in the day, many dressed up, everyone—young and old alike—just hiking over rough steep cobbled rock surfaces, often with some vertical exposure. Just as in Inner Mongolia I am impressed by the physical robustness of the people. There is no mincing about, no whining, none of the behavior I expect at home. And the women are up here too, in high heels and all. This is indeed a tough people. Earlier in the day the Great Wall isn't too crowded, but enough crowded if you can sense what I mean. For this is a communal sharing of the effort and the steps and the countryside. It is a monument to be experienced. I take more pictures than at the Summer Palace, which is much richer in design and execution. I mean to buy Great Wall postcards and am told “no” by Xiaoman, “absolutely not.” He presents me with a set of postcards he bought yesterday in Beijing at one-quarter the price, and he has inscribed a message to me with his gift. It is indeed touching. He is a sweet boy who wants to

study biology as an area to apply his mathematical skills. Perhaps he will come to USC in our program. I sense that Minping has that in mind and Xiaoman does come to USC.

We return to the bottom and the shyster carnival that goes on there. I suggest an ice cream and head over to purchase one for everyone. “Stop! Step away,” my companions say. “The price goes up if you come along.”

Weather has gathered and thunderheads are moving to us from the west. Back in the car, we head down the pass, continuing the journey westward, passing a succession of big blue trucks carrying, yes you guessed it, coal. But a slightly smaller model than in Inner Mongolia, they do not pull trailers. Then the traffic stops dead. Our driver becomes frustrated and pulls into the oncoming lane, where he drives ahead for an eighth of a mile. (Driving in Beijing and surrounding roads is less chaotic than in Mongolia, but it remains free-spirited.) Then we poke into a space between trucks as an emergency vehicle is approaching. After a 30-minute wait, traffic pokes and jerks ahead. A truck headed the opposite direction reports that he was held up for five hours. We are now feeling fortunate to have an open road and safe traffic. Only in circumstances like these do we bother to feel grateful for our fates.

Nearing the Ming Tombs, our next destination, a pair of girls tries to pull us into their restaurant by putting their bodies before the car. The driver swerves into the other lanes to avoid hitting them, and everyone smiles at the energy and courage of the girls. Parking is in one of a selection of lots; the driver finds a tree to park under. There are negotiations with a lady in lavender who eventually leads us through one lot and then another to finally reach a far-flung restaurant from which she must get a commission. The food is of fair quality and there is a large amount. Xiaoman Li from Beijing University is 20 years old, and he tells me after he is handed a menu that he cannot make sense of it. Xiaoman has seldom eaten in a restaurant, perhaps never before this. The driver has joined us and does well with his opportunity to supplement his driver’s pay with some restaurant food. Taxi drivers earn several times the salary of university professors. This is a strange and I believe unstable system.

Of the sixteen Ming emperors, thirteen are buried in this excellent valley. They each wished to have their own mountain and river, so their remains are flung about the landscape in a graceful way, grave sites sown by geography itself. I fall in love with the countryside, and several times think it would make an excellent cattle ranch. There is the usual foreigner-pays-twice negotiation-renegotiation at the entrance. Then we walk up a raised stone-

marble way flanked by cedar trees, generous, wide and grand. The only excavated Ming Tomb goes deep into the earth with a succession of heavy—several tons each—engraved doors. 30,000 workers spent six years making this tomb. We view big stone seats for the emperor and his two wives. (I wonder where they sat all those other wives.) They have placed the remains and the treasures into big red packing crates, and we pass by, stop, and stare at the boxes. I try to imagine what the Chinese are thinking, and why they pause, with blank reverence. As usual I am in total ignorance.

We ascend and emerge into the open again. An old road cobbled with bread-loaf-sized rough stones heads away from us in an arc. No signs explain its destination, but as foreign guest, I insist on walking along it. The others are reluctant—it is not a known quantity—but I stride off, and they are forced to follow me. After all they cannot lose me here, even if I behave in a crazy fashion. The sides of the road are built up to waist height, in a sawtooth, step-up, step-down style. The road is 20 feet wide, and the roadbed is 20 to 30 feet above the ground. The stones are weathered after centuries. Cedars are to our left, to the inside of the arc, and to our right and ahead, the valley floor covered with poplars runs up into nice pine-dotted foothills. I am inexplicably happy in this place, just pleased to be alive and experiencing an ancient man-made structure constructed with such taste and of such solid quality. I imagine coming along this way in the emperor's caravan, riding a cart, going around the country to lord it over the previously dead monarchs, chanting (*you are all dead, and I am not*), looking for where the next huge grand burial will take place. Just which valley corner will be dug up to make the next grand gesture yet to immortality? But today we are just ordinary people at the end of the twentieth-century walking over all these bones, and each of us lives so much better than those long-since-dead kings. Coming to the mid-point of our journey, I spy some people through the trees, and this greatly reassures my nervous hosts. Xiaoman recalls the same four soldiers at the stone table we passed as we descended into the underground tomb. Their relief is palpable. We continue along our ancient road, cedars growing in the roadbed itself, 25 feet above the earth's surface. While the roadbed is framed by stones, it is filled with earth that must have come from the tomb excavations. Off in the distance is another pleasant nook where an emperor located his remains. It would be a wonderful livestock ranch. And what a glorious place this is, not producing any crop but hosting the bones and treasures of these long-dead rulers, no crops today except for yuan harvested from tourists such as us. The road oval is about 3/8 mile in diameter, and

the exit branches gracefully toward the inside with a road turning back under the elevated roadway, heading out into the countryside to bury more dead emperors.

Our ride back to Beijing is swift on the Badaling Expressway. Those Ming monarchs never had it this good. That evening I dine modestly in the foreign guest side of a Beijing University dining hall. Scallops with boc choy, delicate fried rice and a Tingtao beer. Total of about \$4. The monarchs did not eat this well either.

June 11. Early this morning, I discover the origin of the strange commotion I hear each morning. During the Cultural Revolution, speakers were mounted on posts throughout the campus in order to broadcast Maoist propaganda. Now the same technology broadcasts the morning news. They are not prone to waste, these folks.

Mr Luo comes to Beijing University to fetch me. While I have complained here about the excessive handling, getting about in this city is a non-trivial task for anyone who does not speak Chinese. We go to Momiao's hotel and he explains the schedule. We wait for Mr Zhu. Then we go to the Forbidden City, after the Great Wall the best-known feature of the Beijing region. We have all seen it in the movies.

The Forbidden City covers 175 acres and is another example of the shameful excesses of monarchs. Palaces, courtyards, gardens are defended by a tall wall and a wide deep moat. There are wretched extravagances: the "toy" exhibit is a collection not of actual playthings of children but of big expensive donations from foreign governments; the "jewelry" exhibit is mostly gold. Gold that was distilled from the blood of peasants, if you ask me. But the shining bright spot for me is the pottery exhibit.

I love pottery and have seen exhibits from Paris to London to New York, some of the best exhibits and collections in the world. Wrong! The Chinese invented their ceramics 10,000 years ago. An exhibit in the Forbidden City runs the length of three halls. It is worth a trip to China just to see it. At the exhibit's beginning, thousands-of-years-old pots are remarkably familiar to frequent visitors to the American Southwest. Do those appealing and basic designs reside in some corner of the human brain? The designs from the ruins of the desert Southwest are wonderfully congruent to the earliest Chinese pottery designs, and they start a visitor off thinking pleasantly deep thoughts about the artistic and spiritual basis of mankind. (And what a relief after what I have been seeing: tree trunks plastered with gold leaf and

even more disgusting crass displays of wealth and power!) Then the journey goes to recent times, display case after display case, each containing a few magnificent examples from each region and period of the development of pottery in China.

And I remind my hosts of the acquisition of China's technology by the British (of course they know the story), and how Americans took up owning those sets of dishes as a mark of sophistication and style, how my own rural family and each one of our relative's families had special dishes, how on holidays only were the tables set with those dishes. Getting out the good China, it was called.

The day is wasting and we set off to Tiananmen, one of the largest outdoor malls in the world. To the outside world, where it is a symbol for the 1989 crushed demonstrations, the word Tiananmen is sufficient to summon up that sad debacle. Today it seems to be just another place. But that is not true, people are well aware of its functional and political importance. The broad streets and the rules for getting a taxi confound us for a while. I sense an underground street crossing which I lead us to, but I have misunderstood the objective. We forgo Tiananmen and locate a taxi that takes us south through a region undergoing massive reconstruction on our way to the Temple of Heaven, Tian Tan Park. In 2013 I attended a 5000-person banquet at Tiananmen.

Temple of Heaven is strongly recommended by Professor Qian, and her fierce will and insistence have caused this to be scheduled by my current handlers. We pay with the usual re-ticketing for my white skin at the entrance. The place is an architectural masterpiece. It belongs in a class with Notre Dame on the Seine in Paris. This is something else, again. Geometry and symmetry groups must be required to understand the layout fully, but one's intuition surely will do an adequate job. Built in the 15th century, it is arranged on a long axis with various temples on a line and to the sides. Yearly the emperor would come here and make supplication for good crops. We are hungry ourselves and stop in an unlikely stall where we eat plates of steamed pork and vegetable dumplings. Then on to see more wonders of supplication to the heavens. At dead center is the magnificent blue-tile-roofed Hall of Prayer for Good Harvest. Not a single nail is used in this building which stands 125 feet high. Symmetries: four huge central columns represent the seasons; then come two concentric circles of 12 columns, representing the months and the dozen two-hour periods the day was divided into; finally a ring of 28 hardwood pillars represents the constellations. In places, I detect

some Islamic influences along with the Buddhist and Confucian. What an architect they had for this job! The world isn't building more public works like this, is it? Nowadays we make airports and highways and big box-like skyscrapers.

Now we return to the Institute of Medical Sciences. My time is allocated between Mr Zhu and Momiao Xiong, the real objective of either I am never certain. First Mr Zhu places me in a room with about 25 people around a big table, inevitably sipping yellow tea. I am asked to give a speech for which I am unprepared. So I give a history of Computational Biology in the US, some of our experiences, and some of my own, ending with a sketch of how huge it has become, SmithKline Beecham hiring a new department of 90 people. Then comes a bewildering round of questions directed at me. Can you solve the problem of multi-point linkage? (No that is an industry I don't work in.) Can you identify the function of promoter elements? What have you done that is of any importance? What are your projects? Who are your people? I am unused to being asked such questions unless I have applied for a job. God only knows what Mr Zhu has told them. I try to contain my irritation.

Then after a rest in a lounge with more yellow tea, we come to Momiao's part in the form of a dinner. Typically (or so it seems to me), we descend into a dirty busy steamy basement to pull back folding doors and enter a room filled with a round table. About 20 people are at this dinner, with me sitting by the Director of the Institute. I am not an important scientist but this guy is; he runs a big piece of Chinese science. And he is smoother than my crude questioners of the afternoon. We hit it off okay and it probably helps that I am at my best with food.

We are served a traditional dish of summer, bitter melon. I tell my tale about living in Hawaii, where I tried to learn to cook Chinese food by working my way through a Taiwanese cookbook. I went to the open market to buy bitter melon, pork and shrimp. The old Chinese ladies made over me when I purchased the bitter melon. Later I was to find out exactly why it is called *bitter* melon. And I reacted just as most cooks would, by cooking the dish more which caused increased bitterness. It was a disaster. I had not tasted bitter melon since that day in 1979, but I am always impressed when I see it at the Asian markets in Los Angeles. Tonight at the urging of my hosts, I try bitter melon again; these cooks are far more skillful and I enjoy the dish.

Dish after dish comes, and three times I think the meal is over. The food is on a par with that Professor Qian fed me; top notch. I should have guessed

when platters of duck tongue and duck heart came, for there is Peking duck at the end of the meal. The duck is fantastic; I eat a full quota on top of having already eaten too much. And the closing creamy duck soup is better than the one I had with Professor Qian. I realize her husband was right about the number of hours of preparation for the soup at our dinner. Rounds of flattery and invitation are exchanged after the meal.

I ascend to wait outside the restaurant, still impressed by the dirty chaos and the fantastic food. A handsome young man in white, wearing a chef's hat comes out to get air and cool off, and I imagine that he has cooked the meal I just ate. He is flattered by my desire to photograph him and poses sitting on a bicycle.

Mr Luo and the Xionsgs help me buy my daughter a string of pearls. On the way to the shops, Mr Luo gestures to a construction pit and tells of an archaeological find there. Ten meters down and 100,000 years ago people lived on this flood plain. The time estimate might be a bit on the long side as that's the length of time since humans are estimated to have come out of Africa. "Beijing has always been a good place to live," he says. That does seem to be the case, indeed.

June 12. The next day a driver hired by Professor Qian takes me to the airport. I am going to Hong Kong two weeks before the handover to PRC (People's Republic of China). To make conversation with Dayue Chen, I say that I will go now to the international terminal at Beijing airport, but on my next visit, I will go to the domestic terminal as Hong Kong is shortly to become part of the mother country. "Oh no," Mr Chen exclaims. "That will not be true. We will continue to treat Hong Kong as if it is a foreign country." This is to be the most insightful thing I hear on my trip about Hong Kong and the handover, and that remained true for 23 years.

After the plane leaves Beijing and passes over some mountains, villages are sprinkled out over the plain like a growth of bacteria on a petri dish. I see a river that runs in straight lines and turns ninety-degree corners. It is one of those Chinese-control-nature efforts where the river silts up each year so in response they build the dikes up even higher. As a result the river flows high above the surrounding land, and a huge disaster only awaits a wet enough year. There must be a Chinese Corp of Engineers that designs such well-thought-out projects. They could have meetings with the US Corp of Engineers.

Finishers. Indeed, even two weeks before the handover, Hong Kong reminds me of the ethnic Chinese cities of Los Angeles. Just like Monterey Park, Alhambra and San Gabriel, with some water and a public transportation system thrown in. Well, things are much more vertical here. Monterey Park with hills and humidity, that's my phrase, and the Hong Kong humidity is remarkable. But both places possess a vibrant mix of Chinese-and-English language-and-culture and the sense of a first-world country. I give a lecture, dine with university people, and search out art galleries where I find Chairman Mao in expensive large pop-art cartoons. I crisscross the city, go up Victoria Peak in the famous tram, several times ride the cross-bay ferry, and take a train in a driving rainstorm through the New Territories to the P. R. China border. In my hotel room, I see the CNN version of the leap across the Yellow River that I saw on Mongolian TV. The CNN footage, filmed to be dramatic and exciting, is an entirely different take than I saw earlier. They slowed the film to make the jump last longer. What a contrast! My trip to the good China is over.

Back home in Los Angeles, I play a tape of a Mongolian horse-head fiddler someone on the bus trip bought for me, but the music is syrupy and sentimental. I drive across the city to a Virgin Megastore on Sunset in Hollywood and search out a CD of Mongolian music while rap blares out of the huge store speakers. Back home I load my player with the CD of Mongolian music, another of Zap Mama whose female singers spin out African sounds in entirely unexpected and totally modern ways, and for good measure, a great CD of Emmy Lou Harris singing at the Ryman, that haven of working-class musical poetry. The Mongolian music on the CD takes me back to that dingy auditorium in Hohhot, and horses trot and gallop through some of the songs.

Now I am home in Culver City, in a modest house in the city where the Los Angeles motion picture business started, where Buster Keaton did some of his greatest stunts and part of *Gone with the Wind* was filmed, I am living a life accurately described as ordinary. I would not trade places with any emperor of China. Also I am blessed for having been able to observe China at this point of history.

After. The preceding chapter was written as I traveled in China for the first time. And while today I know more about China, it is not so much more. My incorrect opinions and guesses in the preceding I have left intact. That China would emerge economically so rapidly not foreseen by me. The

best writing by a westerner about ordinary life in China is by Peter Hessler, and his book *Country Driving* set in the mid-2000s is truly insightful, as is anything he writes about China.

I have returned to China many times, participating in the creation of the CAS-Max Planck Partner Institute (PICB) in Shanghai. Regular visits to Beijing occurred while beginning in 2008 I was leader of a Chair Professor team in the Department of Automation at Tsinghua University, and after six years I affiliated with Fudan University in Shanghai until 2019. However the most penetrating analysis I can offer remains “It is China.” (Recall “Forget it Jake, it’s Chinatown.”) The bicycles clotting the intersections of Beijing have been replaced by seas of automobiles where the rules of the road are still being worked out. The remaining bicycles are now decorated with the usual locks to prevent theft. This can be seen as progress or not, but it is inevitable.

I became close friends with Minping Qian. Her student Xiaoman came to USC to work with me, as well as other bright students from Beijing University. Minping finally retired officially but did not cease her constant work. I was the only non-Chinese at her 2009 retirement and 70th birthday meeting in Beijing. Her vast influence was evident, with 100 former students and collaborators attending. She gave a sobering speech at the banquet when she described, in sometimes graphic detail, her years during the Cultural Revolution. She was strongly criticized for a study group at Beijing University in functional analysis which was called “underground meetings.” Her two years with the peasants, then time as a bricklayer, welder, marble factory worker and barefoot doctor. The extreme poverty and the near starvation in the early 1960s were vividly chronicled. Minping came to research again when she was 40 years old. Then she went to St. Louis in the US with the goal of learning new developments in stochastic processes to guide Chinese students to the frontiers of the field. “It was too late for me but I hoped I could help others to find their success,” she said. Her irrepressible spirit will be felt in China and elsewhere for many years, where her work with students and research continued for 30 years even though there was, in my opinion, scant financial compensation. She was PhD advisor to 18 students, and thousands passed through her rigorous and inspiring classes at Beijing University. I gave a short impromptu speech which I ended by saying that there are many ways to measure wealth, and I believed Minping Qian to be an extraordinarily rich woman.

A New Degree for a New Century

“At Princeton we have worked out how to properly educate undergraduate biology majors,” David Botstein said with total certainty. I was sitting beside my friend on a bus going from an Irvine Hotel to the Beckman Center of the National Academies of Sciences & Engineering. In the previous year or two, I had heard Botstein, famous for his scientific accomplishments and strong articulate opinions, make similar statements. He had moved from Stanford to Princeton, where he was director of the Lewis-Sigler Institute. Okay, I decided, it is time to see just what he is talking about.

The story was straightforward. There is a general program at Princeton called the Integrated Science Curriculum. Biology students need a solid preparation in the sciences, for example chemistry as a chemistry major would learn it and not “chemistry for biologists.” They will need computer science, and by that, I do not mean just using packages or writing one-line R programs. They will need statistics and machine learning. They will need differential equations. The list goes on in this manner. Botstein told me of a woman who didn’t want to join the program because she didn’t like physics. Just go ahead and take the class, he insisted. She went on to receive a PhD in physics. I liked the idea of the degree, and I have been highly critical of the usual undergraduate education in biology. Many of the University of Southern California’s biology majors are aiming at medical school and few would be able to handle the rigorous program he described. That’s that, I thought, this would not work at USC. Then in our conversation, Botstein revealed that even at Princeton this was a special emphasis degree, and not all biology majors were doing it. The level of support at Princeton for this program was extraordinary with special classes and designated faculty and postdocs to work with the students. Nothing resembling that level of support

would ever occur at USC.

Later I continued to think about the Princeton degree which I liked a lot. It occurred to me that among USC's hundreds of biology majors surely some wanted to pursue research, and perhaps among those were a few who would be interested in and capable of handling such a course of studies. It would not take many students to have a substantial long-term impact. They would go to the best universities for their PhDs or MDs. The more I thought about it, the more convinced I became that it was worth pursuing at USC. I went to the Chair of Biological Sciences, who listened patiently and then said, obviously with a total lack of interest, "That's fine Mike. You can do that if you want to." Perhaps at a younger age I would have begun working on this in spite of having no one else to engage it with me, but after in past years having designed masters and PhD degrees, this seemed too difficult to do alone.

In Israel I had advised the creation of degrees that were constructed along these same lines. And I did not forget Botstein's degree, which more than a dozen plus years ago was novel in the US. Then Remo Rohs, my colleague in Computational Biology at USC, joined me with enthusiasm, and, largely through his energy and skills, a Quantitative Biology degree (QBIO) was approved. It includes solid substantial courses in physics, chemistry, mathematics and engineering as well as biology. Perhaps the most challenging classes are in computer science. While I expected an energetic push-back from biology department members, the reaction was indifference instead of resistance, except for one statement from a colleague: "Biology students do not need physics." I trace this to the fractured nature of the department with its five research sections that independently do faculty recruiting and graduate degrees, and in a mostly unengaged fashion, share the undergraduate programs.

There was a rare full department meeting where Remo presented the details of the new QBIO degree. Someone asked what the point of a new degree was, and Remo referred the question to me. That instant I decided to say something that I knew was outrageous and anticipated that my comment would create useful and spirited discussion. I was already summarizing in my mind exactly what I was going to say, which would give me a chance to explain why this new degree was important to everyone in the department. "It is so that when they graduate with a bachelor's degree, they will actually know something," I said. I was and remain shocked at the complete lack of response. If someone said this in a computer science or mathematics

department meeting, there would be an uproar. I can only conclude that not many cared about these undergraduate degrees, new or already existing. Some faculty do teach excellent classes and are dedicated to teaching and undergraduates, and much teaching goes on in labs to advance the faculty member's research.

The biology department collectively handles undergraduate studies. There is a general undergraduate degree with other degrees in neurobiology, human biology and now quantitative biology. The additional undergraduate degrees are affiliated with the corresponding sections. As we prepared for a university review of undergraduate programs in the department with reviewers from outside USC, the resistance to QBIO that I had anticipated seemed to be materializing, but the degree was approved so going back was unlikely. A handicap of the QBIO degree is the inclusion of courses in biology that are dreary to our students and taught traditionally. Any mention of eliminating such a course causes near shock in our colleagues.

It is late in the second decade of the 21st century. There have been radical changes in almost every area of science, none more than in biology. This mainstream science is converting to a technology and data driven science at an astonishing rate. And much of what we know and learn today will be outmoded tomorrow. Single-molecule studies require understanding physics on another scale than I learned in school. Computing is taking on massive data sets with corresponding issues of storage and the challenge to create and understand the necessary algorithms. AI and machine learning have become central. Quantum computing will revise what we do and how we do it. On the most mundane level, certain tasks in today's laboratories will be eliminated (routine pipetting comes to mind). Laboratories will never disappear in this most complex of subjects. But even people doing whole-organism fieldwork will increasingly use sensors and other means to gather volumes of data. Scientists will learn what data to collect, how to use machine learning for feature selection, and how to take such analysis back to an understandable relevant interpretation. There is no way that we can teach anyone all that they will need today, let alone what will confront them as the years pass. But we can give the students a deeper understanding of solid and important subjects and expect that they will recognize and learn new material when necessary.

The current QBIO degree that began in 2017 is what we have called an elite degree, meaning that it is challenging and at the top level of undergraduate studies. The word elite brings negative reactions, but to pretend

that all subjects and all students are identical is not a productive approach to education, although it is now dangerously widespread. We look at every applicant, and only admit students we believe will succeed in the difficult program. Each semester we examine their grades, and when they are not thriving, we meet with the student. After discussion, we sometimes suggest that they switch out. Our aim is to give them an excellent appropriate education, not merely to inflate our enrollment numbers. In articulating arguments for the QBIO degree, we have realized that the reasons for the QBIO degree are valid for almost anyone in science today. For example, any science student must thrive in the world of big data. Regrettably, in biology, there is not a traditional emphasis on mathematics and computing. The USC undergraduate genetics class does not have probability and statistics in the list of five prerequisites! Using packaged programs and writing small codes is fine, but they will need to know what an algorithm is, how to formulate the computational task and analyze how a method will work. They need to understand the assumptions for statistical methods (saying just apply the t-test or principal component analysis or machine learning will not suffice!). So we have concluded that a QBIO degree would be useful to a larger group of USC students. After enough years it will be a standard course of study everywhere as it already is at Princeton, MIT and Caltech. At USC Dornsife this will require additional and appropriate faculty. We must do what is best for our students! That after all is our job—at least it is supposed to be our job.

Addendum: I often write to document and explore whether I understand what is going on, and I did not anticipate this being made public until it appeared here. Remo felt it should be part of an external self-study of the department's undergraduate programs, and a first-person narrative in a degree study seemed odd but he insisted. The paragraph about the department meeting was not written at that point. This time there was a strong and understandable response from the Department Chair and Dean's office. Calling courses dreary and using the words push-back particularly offended them. To help Remo keep parts of his write-up that were objected to, I trimmed my words to one page and scrubbed "offensive material." Push-back did materialize in nasty and strange ways. When we had a meeting about the review document, I marked all the creative words our QBIO students used in an anonymous survey that objected to the classes I referred to as dreary. Alas

the topic did not come up as I was looking forward to reading that sincere and critical list of adjectives the students used, which made dreary seem to be a compliment.

A Great Hope Fell

*A great Hope fell
You heard no noise
The Ruin was within
Oh cunning wreck that told no tale
And let no Witness in*

—Emily Dickinson

2018 was my 37th year at the University of Southern California, and during most of that time, I chugged along, doing research, advising students, teaching classes, and doing the service and committee duties needed to keep a university going. I did not expect to stay long when I joined in 1982, but for various reasons, I stayed and until recently did not regret it. It's good to be at a university that is better than its image rather than the reverse, I often said. This, I feel, is no longer valid, and finally USC's top-down daddy-knows-best culture has caught up with the university, revealed in a series of depressing scandals. I have written and discarded three different versions describing USC leadership, and this one pleases me no more than the others. I wrote the first version as president Sample retired as USC's president and Max Nikias became president. Nikias increased the rate of building construction, including an expansion on nearby land USC previously obtained. Programs increased, including the hiring of large research groups. Later USC's scandals came into full view, involving many aspects of the university. There was something at every scale, from the Trustees to the president to Dornsife College to departments to research groups.

Let's begin with the alcoholic football coach Steve Sarkisian, hired in 2013

without a careful internet search which would have revealed his addiction. During his first week on campus, he got drunk, swore and insulted a crowd of parents during a presentation. President Sample, suffering from Parkinson's Disease, was succeeded in 2010 by Max Nikias. While I believe Sample would have fired Sarkisian on the spot, President Nikias did not fire him until in 2015 Sarkisian did not show up for practice and was drunk at a team meeting. I do not know what actions took place out of public view. My assessment of Nikias's leadership is that he wished to keep frank statements private, even those remotely negative about USC. I can only infer from the outside.

An appalling scandal involved Carmen Puliafito, appointed dean of the Medical School in 2007. The plot, barely worthy of third-rate fiction, includes drugs, prostitutes and illegal behavior. The LA Times wrote in 2017 that he "kept company with a circle of criminals and drug users who said he used methamphetamine and other drugs with them." The reporters reviewed video and photographs of Puliafito engaging in these activities in hotel rooms, apartments, and his USC Medical School dean's office. A 21 years-old prostitute overdosed while taking drugs with Puliafito in a Pasadena hotel room on March 4, 2016. The LA Times relentlessly reports on USC problems and took the July 2017 article to Nikias's residence before publication where he refused to accept it. Such symbolic behavior sounds like shoddy fiction. The book *Bad City* by Paul Pringle gives a reporter's view of these events which almost escaped becoming public knowledge.

Then in 2018 a USC gynecologist was accused of molesting over 100 young women in his nearly 30 years of practice. Even when in 2016 a staff member reported him to the rape crisis center, and USC determined the charges were true, the university allowed Tyndall to keep his medical license and did not notify the state Medical Board. We will never learn who knew what and when they knew it. USC's usually passive faculty organized a group called Concerned Faculty. On May 24, 2018, they wrote a letter requesting that Nikias resign and the Board of Trustees "restore moral leadership to the university." Although I seldom sign petitions, I asked myself, "If not now, when?" and signed this letter. The Board, mainly comprised of business people, is large and unwieldy. Some Board members felt there was nothing to be concerned about, and when it appeared Nikias might have to step aside, they thought he could apply for the to-be-open position of USC president. What a mess!

The next upsetting news was that the school of social work passed money through the school to benefit a Los Angeles politician and his son. This

was minor perhaps, but it revealed corrupt management of the school and its programs. Mark Ridley Thomas, the politician, and Marilyn Flynn, the former dean, were charged in a 20-count indictment, so this was not nothing. Flynn pleaded guilty and Thomas was convicted of bribery and conspiracy.

Then came national headlines: a USC administrator and three coaches helped students gain admission with faked qualifications. In these widely publicized admissions cases, USC joined Georgetown, Stanford, UCLA, UCSD, University of Texas at Austin, Wake Forest and Yale. This list includes universities of which USC aspires to be equal, so in a sense we achieved our highest aspirations. Ha! William G. Tierney has provided the most insightful analysis of these events in various editorials. Someone needs to do a book-length in-depth autopsy of USC's troubles and why they happened. Tierney would be my first choice to author it.

Now to reveal some biases. Growing up in rural isolation, I had no idea how anything outside our ranch operated, and I certainly did not credit or give thought to management of organizations. Schools, cities, states, and countries just existed, and I didn't consider what it took to keep them operational. Still, when I was an undergraduate at Oregon State, we needed a name for a fictitious student for whom we turned in linear algebra exams; I choose Jack Rice, my high school superintendent, because I thought he was a hollow man with no duties except for sitting in his office. And the president of Idaho State University at my first academic job was another version of Jack Rice. Life at Los Alamos Labs had a lot of "behind the scenes" never observed by me, but Los Alamos was implicitly a scientific meritocracy. Until I came to USC, my view was that, besides teaching and research at various levels of skill, university administration was there to buy supplies, paper and pencils, maintain the buildings and facilities, and do the bookkeeping. This reveals how little understanding and insight I had.

The upward trajectory of USC since I arrived, especially since Steven Sample became president in 1991, is truly impressive. I have described some of this in the USC chapter. I am convinced that, in the words of a country song, it didn't need to be this way—referring to the scandals. The management of universities has become more professionalized, including increased pay for people in leadership positions. Often the goal of those with such appointments is to keep the job, cook up trivial initiatives and titles for their CVs and hope to move up the ladder. They get points for recruiting big-deal faculty who consume resources and often are either over the hill or mediocre. This is not universal; there are gifted and effective academic administrators

and great high-level hires; Mark Kac in mathematics and Kevin Starr in history had significant impact on the university. But far too often that is not what's going on. Maintaining Mediocrity, I have called it. The longer-term strategy of hiring young people with great potential and building a solid identity is often neglected or even shunned. That requires vision and judgment. And, while I have been critical of Nikias, I have no doubt that he wanted USC to have better faculty and be a better university. Today I do not detect any movement toward that.

Next I will briefly describe some events in my former section of Biological Sciences. They are a sad minor offshoot of the general situation at USC coupled with the national #MeToo movement. It is not at the screaming crisis level as the scandals I mentioned above, but I could not avoid getting involved as it involved people I care deeply about: students, postdocs and young faculty. I began to make detailed notes (not included here) when I realized I might be called on to offer testimony, and I wanted to document the dates and events as accurately as I could.

For many years I was in the Molecular and Computational Biology (MCB) Section of the Department of Biological Sciences, where sections are run much like normal departments. Molecular biology (MB) and computational biology (CB) faculty understandably occupy different intellectual universes, and I am a computational biologist. Recently we were divided into MCB and QCB sections, and then QCB became a department where I am a member. In another chapter I briefly described those fractious events.

In meetings of a CB faculty member with his graduate students that faculty member brought up the recent LA Times story and scandal about Dr. Tyndall, the USC gynecologist. The women students, some of them Asian, knew of Tyndall before the LA Times account appeared, and they may have been subjected to him. I look on the CB graduate students as my grandchildren (while I very much doubt that they see me as granddad), and this was deeply disturbing. I was shocked. What else, I asked myself, is under the surface that I have not seen, of which I have no clue? How do we find out what is there, and what can we do to remedy it?

Clearly my male colleague and I could not effectively delve into these matters but, we felt something needed to be done. The result was that a female staff member held a Town Hall Meeting in our building for women graduate students in August 2018. USC's Chief Health Officer attended and

spoke. She said that, in an AAUP 2015 survey, USC was the third worst university surveyed on sexual harassment. Four students attended the Town Hall, and each had a complaint. One brought her issue to four different MB faculty, and it went nowhere. One student talked about changing the culture in the building. They were concerned about the upcoming retreat where, in the past, intoxicated faculty made inappropriate remarks. (I did not attend a retreat for at least 10 years. I considered it expensive and a waste of time, whatever the stated goal.)

The four students' complaints are clearly an underestimate of the situation. A graduate student spends around five years of study to receive a PhD under the leadership of their advisor. And the PhD cannot be granted without the advisor and committee signing off on the student's original work. Therefore the student is vulnerable. An advisor can stop support of research materials and salary. Switching advisors after beginning is not easy as the work will probably not carry over. And an advisor can give negative assessment for the switch and also in writing recommendations, thus greatly damaging the student's career. The same vulnerability holds for postdoctoral appointments and junior faculty.

With the support of the Provost, the diversity office did engage, if only slightly in the beginning. The knowledge that an investigation might be happening reached the dean's office in October. The next day one of the sub-deans asked the staff person about the meeting with female students, and when she was reluctant to give details, he said, "I have my dean's hat on so you must tell me who the students are." What is appalling to me is that he is in the dean's office and also the department in question, so it is inappropriate for him to be learning the student and faculty names, all the more so as he is one of those whom a student named! Both Remo Rohs and I protested to the dean's office and were told there was no issue. No one in the dean's office expressed any concern about the students. Apparently they were worried only about their liability. I have taken online harassment training courses for three universities: USC, Caltech and University of Virginia. There are clear guidelines for reporting, often ignored in practice. Those subjected to improper behavior usually don't tell anyone and, as my example here illustrates, if they do the situation is seldom appropriately handled.

Then we received a visit from another sub-dean, and clearly it was to ascertain what had been reported and when; there was an interrogative and accusatory aspect. The students and their issues went unmentioned. Soon after this news was released that the Business School dean, James Ellis, was

only to serve until the end of that current academic year. The reason given was his inadequate response to sexual harassment and discrimination claims against faculty and staff. As usual USC revealed no details, so it is impossible to know if this action was justified. Then it became clear to me that the visit to us had to do with the Dornsife dean's office making sure they were not vulnerable to similar charges.

On November 9, 2018, an article in the *Chronicle of Higher Education* "How a Department Took On the Next Frontier in the #MeToo Movement" confronted similar issues. Here is a quote: "The professor who stared at a graduate student's chest while crossing paths in the hall. The texting during a female job candidate's lecture. The visiting speaker who opened a talk by describing the students in the room as beautiful women." Our section head in a meeting had recently described one of our job candidates as "so beautiful that I'd marry her." He is of course married himself.

Before the retreat, the students requested a private session on harassment. The organizers said that would not be allowed without faculty present. Then the students created discussion topics, and there were "breakout sessions" covering a variety of issues. At least two of the faculty accused of inappropriate behavior were discussion leaders. It would not be possible to respond in a more intrusive and shameless fashion other than forbidding the sessions.

The situations described here are the result of culture, which is both global and extremely local. Each research group is a different situation as is each section or department. A Dornsife College or USC survey would be almost useless without the department and group structure maintained in the report. There is no discussion of such a survey.

So that's our last sad story which does not rise to the level of USC's more publicized troubles; at least the LA Times would not bother to cover it. This sort of thing has gone on forever and it exists in any organization of some size. It is time to end such behavior which is even more difficult than ending the most egregious actions. In our case the culture allowing and amplifying the situation was created by the leadership and individual research groups. At the highest level, there is the contrast between president Sample, who would have said, "I will not have this," and president Nikias who might have said "Do not let anyone know this is happening." The latter strategy works if issues are effectively dealt with. It will help if every administrator at every level is alert to problems and addresses them. That will not happen anytime soon, I fear. Regular assessments of the atmosphere within each

department by a committee of sensible and sensitive faculty and staff could reach into problem areas and bring progress. It could also be vindictive and destructive. We need explicit standards of behavior and we also need genuine culture changes. Is that to be the task of the next generation? Or will we never get around to it?

Speak to Me and I Shall Scream

March 2020

I lived in a high-rise on the western edge of Downtown Los Angeles for a half-dozen years. Not owning a car, each morning I walked east on the Wilshire Boulevard overpass across the 110 freeway, which in that region is called the Pasadena Freeway. Reaching Flower and 7th, I would take a bus or the Metro to work. Downtown LA was a high-profile city in the 1920s and 1930s with many branches of the financial industry and luxury hotels such as the Alexandria, the Rosslyn and the Biltmore. After World War II the city's population exploded and left Downtown LA in a long decline. Downtown was forbidding when I arrived in Los Angeles in 1982, especially at night. But there were bright spots, such as the area of Broadway near Grand Central Market. In daytime, it was like visiting a Central American country with Grand Central's still vibrant neon signage from the 1920s. And right across the street was the Bradbury building, my favorite interior architecture in Los Angeles, which was in such disrepair that allowed Ridley Scott to afford shooting there some scenes in *Blade Runner* (which premiered in 1982). That noir science-fiction Phillip K. Dick vision of the future of Los Angeles seemed to be accurate as the 1980s and 1990s progressed, except for the women's hairstyles. In those decades I walked along Broadway looking in awe at the defunct hulls of movie palaces of the 1920s and 1930s. The Million Dollar Theater, The Mayan, The Arcade, The Roxie; by one tally there had been thirty-six just on Broadway. When I walked by, the ones still functional were showing Spanish language or porno films. What it must have been like to stroll along those streets in 1925! And there was Clifton's where in the Depression you paid whatever you felt you could afford, if anything, for meals: "Pay What You Wish, Dine Free Unless Delighted." By the 1990s Clifton's was barely operating, and after a fire around 2010, the restaurant

closed. I am happy to note that a revitalized Clifton's opened in 2015.

In the 1980s a larger homeless population emerged. As in many modern cities, the poor clean our homes and businesses, cook and serve our food, trim our trees, and mow our lawns. The cost of living shot up and more people became homeless; this was visible even to me as they sheltered under freeway overpasses. The population living on the streets in the so-called skid row of Downtown grew substantially. In 2020 the city had about 60,000 homeless and Downtown had a large share. But this is overlaid by and conflicts with a renewal of Downtown business and buildings. New construction and renovation of run-down buildings came with an influx of younger hipsters—Downtown is again a desirable place to live, work and recreate.

The increased population in Downtown Los Angeles may help the homeless with more handouts, I do not know. But that younger population overlaps with the less affluent, creating ironic and sad interactions. Friends expressed concern about my living in Downtown but I felt safe. It was necessary to be alert, and I did not walk near skid row after dark. Instead of handing money out on the streets, I make monthly contributions to charities that feed many people in the area. Still, that does not make it easy to walk by desperate people, and I did buy meals for a few families I could not pass by. I loved living in Downtown LA; it has a spirit and a sense of becoming and transformation that gives me energy and optimism. Restaurants close and more restaurants open. New buildings go up and more people fill the streets. When Ralphs first opened, there was a line before daylight to buy groceries, and now there is a Target and a Whole Foods. Grand Central Market has become an “in place”—I nostalgically prefer the older version but life happens. A restored Bradbury has, among other occupants, the headquarters for the Los Angeles Police Department Internal Affairs Division. Put that in with your mental images of the Bradbury scenes from *Blade Runner* and the Amazon series *Bosch*.

On the western edge of Downtown, there are fewer homeless than on skid row, but they are present. A long row of tents and shelters along nearby Beaudry borders the administrative offices of the Los Angeles Unified School District. (I mentioned irony above. Well-paid public executives park indoors and never confront the downside of our culture suffering on the street that goes past their workplace.) Frequently I walked by people who pitched tents on the sidewalks of Wilshire Boulevard. I am a wilderness hiker and camper so this struck me, people camping on a sidewalk perched over one of the busiest freeways in America. Guy Clark has a line in one of his songs, “He

ain't passed out, he's campin' on the lawn," but this was not the kind of alcoholism or camping Clark referred to. Despite this, I never walked along Wilshire over the Pasadena Freeway without a feeling of wonder at striding over snarled traffic in the shadows of tall buildings. This is somewhere, I told myself, this is something to remember.

One late morning I headed down the slope of Wilshire from my building to catch public transportation to work. There was a young man in his late 20s or early 30s, tall with a beard and long hair, dressed in flowing robes. He appeared strikingly like images we see of Jesus, and he stood beside a stand that had a large poster on which he had written Jesus Saves/Find Redemption Now. He did not speak, but the Christ-like figure held a New Testament and a long staff and intensely stared straight west toward the freeway. As he stood facing the stalled traffic, someone in a car stuck his head outside his window and shouted, "Beam me up Scotty!" Three or four hours later I returned home, briskly walking up the Boulevard, and the young man was still there, now sitting in a bent lawn chair. As I came by I noticed that his New Testament had been strapped to an upright barrier, shielding us from the drop to the freeway, the text facing the stream of cars. Then it hit me; he was Spamming for Jesus! Recall those emails we get that try to extract money from us which work on the principle that a tiny fraction of the recipients of the emails will take the bait, and they cost nothing to send. This was the same thing, only to catch converts to Jesus. And you could do it sitting down, while traffic crawled below the bridge.

Near the DASH bus stop on Flower Street at 7th, I noticed a homeless guy who often set up there. He arranged himself in a way that I might were I homeless. He found substantial boxes and organized everything he had including his sleeping bag within that space. It brought thoughts of how I position my sleeping bag and gear when camping by Wildhorse Creek in Idaho's Pioneer Mountains. The short Hispanic man had a reddish beard and stringy hair. Somehow he found copies of the LA Times, which he intently read, tucked into his sleeping bag, while sidewalk foot traffic flowed by him on his right and Flower street auto traffic on his left. Once I came along to see the title of the LA Time's page he was reading: "This Weekend in Los Angeles." You could smile at this in a superior way, but this guy was as much a resident of Los Angeles as anyone is, taking pleasure in what is out there in this vast city. While you cannot do it all, you can be cheered knowing that it is somehow available. I started giving him some cash each week. He clearly recognized me but never used his knowledge that I gave him money

to imply that I should give him more money. This revealed a dignity that I also saw in his arrangements. One day two street policemen were trying to move him, and I stopped to talk with them. I said that this was the only person in Downtown I gave cash to, and they admonished me: “Don’t do that; you just keep him out here on the street.” They were trying to get him into a facility, and he refused to go, so it may be that they were wrong about the consequences of my helping him. I wondered, isn’t this man doing exactly as wishes, given his circumstances? Still, they shook my confidence in the worth of what I had been doing, and my cash donations did not stop but diminished somewhat. This went on for perhaps three years and then he no longer appeared in his camping spot.

I am writing this in March 2020. A half year ago, I moved to Pasadena, near California and Lake streets in a comfortable neighborhood. I miss the youthful energy of Downtown LA and the “zip” in the air. I joke that I used to think Pasadena boring, and either Pasadena has changed or I have, meaning that I have changed by entering into the category labeled elderly. But Pasadena has also changed, and I love being within a one mile walk of the Laemmle movie house that shows independent films and there are various playhouses and museums. Within one block, there are several coffee houses, two grocery stores, three higher-end restaurants, and other options such as the famous Pie-and-Burger. Oh, and Caltech is two blocks away.

At first, in Pasadena the homeless seemed nonexistent or nearly so. Then I noticed a few people. A guy in his late 20s stashes his gear during the day (in Downtown it would not be there that night) and leans against a planter in the evenings, later sleeping in a nearby doorway. A large, healthy-looking African American man who owns an expensive bicycle sits in front of May Company asking for money. And a woman who wears clothes and blankets draped over her body. She looks the most desperate, quietly desperate, and sorts out bottles and plastic from garbage cans. I have not seen her for some time. But the most interesting street person is a guy, the little man I call him, although slight is a better word than little to describe him. Perhaps in his 50s, he has a narrow face with sharp features. His shirts and pants are tan colored and surely polyester, his upper clothes a bit darker than his pants. He is not dirty but he is not clean either. I wondered about where he spent his nights. He has a little pack and a water bottle and works the trash cans removing food, bottles and plastic. Midday he often sets up on a table outside the local Starbucks. One of the residents in my apartment building tried to talk to him, asking if he could help, and the guy exploded, screaming

and almost having a fit. I was two miles from my apartment near Pasadena City College around 9:30 a.m. Returning, I caught the bus that goes west along Colorado Street from Azusa in the east to Hollywood in the west. As I boarded the bus, there was the little man and only two other people. I did not look at him directly but heard him make odd noises. The bus came to Lake Street and I got off to walk the mile down Lake Street to my home. The little man got off too and it dawned on me that he lives somewhere out toward Azusa, and he commutes to work, to pick up salvage in the affluent trash cans of Lake Street. After a morning of picking along Lake Street, he can lunch at Starbucks's tables, resting for the afternoon of gathering back up Lake Street before he returns home. We all need structure in our lives, and this guy has that solved, commuting to and from work. Now he comes earlier as the amount of food and recyclables going into Lake Street trash cans is greatly diminished with COVID-19 restrictions, and he lives on the streets nearby, apparently having lost his housing.

How to end this? And by "this" I mean not only these paragraphs, but also the huge number of homeless on our doorsteps and how to help the variety of human beings out there in our cities—how to reach them, how to respect and at least support their human rights and dignity. These are human beings as varied and creative as is any group you might choose to examine closely. And how will the City of Los Angeles protect them in the harrowing crisis of COVID-19 that many of us hover in our homes to escape? As I am sure these paragraphs illustrate, I do not have much to offer.

Endings

It is late afternoon on an April day in a hotel room next to the North Carolina State University campus in Raleigh. I am here to deliver a lecture—not just any lecture but the 2009 Einstein Public Lecture of the American Mathematical Society. Mine will be the fourth in this annual series, and when I look at my predecessors’ names, I realize that agreeing to do this was naive, to put it most kindly. When I was invited to give the lecture, I was pleased a 1995 paper of mine had introduced the method most programs use to determine DNA sequences from the new generation of sequencing machines. The paper was almost unnoticed when it appeared, so the recent attention was gratifying. The volume of data produced by the Human Genome Project during 1990-2001 could in April 2009 be produced by a one-morning run of one of the new generation machines. So I have a good scientific story, and some mathematics to apply that originated with Leonard Euler. The title is “Reading DNA Sequences: Twenty-first Century Technology with Eighteenth Century Mathematics.”

Euler wrote a paper in 1736 that began the field of graph theory, and Eulerian graphs are the basis of my method. Students sometimes learn about these elegant graphs before their university studies, although I came upon them long after I received my PhD. Many people believe Euler was the greatest mathematician in history; Euler or Gauss, you can’t go wrong. His identity

$$e^{i\pi} + 1 = 0$$

was labeled “the most remarkable formula in mathematics” by Richard Feynman. Feynman cited the use of constants 0, 1, i , e , π as well as the operations of equality, addition, multiplication and exponentiation, each employed exactly once. This is only one instance of Euler’s celebrated formula connecting

the so-called imaginary number $i = \sqrt{-1}$ and the trigonometric functions with points on the unit circle in the complex plane: $e^{i\theta} = \cos(\theta) + i\sin(\theta)$. But I also enjoy describing the wonderful calm personality of Euler the man. Born in 1707, he lost his right eye in 1738, and soon after 1771 due to a cataract, he became virtually blind. His great work continued to flow, and a contemporary said of him, “A child on his knees, a cat on his back, that’s how he wrote his immortal works.” Here is a description of his death in 1783: *[He] outlined the calculation of the orbit of the recently discovered planet Uranus. A short time later he begged that his grandson be brought in. While playing with the youngster and sipping some tea, he suffered a stroke. His pipe fell from his hand and he uttered, “I die.” At that instant, in the words of Condorcet, “Euler ceased to live and calculate.”*

I had given this lecture twice before. The lecture covers the history of DNA sequencing from Watson and Crick’s 1953 discovery of the double helix to Sanger’s mid-1970s sequencing technique which was geared up to be the workhorse method of the Human Genome Project. Then I describe the new sequencing methods, which are amazingly parallel and produce so much data that the old computational methods with all their enhancements can no longer be used. My application of Euler’s graphs rather magically makes the formidable computational difficulties vanish, although substantial new challenges show up, of course.

At the Carl Franklin Lecture on Science and Society at my home university USC, I ended the talk with some material on race and genetics. I have been presenting material on race for a few years, and it is a good way to catch the interest of an audience. Until recently race was a topic avoided by most molecular biologists, but the human genome project changed that. The search for population diversity and its connection with human disease has brought us directly to race, whatever that is. Race is variously declared to be nonexistent, all the way to being totally determinate of human health. An anthropological society said there was no such thing as race; we are anthropologists and therefore we know, seemed to be the reasoning. On the other hand, arguments as contained in *The Bell Curve* by Herrnstein and Murray contend that whites are smart and blacks are not, due to their genetic heritage. (Define race, define intelligence—this is not easy.) Now that there is data with much more coming, neither extreme position is viable, so I argue. Humans share identical large blocks of DNA inherited from our mothers or fathers; the mutations that cause characteristics of our relatives are perhaps important but also not hugely different from those of anyone else. We all

have a crazy uncle, so get over it; that's my message. When I was preparing the lecture, I read the preprint "Playing the Race Card" which demonstrates that racists are dressing racism up with the new data and not changing their positions a bit. This is a depressing turn of events, although a realist could have predicted it, and I ended with this mixed message. I believe the listeners were sobered by this material—as I intended for them to be.

A few weeks later, I gave the lecture with improved animation of the graphs at the opening of the new School of Mathematical and Statistical Sciences at Arizona State University in Tempe. I lopped off the race and genetics part of the lecture as it felt too personal to be appropriate outside my own university. The talk seemed to end with a whimper (or was that a thud?) and was out of balance; at least that was my sense of it. Students in the audience liked the material, and they remarked on the visuals I had made for the elegant graphs. One goal of a good lecture is to make the audience feel smart—which they are of course. However I was now even more uneasy about my upcoming Einstein Lecture.

In North Carolina I take my suit from the closet, my only suit, my elegant, beautiful suit. In the 1980s I owned a nice suit, but during the 1990s my exercise program and an increasing waistline expanded me beyond its boundaries. I thought I would spend the remainder of my years without purchasing another suit. My day-to-day dress style descended to my natural garb: jeans and a clean shirt. In 2005 I was elected as a foreign associate member to the French Academy of Sciences, Académie des Sciences, founded in 1666. In December 2006 there was a ceremony celebrating the foreign members elected in recent years. (There are so few non-French elected to this among the oldest of the world's scientific honor societies that it takes a few years to accumulate the dozen or so to make the inaugural event significant. The Academy has approximately 450 full and corresponding members and 120 foreign associates.) Obviously, I could not escape realizing this was a time to dress properly, and I headed to Academy Award Clothes on Los Angeles Avenue in the Garment District. This venerable institution is rather club-like and old-fashioned, all the more unusual in the almost carnival-like atmosphere and cut-rate businesses of the Garment District. You enter the store and are stopped by a counter. Eventually someone asks what you have in mind. All that is required is to say "suit" or "sports jacket," and then you enter through a portion of the counter raised to admit you. An expert is sum-

moned who guides you to exactly what you want in precisely the right size. I have no idea how it is done, but the staff are expert clothing authorities. This landmark institution the spring of 2009 closed to business, something which makes me sad. Never again shall I be able to place myself in their expert hands, never again shall I be so well guided to appropriate clothing. I had best not require another suit in this lifetime, as I shall have no idea where to find it. Their suit was perfect for my day at the Institut de France.

We gathered in a room in Paris, hearing the history of the Academy, including that Madame Curie was not elected even after her second Nobel Prize. The first woman elected was in the late 1970s. Then we took a tour of the magnificent Academy building, a tour which was theater, an expert telling us details tiny and large, showing how the structure has reflective symmetry with the Louvre on the opposite bank of the Seine. And there is a tall door opened only when the President of the French Republic visits the Academy. We walked through the ancient libraries, ate a very French lunch, which yes included foie gras and sauternes, and then walked down the winding stairs under the famous coupole with stirring music from uniformed musicians. The ceremony was very moving, which I had not expected. Even the fact that I had a severe toothache, which a day later resulted in a painful root canal, could not ruin that glorious day. Such an honor it was, and what a satisfaction to be confidently well-dressed for the event.

Not only does the coupole in Paris come to my mind in North Carolina, but also there is a heavier memory of the last time I wore this suit. This weight had been with me for nearly a year, or was it for nearly a lifetime?

My mother died at 95 during the summer of 2008, and I returned with my daughter to Oregon. We had been there for my mother's 95th birthday in April when a freak snowstorm almost stranded us. We returned three months later on a summer evening and drove from our Bandon motel to my mother's house where we sat at the kitchen table. My brother's daughter Amy quickly expressed disgust at any conversation about what to do with my mother's possessions. "This is gross. I won't have anything to do with it. Gross!" Allocations had not been mentioned at the time, so it was a bit odd. Within five minutes of that display, Amy disappeared into my mother's bedroom; she soon emerged wearing a flowered Polynesian dress, spinning about, saying she couldn't believe her grandmother had ever worn such an ugly thing. A few minutes later she popped out with another flowered

outfit and repeated her weird performance. Then my brother's wife took my daughter Tracey into the bedroom and told her to choose something from my mother's costume jewelry. The expensive stuff had gone wherever such things migrate to whenever there is a death. Later, asked if there was anything she really wanted, Tracey answered: yes there was, that small cream pitcher which my mother used. "No, you can't have that. We want that."

I was handed a copy of the will and a page where my mother had written out her wishes for some of her possessions. The will contained language that gave a tortured justification for the inheritance my daughter and I received, or I should say the inheritance we did not receive, some sentences saying I had done well and didn't need anything. It was clear that Charlie and his wife expected me to be upset and angry. Charlie seemed not to comprehend when I said, "I left Four Mile long ago." He said more than once, "I get the ranch," and I must say the human price he paid to secure the land is staggering. He certainly was welcome to it. All those years at the beck and call of my parents, doing my father's bidding, the anger, the shouting. This recalled some lines of Carrol Ann Duffy from her poem "Selling Manhattan."

Man who fears death, how many acres do you need
to lengthen your shadow under the endless sky?

Needless to say, I didn't quote poetry to my brother who is, to put it kindly, not a reader. Those many years ago I had, mysteriously to my family, gone away and found freedom there. And there are the forgotten Native Americans who for thousands of years lived with this land. That we can feel superior for owning land recently ripped from them, superior because our almost penniless ancestors endured on cheap land in what was then out in back of beyond....

In 2017 my brother and his wife were awarded century ranch status by the state of Oregon. In an interview, my brother said "It's a business now. Farming's risky all right, but you have to be diversified and run it as a business." My grandfather, who started the ranch, would never have had such a thought, let alone spoken it. His life was important to him; his possessions were not. My father, who with unending labor glued the ranch together from thirteen separate properties, was mysteriously missing in my brother's comments. My father would have said something like, "making money is what matters," but his life contradicted that. Accumulating property was deeply important to him. In another generation or two, the land and wealth that my father created will have diffused like Oregon's mist after a storm.

Just as with my father's death there were no occasions of recall of the departed. The talk was of land, goods and weather, never of memories or gratitude for my mother's life. No stories about her.

Repeatedly I was offered presents I made to my mother over the years, offerings I found disturbing, as if the gifts to my mother were made in expectation of them being returned. I had made a game of trying to find things she might appreciate; her taste and mine were a world apart. They were drawing a line: this all is ours; you take back your trinkets. (An elegant obsidian necklace from a Mediterranean island and a Murano glass bowl were not on offer however.) I had delivered these items from the outside world and now there was a strong desire to send them back to wherever they came from. My daughter and I took back to Nevada the painting of my great-grandfather's Tucannon River ranch. After years of searching I had located and hiked in that country; this small painting hung in my grandfather's house and was part of my childhood geography. Fortunately my relatives had no desire to keep the painting.

In the late 1950s, Harley Hildebrand took wood from a Four Mile maple tree and made two end tables and a small shallow bookcase for my parents. To take back some Four Mile wood and nostalgia, I asked Charlie for them. At that point, I knew I would take only the bookcase back, as the end tables were too large to fit in the car, but I had seen the naked greed and wanted to test what would happen if I persistently asked for something. "No. You cannot have those, we are using them," was the answer. I repeated my request several times and there was no give. My brother's inheritance by any estimate was worth serious millions, but inheritance did not induce generosity, perhaps the opposite. What was theirs was theirs alone, not for the likes of disinherited us. I did not want anything except the little painting which was part of my relationship with my grandfather. My inheritance was childhood memories; nothing else remained.

The handwritten sheet from my mother had my daughter's name down for the family silver, but her name was crossed out and replaced with the name of the other granddaughter Amy. Amy, who sells formulaic relationship-advice books over the web, already had carried off the silver to her home in New Zealand. (After a divorce she returned with her child to live in the old ranch house.) Amy was also left the collection of sheep figures, ceramic and otherwise, that my mother had gathered over the years. As she was wrapping these silly objects for shipment to New Zealand, I found it humorous that the two people in the family who had no hands-on experience with actual

sheep were the ones to have such romantic unrealistic inclinations. A few days working with real animals would have put an end to that.

The next afternoon there was a small gathering at a mortuary above a Coos Bay slough. I wore my suit. Women in the Waterman family handle all transactions that have emotional content, and Sharon, my brother's wife, was in full charge with Amy talking non-stop, talking about nothing but she wouldn't even stop for air as the saying goes. Charlie and his son Franklin stood back from the activities, dressed in Levi's and work clothes. Charlie did recite how much my mother's new bathroom had cost and how few months she had used it. Franklin was the only person who appeared to be genuinely and deeply sad. My brother on the other hand seemed to be quietly and smugly elated. How many decades had he waited for this day? The ranch was now his and his alone. With a cubicle open to place my mother's ashes with my father's, Amy went on about how drab the interior was, how she would install a silk lining and one of the sheep figurines. It was a black comedic note worthy of Evelyn Waugh. Later I wanted to ask Amy if she was regularly going to send new model sheep from New Zealand because animals need to be rotated into new pastures. As my father used to say when livestock would break into my mother's yard and leave manure, "Ya gotta have fertilizer."

Sharon said she was puzzled by my mother's refusal to be buried beside her parents. My mother had said she did not want to be outside in the weather. This was how my mother spent her life, an entire lifetime hiding from her body and the world external to the rooms of her house, self-imprisoned for 65 years.

After this sad affair, there was a gathering at Franklin's home. My daughter and I stopped at the cemetery in Bandon and tried to locate my Waterman grandparents' graves. We walked back and forth across that damp ground, and even though I vividly remember my grandfather's funeral in rain, we failed in our search. It turns out that there are two cemeteries in Bandon near to each other, and we were at the wrong one. Then we went to Franklin's home to a gathering of people from the neighborhood and some relatives. The food was typical tasteless Oregon coast grub, in perfect keeping with the society gathered there. Not once were people asked for their memories of my mother, nor was there even a moment of silent tribute to her life.

I was the only person in a tie, let alone a suit. For some time it sheltered me like a flak jacket protects during a horrendous battle. I did not take

one drink of alcohol, trying to avoid saying something I would regret. My daughter reported the following conversation. Franklin was asked how his father was doing. One expects one of those comfortable cliché answers such as, he is doing as well as expected under the circumstances. Instead it was, “My father is doing as well as he *ever* has.” My brother and his son are as conflicted as were my brother and his father. Relationships built upon shouting and fierce righteous anger.

On the long drive to Oregon we played “Black Cadillac” by Rosanne Cash, an album memorializing her father Johnny Cash. (“It was a black Cadillac drove you away/ Everybody’s talkin’ but they don’t have much to say”.) On the return through ancient southern Oregon mountains, I kept quoting Townes van Zandt: “It’s snowin’ on Raton—come mornin’ I’ll be through these hills and gone.” “Black Cadillac” with its heartfelt grief and, yes, appreciation was off the table on the way back. Then as Tracey and I emerged into the high-desert land of the Great Basin we played The White Stripes and came once again to find the redemptive power of good rock-and-roll played loudly.

Fortunately that afternoon in North Carolina, my suit-induced freight cars of thought and emotion left me, and it was time to head for the lecture hall. The lecture was as good as I could make it, I reassured myself. The solution I used to conclude my Einstein Lecture was to describe the way forward from the Human Genome Project, to list some large projects currently underway. One is the Cancer Genome Project which seeks to find genetic characteristics of various cancers. Just accurately classifying cancers and linking them with appropriate therapies will be a significant advance. Next is the Metagenomics Project to sequence all microbes residing within and on our bodies. We carry on and within our bodies ten times more bacterial cells than human cells, which are key to our health. Then an international consortium wishes to sequence 1000 human genomes to map human genetic variation in order to support disease studies. (A year later and it was 10,000 genomes; now it is in the millions.) The next to last slide was the first phylogenetic evolutionary tree taken from Darwin’s famous book and then a stylized tree of life representing a large collaborative project to incorporate all knowledge of all species on earth and represent their evolutionary relationships in a “tree of life.” It is an idealistic and important project which suits my sense of something worth doing!

I left the hotel and walked along Hillsborough Street, very much at ease. The spring day had been bright, and afternoon shadows from the buildings kept me from getting too warm. I reached Nelson Hall just after 6:30 p.m. There were no signs or posted directions for my lecture, and I began to feel uneasy. And the front doors were locked which did not quite panic me. I began to circle the building looking for an entry. At a lower level, I found an unlocked door I could enter and, at another level, let in four or five people including the Dean who was to introduce the mathematician who was to introduce me. Amazing to me, the large lecture hall eventually was half full—I resisted the urge to begin my lecture by asking the audience however had they found their way into the building.

The conclusion of the lecture felt right, leaving the audience with a sense of fast-breaking future developments in genome biology without a tangle of technical details. I hope they remember that mathematics and computation are involved, but that is not as important as communicating the new biological science. Even with the hall 50% full, I felt I had given very nearly the best lecture I am capable of, beginning, middle and end, and that's about all one can do.

When I was an undergraduate I read Thoreau's *Walden* and it made many permanent marks on me. For years I have quoted "I say beware of all enterprises that require new clothes." I have been writing here of enterprises that I believe went better by the application of new clothes, in particular by wearing a graceful suit, although perhaps I am stretching the definition of new clothes. Each application of new clothes I have mentioned involved conclusions, of an election, of a life, of a lecture. I wonder if Thoreau might have made an exception for enterprises that require new clothes exactly once and not forever. Perhaps not. If ever there is another appropriate event in the offing, I still have that suit hanging in my closet. And it is no longer new.

Acknowledgements

The cover photo was taken by the author in Mancos, Colorado in 1978. The author's photograph was taken by Lowell Euhus at South Boone Creek in Wyoming near Yellowstone Park in August 1972.

Chapter 1 contains material from my book *Getting Outside*.

Chapter 2 is a slightly edited version of Chapter 40 from *Getting Outside*.

Chapter 9 is an edited version of my section of an article "Gian-Carlo Rota (1932-1999)" in *Notices of the AMS* February 2000, Vol **47** pages 203-216.

Chapter 10 contains quotes from Ted Harris appearing in *Statistical Science* 1996, Vol **11(2)**, page 152.

Chapter 18 contains material from my article "The Human Genome Project: the Beginning of the Beginning" from *Quantitative Biology* 2016, Vol **9(1)**, pages 4-7.

The ashes poem in Chapter 21 is from my book *In the Gila Headwaters*.

The quotes in Chapter 23 are from Rebecca West's great book *Black Lamb and Grey Falcon* in the chapter titled Trogir.