Nested Scrolls

Excerpt from a Memoir

by

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A year before we left Lynchburg, I became interested in some computer programs called cellular automata, or CAs for short. My first contact with the modern CA mind-virus was through an article by Stephen Wolfram in the *Scientific American*. He was displaying his cellular automata as changing patterns of pixels on the computer screen.

The colorful images had an organic, natural look, neither too orderly nor too random. They spoke to me at a deep level, I felt a sense of recognition, as if I'd been waiting to see these pictures for my whole life. You might say the CAs were a trigger that awakened an alien mind within me, and sent it on a ten-year rampage. The hacker mind.

From Wolfram's article, I learned that a CAs are based on the idea of dividing a region of space into a grid cells, and then letting a tiny program run inside each of the cells. It's a *parallel* computation, in that each of the thousands of cells acts like an independent computer. With each tick of the system clock, the cells look at their nearest neighbors and use their tiny programs to decide what to do next. You can put random starting values into the cells or input some particular pattern. And you can change the little program that goes into each cell. Incredibly rich patterns arise: tapestries, spacetime diagrams, bubble chamber photos, mandalas... Wolfram seemed to think that CAs were rich enough to emulate anything at all, be it a society, a brain, a pond, or a galaxy.

The CA images spoke to me at a deep level. In an informal fashion, I'd been thinking about these kinds of patterns for several years. For my novel *Software*, I'd wrapped my bopper robots in colorful plastic that acted as a computational tissue, generating unpredictable patterns. I'd called the stuff flickercladding. But now, in hindsight, I could see that I'd in fact covered my boppers with CAs.

I convinced the magazine *Science 85* to pay my expenses for a journalistic trip up the East coast to visit the cellular automata researchers. Wolfram was first on my list. He'd gotten his Ph. D. in physics at age twenty, and now, at the ripe old age of twenty-six, he was a visiting fellow at my grad-school haunt, the Institute for Advanced Study in Princeton.

Wolfram was stocky and tousled, with the directness of a man who knows what he's doing and doesn't much care what others think. I felt a kinship to him right away. We were even wearing the same kind of clothes: oxford cloth button-down shirts and chino pants. I started out by having lunch with him in the good old Institute cafeteria.

One of Wolfram's hopes for CAs was that they could be used to analyze certain kinds of phenomena that resist being reduced to any simple formulas. I asked him what engineers thought about, for instance, modeling air turbulence with CAs.

"Some say it's wrong, and some say it's trivial," said Wolfram in his thoughtful

Oxford accent. "If you can get people to say both those things, you're in quite good shape."

We went up to his office and he introduced me to another CA researcher, a cool guy called Norman Packard. They began showing me cellular automata on the computer screen. Some of the patterns were predictable as wallpaper, some were confusingly random, but every now and then we'd hit that pleasing balance between order and chaos that characterizes gnarly CAs. We found one that was shaped like a pyramid, with red and blue lace down the sides, and a symmetrical yellow pattern in the middle — a pattern vaguely like an Indian goddess.

"What's the number on that one?" asked Wolfram.

"398312," answered Packard.

"This is the way to do scientific research," I remarked. "Sit and watch patterns, and write down the numbers of the ones you like."

"Oh, this isn't for science," said Wolfram. "This is for art. Usually I just talk to scientists and businessmen, and now I'm trying to meet some artists. Wouldn't that last one make a good poster?"

At this point a small baggie of what appeared to be pot dropped out of Packard's jeans pocket. Wolfram picked it up, impishly sniffed it and raised his eyebrows. "What's this?" he demanded, as if pretending to be an irate schoolmaster. "What's this?"

Packard didn't say a word. After all, he was in the presence of a journalist! Wolfram handed him the tiny baggie and he stashed it away.

Over the coming years, I'd learn that computer hackers are very tolerant people. All they really care about is whether you can make machines do interesting things.

I'd also learn that it's common for hackers to begin seeing the entire world in terms of the computer concepts that they're working on. You don't hear carpenters saying that everything is made of lumber—but there's something about computers that gets deep into a hacker's head.

I think of a guy I'd meet at an IBM research lab later on. We'd been in his office talking about his work, and then we walked outside together and were looking at a range of low, wooded mountains, and began telling me that the ridgeline of the hills—with trees included—was essentially a version of the same exact noise wave that he was studying in

his lab. He was saying this with a complete lack of irony. I felt sorry for him. But later, as I became more of a hacker, I'd often be just as bad off.

I need to pause and explain that I use the word "hacker" in its original, positive sense of "clever person who delights in doing complex things with computers." Unfortunately, by the end of the 1980s, our ignorant and hysterical mass media had begun using "hacker" exclusively in the negative sense of "computer intruder, embezzler, computer criminal." It's as if the media were arbitrarily to begin using "realtor" to mean exactly the same thing as "sleazeball, scam artist, swindler." The honest and constructive hackers far outnumber the rogues.

But in saying all this, I'm well aware that I'm ranting against the wind. There's no stopping a language's evolution. I remember Pop taking exception to ordinary turns of phrase that Embry and I might use, phrases as innocuous as, "a lot of food."

"What do you mean *a lot*?" he'd demand. "A lot is a piece of land. And what is this disgusting phrase 'make out' that I heard one of you use? You make out in a business deal, but it's degrading to say you make out with a girl."

Embry and I would look at each other and laugh. We were going to talk however we liked. Pop was getting old.

On my journalistic cellular automata tour, I continued up to Boston and met some more CA hackers. A Hungarian computer scientist showed me a screen full of boiling red cottage cheese. Despite the boiling, the cheese was staying mostly red. To him, this represented the persistence of memories in the seething human brain.

"With the cellular automaton machine, we can see many very alien scenes," he remarked. "We have a new world to look at, and it may tell us a lot about our world. It is like looking first into a microscope."

Seeing the CAs running in real time fully converted me. These hackers were having so much fun, looking at such neat things, and making up such great theories about what they saw! I started wondering if I might become one of them.

By the way, my editor at *Science 85* just didn't get it about cellular automata. He shelved my article—and a few years later it later it appeared in *Isaac Asimov's Science Fiction Magazine.* The science fiction world takes care if its own.

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Meanwhile, as I mentioned before, I was running low on money and getting worn down by the freelance life. I happened to be complaining on the phone to an old mathematical logic friend about how broke I was, and he told me that they had an opening where he worked, and that several of the faculty admired my book *Infinity and the Mind*.

The place was the Department of Mathematics and Computer Science at San Jose State University in San Jose, California—which lies in the heart of Silicon Valley at the southern end of the San Francisco Bay, some seventy miles south of San Francisco. It had never before occurred to me before that I might possibly move to California. It seemed like moving to China, or to Mars.

I flew out to San Jose State for an interview, and gave a talk about complexity, computation, and cellular automata. The talk was well received. And the other faculty thought it was great that I wrote science fiction as well as popular science books. The interview committee took me to an inexpensive outdoor cafe and we drank a couple of pitchers of beer, with dappled patches of shade and sun bobbing over us. Everyone was hip and mellow. Welcome to California.

"If you want, you can teach computer science as well as math," one of them told me. "If you do that, we'll pay you ten percent more."

"I'd like that a lot."

Back in Lynchburg, I got the formal job offer on my fortieth birthday. We were going to San Jose.

Sylvia was up for it, she had it with being poor in a small, Southern town. And the kids, though somewhat anxious, were excited too. They were interested in the California things like skate-boarding, beaches and Valspeak.

We had a huge yard sale. We parted with some big things: the upright piano that we'd tormented our children with lessons on, the slate-bed pool table that I'd bought from Mike Gambone, and, most painful of all, the 1956 Buick. We packed all our remaining goods into a huge rental van.

Arf was worried that we might leave him behind. While we were packing, he spent as much time as possible in the back of the van, lying next to the furniture. Don't forget me! Isabel and I had a running joke that Arf thought the place were moving was

called Cowifornia.

Once we got going, Sylvia drove our station wagon, known as the Purple Whale, with two of the kids. The third kid would ride in the truck with me and Arf. I rotated to a different kid each day.

On the first day, Isabel was my passenger. We were listening to the truck's feeble AM radio, and as we headed through the overgrown hills of rural Virginia near the North Carolina border, a hillbilly evangelist came on the air, preaching the usual farrago of fear, guilt, and resentment. And then, as if he didn't already sound stupid enough, he began *speaking in tongues*, slobbering and babbling.

"I'm so glad to be leaving Virginia," I told Isabel. "I feel like a Jew leaving Hitler's Germany."

The first big stop was Graceland, in Memphis, Tennessee. They had a special parking lot for people driving rental moving vans. We chained Arf up in the shade under the van. At Elvis's grave, I got Georgia to pose by the stone and pretend she was crying. The people behind us frowned that we were treating this as a joke.

As we got further out west, Isabel and I noticed something. Whenever cows came into sight, Arf would slide off the van's seat and stand four-legged on the floor next to me.

"Arfie is a cow detector!"

I told the kids about Mountain Cows—I'd read about them in a *Tales of Paul Bunyan* book as a boy. Given that the cows graze so much on steep hills, some of them have evolved to have their left legs shorter than their right legs, so they can comfortably progress along a mountain with the shorter legs uphill. These are the Right-Moving Mountain Cows. There's also a race of Left-Moving Mountain Cows; they have their shorter legs on the right. It's almost impossible for Right-Moving Mountain Cow and a Left-Moving Mountain Cow to mate.

"What happens when they get to the edge of a hill? How can they get back?"

"Well, they only pasture them on conical hills. The cows go around and around."

There were no cell phones in those days, and we didn't have a list of the motels up ahead. In order to meet up at the end of each driving day, Sylvia and I relied on—synchronicity. One of us would pull over at a likely looking spot, and wait for the other

one to show up. Somehow it always worked.

It's been my experience that, more often than seems likely, meaningful coincidences do occur, just as if the world were well-written novel. The fact that the world exists at all is already wildly improbable, so why not suppose that some cosmic forces have arranged events in an artistic way?

The trip out West took about a week. It was a wonderful adventure and we hardly wanted it to end. Sylvia said that she stopped at each state line and had the kids take her picture under the "Welcome to ..." sign. I kept thinking how cool it would be if the Earth were flat and infinitely big, and you could take a road trip that went on forever, always in transit, never having to reach an endpoint and face the music.

I'd found us a house to rent near San Jose, in a village called Los Gatos, at the base of the coastal mountains west of town. Los Gatos was like a river settlement, in a way, except the flowing river was busy Route 17, which led over the mountains to the beach town of Santa Cruz. Los Gatos was prosperous little town, with a nice shopping street and rich yuppies in its hills. Apple's Steve Wozniak lived there.

Sylvia hadn't seen our house yet, and initially she was disappointed. It was very large by California standards, but rundown. Another problem with our house was that, for the whole two years that we rented the place, it was continuously for sale, which meant that we had deal with an endless stream of pushy realtors wanting to show the property. I came to think of realtors as terrible people.

Initially, buying a house was out of the question for us. We weren't making enough money. The houses in California cost eight times as much as in Lynchburg.

Adjusting took some time. I'd always thought of California as a lush paradise, but it was drier than I'd imagined. In fact, for the first seven years we lived there, it hardly rained at all. And you had to get into your car to do almost anything. It seemed like we were constantly driving on the parched freeways, baking in the endless sun.

We immediately found a set of faculty friends from San Jose State. Two of them were fellow mathematical logicians who'd also reinvented themselves as computer scientists—Michael Beeson and Jon Pearce.

"Computers are the LSD of the 1980s," Michael remarked soon after I arrived. I could see what he meant. These machines were becoming an all-consuming society-wide

obsession, and in the process they were changing our self-images and our perceptions of how the world worked.

Michael had a mathematician's trait of being rigorously logical, which gave conversations with him an odd feel. Sometimes I'd derail one his deductions with a completely random remark, which he'd then ponder and decide how to handle. He might shove my interruption out of his way and continue as before, or burst into laughter and request amplification, or start an entirely new line of logical investigation.

Although Michael could be stern when arguing a logical point, he had a very warm and humane side as well. His face would light up with pleasure when we met, and he'd hug me when we parted. He greatly enjoyed the jokes I'd tell him, like when I told him, "Our dog Arf's so smart he can say his own name," and then, several weeks later added, "Arf's so famous that the other dogs talk about him."

Both Michael and Jon were married with young children, and we spent a lot of time socializing with them. Jon was California mellowness incarnate. He scattered his speech with words like "groovy," "awesome" and "trippy," and was a master at inserting the word "like" into a sentence. Somehow he could get away with this.

It was such fun to listen to Jon's slow, oozing voice that he could say almost anything. Like one time, he was talking to me and the kids, and I jokingly asked him about the secret of his alleged appeal to our female students, and Jon made a remark that the kids and I would repeat to each other for years.

"I tend to dazzle."

Jon said he required very little sleep, and was constantly mastering great new swaths of computer science and writing up lecture notes on them. At times his notes seemed to bear the imprint of his experiences as a Berkeley logician—for instance he might diverge into a discussion of an imaginary "metalanguage" when an outline of some actual programming language would have been more to the point. But if I mentioned this, Jon would argue that it was a mistake to teach about actual programming languages, since they changed every couple of years anyway, going in and out of fashions like hairstyles, but the platonic ideal of the underlying metalanguage could serve as a programmers' beacon throughout his or her working life.

The people we bumped into around Los Gatos itself weren't especially friendly.

Everyone seemed to be in a hurry, or demented, or stand-offish—as if they were worried I might ask them to give me money or to join a cult.

Los Gatos High School was an impressive place—it looked a lot like the Riverdale High where Archie and Betty went, an imposing 1940s building with palm trees on the lawn and a big stone staircase. It took the kids almost a year to fit into the intricate social scene—and Georgia never really managed it, as it was her senior year of high school. Imagine emerging into the last fifteen minutes of some California teen movie and trying to make the scene. Impossible.

This said, Georgia did dig up a few bitter outcast punker friends to hang with for that last stretch of school. And the following fall, she was off for college, back East to the same Swarthmore where Sylvia and I had met. Georgia was never the most efficient packer, and somehow she ended up carrying the speakers for her music system in one of her purses. Putting her on the plane was one of those threshold moments when I could can feel my life change—it was the mirror-image of moon-silvered night when I'd first fed her a bottle of milk.

Rudy and Isabel got involved with the high-school track team—it was a cozy scene for them, with road trips to meets, and they could hang around in the track shed after school. Pretty soon Rudy had an after-school job putting together computers. And he'd come to like heavy metal. He was filled with zest and gusto—as if life was spread out before him like a huge wonderful banquet, endlessly fascinating and filled with unlimited opportunities.

The Pacific Ocean within striking range—amazing. We made weekly family trips to the beaches in Santa Cruz—it was only a half hour's drive over the mountains. I found the California beaches to be nicer than those of the East Coast. The water was cleaner, there weren't so many buildings at the water's edge, and all of the beaches, everywhere, were public, with free access. I particularly liked the wild and pristine beaches bordering the farmlands and nature preserves lands north of Santa Cruz.

Sylvia's parents came over for our first California Christmas, and her father, Arpad, gave me the money to buy a used surfboard and a wetsuit from a local surf shop.

"This was Chang's board," said the proprietor, eyeing the battered but attractively priced board I'd selected. "He..." The guy's voice trailed off. I never did find out what

happened to Chang.

My second-hand surfboard was long, robin's egg blue, and with the brand name Haut. I bought a fiberglass repair kit—remembering how brother Embry had used a similar kit to repair the rusted-out spots on his Model A Ford. I laid out by board in our basement and spent a week patching up the gaps in the smooth outer plastic that covered the inner core of plastic foam. And then, finally, it was time to hit the curl.

As I really had no idea at all about how to surf, I decided to have my first session at the obscure Three Mile Beach north of Santa Cruz. We went out there on New Years Day, 1987. The beach was a little hard to access, with , like, a cliff that we had to clamber down. But we made it—Sylvia, the kids and me, also our new friend Marc Laidlaw and his wife Geraldine.

Marc was about ten years younger than us, a California science fiction writer with a skewed sense of humor that I loved. Eventually Marc and I would collaborate on four SF short stories about a pair of surfers called Zep and Del. Although Marc had grown up in Laguna Beach down in SoCal, he didn't seem to know much more about surfing than me.

I dug how crazily chaotic the waves were on the deserted beach. In my thick, cushiony rubber wetsuit, my body felt warm, even cozy, although the touch of the Pacific on my hands and face was stunningly cold. I swam out and rode some tiny waves of foam on my stomach—but I quickly came to understand how hard to would be ever to catch a glassy big wave, let alone stand up.

Even though I never really learned how do it, surfing came to be a mental metaphor that I liked to use for my activities. Serious surfers are out there nearly every day, year after year, in all kinds of conditions, engaging with the sea—and that's sort of what it's like to be a pro writer.

I met Marc and a bunch of other San Francisco SF writers through Richard Kadrey, who had Sylvia and I over to the apartment he shared with his woman friend, Pat Murphy, who was also an SF writer. From my years of reading about the Beats and the hippies, I was overexcited about meeting San Francisco writers. Laidlaw's oblique way of expressing himself caused me to jump to the (fallacious) conclusion that he was high on mescaline. And Michael Blumlein's recently shaved head led me to deduce

(incorrectly) that he was a junkie with AIDS.

After a few more meetings, I more correctly calibrated these new people. In some ways they were more serious than our Lynchburg friends. I found that I couldn't run my mouth in quite the same self-aggrandizing way. If I'd start sounding too puffed up, they'd just glance at each other and laugh. I was in a more sophisticated community now, and I had to adapt.

The kids particularly liked Marc—he was as close to them in age as to Sylvia and me. Marc and Geraldine had cool little statues of the elephant god Ganesh all around their apartment, and they had a pet python that was about eight feet long. Marc fed him a white mouse now and then, and he'd act out the mouse's reactions for us.

Geraldine was livley and irrepressible—when I'd call Marc on the phone, she'd stand near him, interrupting him, even though she couldn't hear what I said. She made a little money telling fortunes with Tarot cards at an occult supplies shop in the Haight Ashbury.

To gear up for our first collaborative surf story, Marc and I began studying surfing magazines. There was a phrase in one of the ads that Marc particularly liked: "Life on the edge measures seekers, performers, and adventurists." Marc deemed this line to be worthy of enshrining as the key text of a new literary movement that we called Freestyle.

"There it is, Rude Dude," Marc wrote me. "The Freestyle antifesto. No need to break down the metaphors — an adventurist knows what the Ocean really is. No need to feature matte-black mirrorshades or other emblems of our freestyle culture—hey, dude, we know who we are. No need to either glorify or castrate technology. Nature is the Ultimate. We're skimming the cell-sea, cresting the waves that leap out over the black abyss."

For about ten minutes we convinced Richard, Pat and Michael that they were Freestylists too, not that any of them ever took our idea all that seriously. We were all diverging along our own worldlines.

One more person appeared in our social circle when we moved to San Jose—Dennis Poague, the inspiration for Sta-Hi in *Software*. He was living in a rooming house and working as a cab driver. He was down and out and friendless, maybe a little strung

out on speed, and happy to have us in town. By now he thought of us as family.

It was fun to have Dennis come over, up to a point, although he was always one for pushing your hospitality too far, yammering on and on about something until you'd relent and say yes. He'd acquired an ancient old milk-delivery truck that he'd spray-painted in silver, and he got us to let him park it our back yard. It barely ran, it was more like a storage locker for him. The back was stuffed with various treasured bits of junk—parts of motorcycles, broken electric guitars, boxes of old skin magazines, industrial laboratory equipment, mounds of Goodwill clothes—whatever.

One of the greatest nights I had with Dennis was when the Beastie Boys gave their first concert at a small college auditorium in San Jose. I'd been reading about the Beasties, so I'd gone ahead and bought three tickets, treating Dennis and Jon Pearce. Sylvia wasn't interested in seeing this particular show, so I was taking the guys along. Dennis showed up his Goodwill finest—he had a giant gold lamé jockey's cap, a leopard print shirt and mauve bell-bottoms.

Jon was bemused, but game for the action. "These guys are—geeks!" he happily exclaimed after the Beasties delivered their first song.

It was one of those rare concerts that was unimaginably better than anything I could have expected in advance. A gift from the gods. I played the songs in my head for months.

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At school, I'd been assigned two CS courses, plus a course on the good old history of mathematics.

For me the hard computer science course was the one about assembly language. Assembly language is very stark and simple, with about a hundred elementary commands. What makes assembly language tricky is that in order to use it properly, you need to have a very clear image of what's going on inside the specific kind of computer that you're writing your program for. At San Jose State we were using IBM-clone machines with Intel microprocessor chips, and I bought myself one of these beige boxes. Learning Intel assembly language was a little like learning, say, the complete set of the part numbers for a 1986 Ford Motors Company carburetor.

Fortunately for me, there was another mathematician-turned-computer scientist at

San Jose State who was teaching Assembly Language. His class met the period before mine, and he was kind enough to let me attend his lectures. He was a good guy who wrote a lot on the blackboard with chalk. By the end of the period the front of his body would be covered with white dust—and his back too, because he liked to lean against the board while he was talking. In a way, it was fun sitting in someone else's class like a student again, soaking up info for free.

I wrote down everything he said, and then I would teach that to my students. Not that I was understanding everything. When my own assembly language students would ask me how to do the homework, I'd tell them the truth.

"Hell, I can't do it either. I only figured out how to find the on/off switch on my computer last week."

For some reason the students liked this. "You're a good guy, Dr. Rucker," they'd say. Even though I had no idea what I was doing, I got great student evaluation ratings in that course. I was really bringing the material down to their level.

There was a full spectrum of races among the computer science students, with many Indians and Chinese, a few Filipinos and Latinos, some Iranians and, more populous than any other group, the Vietnamese. San Jose has one of the largest Vietnamese communities of any town in America—the signs in buses and voting booths are in English, Spanish, and Vietnamese.

I really enjoyed hanging around with my students and taking in their off-beat accents. Who needs intergalactic aliens, when you have computer science majors in San Jose? And, by the way, after meeting the Vietnamese, I was gladder than ever that I hadn't gone to fight in that crazy war.

In the summer after my first year at San Jose State, I persuaded the department to buy me one of the cellular automaton machines that the gonzo MIT hackers had told me about on my journalism run back East. The "machine" turned out to be a memory-chip-laden card you could plug into a slot in an ordinary PC-clone computer. It had the effect of making my new home computer feel as powerful as the Silicon Graphics and Sun boxes that Wolfram had been using to look at his CAs.

With my new card, I could watch globs of red and blue oozing around, almost like oil-globs in a light show. And to make it the more geekily titillating, the language for

programming the cellular automaton machine was a willfully obscure "Reverse Polish" dialect known as Forth. I soaked it right up. Programming was close enough to mathematical logic to be congenial for me.

I'd always envied laboratory scientists for having machines to play with. And now I had one too. I relished the hands-on, experimental nature of computer work.

From grad school I knew all too well that if you find a hole in a mathematical proof, you can very well be left with nothing at all. But if a computer program has something only slightly wrong with it, you still might see something interesting on the screen. Hackers have a saying for this: "It's not a bug, it's a feature." In any case, the interactive, iterative process of programming meant that usually I could, in time, get my programs to do what I actually wanted them to.

I took to lugging my heavy PC-clone computer to parties to show cellular automata to whoever was there. Sometimes, if I was sure of finding the right kind of host machine, I'd just bring the bare cellular automata board with a connector cable. Musician-style, I took to calling the board my "axe." It was wonderfully science fictional, bringing my axe to parties and playing symphonies of living colors.

One of the King Kong Original Hackers of the Valley was a guy called Bill Gosper. Back in the 1970s, I'd read about him in a column by Martin Gardner, describing how Gosper had discovered a special pattern called the Glider Gun for an early cellular automaton known as the Game of Life. Gosper and his friends were among the very first computer types at MIT, majoring perforce in mathematics. It was they who'd first adopted the word "hacker" as a proud name for their ilk.

One night I mustered the courage to phone up Gosper, and he cheerfully agreed to have me visit him at his office. He was working for a company called Symbolics that made computers the size of refrigerators. His office was filled with beige plastic artifacts: an ellipsoidal electric pencil sharpener, a stack of computer monitors, odd-shaped modern chairs.

So far as I could make out, Gosper's job at Symbolics was to work on a program that could in some sense behave like a mathematician—manipulating algebraic equations, geometrical constructions, matrices, integrals and the like. But he spent most of his time devising weird graphics involving cellular automata, fractals, continued fractions, and the

like. At one point he held the world record for computing the most digits of pi.

Although Gosper didn't have an PC-clone machine, the desk of his absent secretary did, so I opened up her computer case and jacked in my axe, showing Gosper the new wave of East coast cellular automata. He was only mildly impressed. The old Game of Life was world enough for him. He'd recently devised a hack that let him explore spaces with trillions of cells at a time.

I came to love hanging around with him, and occasionally he'd join our family for holidays. He always reminded me of a giant prehistoric bird, with his beaky profile, bouncy gait, and discordant voice. About ten percent of Gosper's words weren't standard English, they were odd phrasings peculiar to him. Like he'd use "mumble" as an ordinary word, as shorthand for expressions too complicated or dull to actually say.

"Let's set mumble to mumble," he once said, leaning over his screen, wanting to show me something. "Ooh! It's not converging. What the hell's going on? 572??!!! It's supposed to be 570! God help us. It's batshit. Oh, this should be a Taylor series, right? I have to stun it, I have to neutralize it. Now we can crank up the value. And this is the *right* answer." Gosper paused and gave me a sly smile. "Now let's see if I can earn my nerd merit badge."

"How?" I asked, greatly enjoying myself even though I had no idea what he was talking about.

"By typing in this number," answered Gosper, the keyboard clicking. "The nineteen digits of two to the sixty-fourth power."

Eventually he'd tire of discussing cellular automata with me. "That's enough about *square* things," he'd say. "How about *round* things?"

By this he meant that we should switch to his other obsession: throwing his Aerobie flying rings. He had several hundred of them, each one labeled with a number. Gosper knew the flight characteristics of each Aerobie as if they were cattle in a herd. He liked hacking the physics of toys. He usually carried a Superball with him to toss at things with some weird spin on it that made it bounce right back to his hand.

The most recent time I met him for lunch—invariably he insists on the buffet at an Indian restaurant—Gosper showed up carrying a pizza box, and with a three-foot tall man at his side. The box held a steel packing puzzle of his design, known as the

Twubblesome Twelve. And the little person was a random person he'd met at a donut shop. Gosper was teaching him math.

My cellular automata machine card took me all kinds of places. I was at the first-ever workshop on artificial life, in Los Alamos. The town of Los Alamos is weird and quiet, like a *Twilight Zone* movie set. No less a man than William Burroughs went to a boarding school there.

The idea behind the conference was: Forget artificial intelligence, let's do artificial life, lets make a pool of simple programs that interbreed and compete and get more interesting as time goes on! It was another of my science fiction dreams coming to life, for in *Software* I'd written about a race of self-replicating, evolving robots who shared and recombined their programs like DNA.

The conference had a relaxed vibe, with a lounge outside the lecture hall where lots of computers—including one they'd lent me—were running artificial life and cellular automata demos. I spent most of my time in the lounge, tweaking with the hackers.

Around the same time—this would be during my second year in San Jose—I attended an annual event called the Hackers Conference. Remember—hacker was still a good word, so these guys were Silicon Valley programmers and hardware tweakers. Some of them were even fans of my books. The fact that I'd written a science fiction novel called *Software* had put me on the hackers' radar.

I brought my computer with its CA axe, and I stayed up all night with them, drinking beer, smoking pot, and admiring our weird screens. Although Hollywood often depicts hackers as nerdy, inhibited types, that's not generally accurate. It's more common that hackers are like hippies or acid freaks or mad scientists or car mechanics.

In the wee hours of the night, they examined my cellular automaton machine card and told me how it worked. One of them remarked that it should in principle be possible to get rid of the card and accelerate the CA programs with pure software.

I even gave a special Christmas talk and demo at the IBM research lab in San Jose. I jacked my cellular automata card into one of their IBM PCs and connected it to this monster projector that they had. Nobody else had computer projectors back then, so it was incredibly exciting for me to see my images get so big. I wanted to take off my clothes and let the sparkling little squares of the CA graphics slide across my bare skin.

The guys loved my realtime animated images, and when I was done I got more applause than I'd heard since being on a panel with star writer Larry Niven at a science fiction convention. But then some execs took me into a conference room and started asking me, "What are CAs good for?"

And I didn't really have a convincing answer. I mean, yes, I could make promises about CAs eventually being able to simulate air turbulence or the heat flow in a jet engine. But, to me, it was evident that the main thing about CAs was that they were beautiful art that had permanently changed my way of seeing the world. The guys at the Hackers convention had immediately understood *that*.

My life was becoming more and more exciting, what with my faculty friends, the Bay Area science fiction writers, and the hackers I was meeting. I was out of the cave and into the marketplace. New opportunities kept cropping up. I was like some Darwin's finch with a beak evolved for cracking open a special kind of seed. There'd been no seeds of the proper type in Lynchburg, they were all over the place in the California.

A guy called Marty Olsen phoned me at my office at San Jose State, very voluble and friendly. "You sound bummed," said Olsen. "A guy like you shouldn't be bummed. You're a great writer."

I was in fact feeling a little downcast because I wasn't getting much writing done. But Olsen had an interesting proposal. He wanted me and my old SF mentor, Robert Sheckley, to write scripts for a TV series about the future. The show would be hosted by no less a figure than the psychedelic pioneer Tim Leary.

Olsen wrote me a couple of letters to set up the visit. He was in Venice, California, trying to make a living as a screenwriter. He had a penchant for pretending he was living in the Venice of the Italian Renaissance. The letters would begin, "Dear Ruckella."

So in the spring of 1988, I flew to L.A. and met up with Olsen and Sheckley. It was great to see the Sheck-man again, he was mellow and relaxed. My hero. It was like being with the magic gnome in a fairy tale.

"This is all bullshit down here, Rudy," Sheckley told me. "Just get as much money in front as you can. I had a deal here to write a TV series about two robots running a filling station on Mars. We had lots meetings, they all acted excited, and it

died."

Sheckley and Olsen smoked a joint on the drive over to Leary's house in Beverly Hills, but I abstained. I didn't want to blow my big meeting!

Tim and his wife were glad to see us. He was very friendly and personable, handsome and charismatic. He'd cleared off a dining-table and set out pencils and pads of paper so we could brainstorm and take notes. But first I showed Tim some cellular automata.

I had my cellular automata card with me, my axe, and I took apart his PC-clone box and jacked it in. Tim liked the images, of course, and thereafter he started dropping the phrase "cellular automata" in his diffuse but rewarding essays.

We sat around the table for an hour or so, thinking of good topics for shows—we could do one about virtual reality, one about robots, one about smart drugs, and so on. Tim would be the genial anchorman, reading the scripts that Bob and I would produce. It sounded great to me.

"These are the guys," Leary told Olsen happily. "You found the right guys."

But the show never got funded and none of us got paid.

***

As soon as we moved to California, Sylvia lined up a job teaching French at a public two-year community college. But it was only a part-time position, as they only had the one introductory French course. So she started to think about teaching English as a second language (ESL). The catch was that, in order to be certified to teach ESL, she'd have to take two years' worth of courses in linguistics.

The first spring after we moved to California, Sylvia's mother died unexpectedly, a terrible shock. Sylvia flew over to Switzerland for the funeral, and I stayed home with the kids. Sylvia was brokenhearted. Partly to take her mind off her grief, she started taking courses at San Jose State, picking up the linguistics courses that she needed for certification to teach ESL. Both of us were retooling as fast as we could.

Meanwhile the realtors' efforts bore fruit, and we were evicted from that first rental house. We had very little time to find a new rental, and we ended up in a small beige tract home on a busy street, so busy that wrecked vehicles regularly careened into our front yard.

It was an impossible situation. I felt like a piece of dust in the cheap-ass San Jose maelstrom. So a year later, we found another rental, this time on a leafy hillside street in Los Gatos. It was a pleasant house with a large deck overlooking the flatlands of Silicon Valley, twinkling with lights at night.

An upside of being in the Bay area was that we could see great music as often as we wanted to. My favorite punk band, the Ramones, passed through San Jose every year, always playing at the same rudimentary night club, One Step Beyond, a box amid warehouses. Sylvia and I took Georgia there soon after we arrived, and a couple of years later we took Rudy Jr. These were very small shows, like dances at a private high-school. The Ramones weren't all that famous yet.

A couple of years later I took all three kids to see the Ramones at the outdoor Greek Theater in Berkeley. Isabel was young enough that she didn't want to venture into the mosh pit, so she was sitting by me. The lights went down, a fog of dry ice smoke washed across the stage, and two red spotlights silhouetted a pair of figures standing on amps and holding guitars.

"Isabel!" I exclaimed happily. "Remember this. *This* is rock and roll."

Joey was an unlikely figure to be a rock star—puffy and pale as an alien grub worm, spindly and awkward when he'd menace the crowd with his microphone stand. He had a wonderfully emotive voice—that was always the juicy core of a Ramones song. Joey had feelings, he cared—he wasn't at all like the stereotype of a harshly screaming punk rocker. In concert, I always felt like Joey was talking directly to me—but maybe everyone else thought that too.

I liked the way that the Ramones played straight-on classic rock and roll—and managed to make it new. They amped it up, they made it faster and tighter, they wrote goofy lyrics—and middle-of-the-road people didn't like them. I thought of my science fiction as having a similar style. That is, I write tales with classic SF themes like higher dimensions and aliens, I push my effects to new levels of weirdness, and my characters are suffering and realistic humans. As with the Ramones, the middle of the road fans are leery of me.

The very last time we saw the Ramones was with a large crowd at a battered old theater hall on Market Street in San Francisco. Rudy Jr. got thrown out of the concert

during the first song for stage diving. The Ramones had something like an immense Presidential seal on the curtain behind them, edited to be a symbol for the Ramones.

The song that sticks with me from that last concert was their rendition of Bob Dylan's "My Back Pages," with the refrain "Ah but I was so much older then, I'm younger than that now." Being the Ramones, they turned Dylan's folkie, meditative music into a hysterical buzz-saw of guitars played faster than seemed humanly possible. As always, Joey's tuneful, insolent, jaded voice gave the song heart and—above all—made it new. Pretty soon after this, all the Ramones would be dead.

When Sylvia and I arrived in California, a couple of Berkeley freaks named Queen Mu and R. U. Sirius were editing a radical magazine called *Mondo 2000* —I saw my first copy of it in a rack of screwball zines at the fabled City Lights Books in San Francisco. The Mondo crew were pursuing a weird fusion of computers and psychedelic drugs.

Somehow hearing of my arrival, Queen Mu got in touch with me and asked me to give a talk on cyberpunk at a ratty venue on San Pablo Street in Oakland. She was a fey, breathless woman my age, elegant in a New England kind of way, given to showing all her teeth in the ecstatic rictus of a smile. I'd asked her if she might pay me for my talk—after all, she was charging the public an admission fee to attend. Mu was somewhat tight-fisted with her workers, and a payment wasn't possible, but I seem to recall that she made me a gift of a flat metal peppermints box filled with buds of pot.

I went to the venue, ranted about cyberpunk and read some weird scene from *Wetware*. And therewith I'd brought the Movement to the Bay Area! Fellow cyberpunk John Shirley would be moving here too before long.

After my talk, we had a show and tell session. The evening was more like a soirée than a lecture. Some of the Mondo people had brought brain toys that they'd discovered or even made on their own. One that intrigued me was a pair of ping pong ball halves that you wore over your eyes like goggles, and the balls were lit in stroboscopic flashes from little diode lights you controlled with a dial on a box.

I donned the device and began tuning it. To my amazement, I started seeing—deeply zoomed images of the Mandelbrot set fractal. Had I discovered the essentially fractal nature of the human sensory system? Or was just Mu's insanely strong pot?

When I'd experiment with the flicker effect later, I could never see the fractals quite so well as that first time.

I learned that almost any flashing light source can set off patterns on your closed eyelids, and you don't really need an electronic strobe system. Simplest of all is to lie on your back on the beach, spread your fingers, and move your hands up and down above your eyes, casting a series of rapidly flickering shadows. Of course if you do this, the people walking by think you're weird...but in California that's not such a big deal. For that matter, you can flop down and go into yoga poses wherever you like, and people just step around you.

You do see some nice stuff if you look inside your head. We have a tendency to ignore the more subjective aspects of our perceptions in favor of the shared elements that everyone sees at the same time. At some level there's an equal reality to the things you see on your eyelids or out of the corner of your eye. Beings from the higher dimensions?

Mondo 2000 magazine would ramp up to national distribution and I'd write some reviews and short articles for them, but not many, as Queen Mu tended to lose whatever I mailed in and make me send it again, and then when she'd finally read it, she'd demand a complete rewrite, and then she'd lose that, and I'd have to mail in the rewrite again, and after the article came out, she'd never pay me. Nevertheless I valued our relationship. Money isn't everything.

It was always a treat to go to the Mondo parties—Mu had rented an immense California Craftsman style house in Berkeley for the magazine's offices, and some of the staffers lived there as well. Everyone there would so frikkin' hip. A Kentucky boy's dream come true.

Tim Leary would be there sometimes and act like we were old pals. To Sylvia's surprise, he was curious about where she'd gone to high school in DC. The very last time I saw Tim was at another Mondo event, a panel on cyberspace, and I asked him a question I'd always wondered about.

"Tim, I only took psychedelics, like, two or three times, and that was enough to last me a lifetime. It would always wipe me out. How is that you can keep on tripping year after year and still be able to use your mind?"

Rather than speaking directly to my question, Tim told me about a trip he'd taken

that week. He'd wandered out into the streets of downtown L.A. and had totally forgotten where he was. He'd ended up sitting on a bench with an old homeless woman, drinking in the cosmic beauty of her face.

Tim was a tough old bird, a revolutionary leader in his own way, and he's sorely missed.

When Georgia finished college as an art history major, she was working as a temp in San Francisco for awhile in the offices of Pacific Gas and Electric, known as PG&E. For a while there, she began calling herself GE&O. She was hungry for a more art-related job, and I urged her to ask *Mondo 2000* to hire her on to help with the graphics, and that worked out.

Mu, being fairly paranoid, worried anyone she hired might be from the CIA, so she felt safer bringing in the children of personal friends. And Georgia had a flair for graphical design. Her time at *Mondo* was like a postgraduate education for her, readying her for a professional career in the field.

My final *Mondo* score came when Mu and R. U. Sirius got a contract to do a major book with the full title, *Mondo 2000: A User's Guide to the New Edge : Cyberpunk, Virtual Reality, Wetware, Designer Aphrodisiacs, Artificial Life, Techno-Erotic Paganism, and More.* R. U. phoned me up and asked me to edit the book for them. The idea was to take excerpts of articles that that had appeared in the magazine and somehow arrange them into a book. But neither Mu nor R. U. could quite see how.

"We need a mathematical logician for this, Rudy," said R. U. "You're the man."

I agreed to do it, but only if they'd negotiate a contract through my agent, good old Susan Protter, and if they'd pay me my share in advance. Otherwise I knew that the money would disappear before I ever saw any. So we worked out a deal and I organized the book as a kind of encyclopedia, alphabetically arranged by keyword hot topics, with good bits from the magazine pasted in and some additional entries that I made up myself, such as the one on "wetware," defined in terms of viewing your DNA as a kind of computer program for constructing your body. As my authority, I quoted Max Yukawa, who was in fact a character in my novel *Wetware*, not that anyone picked up on this.

The book hit with a big splash. We actually made the cover of *Time* magazine with a picture by the *Mondo* graphics staff and the following text.

CYBERPUNK

Virtual **sex**, smart **drugs**, and synthetic **rock 'n' roll**!

A futuristic subculture erupts from the electronic underground.

I'd done my work well.

After this big publicity burst, one might have expected *Mondo 2000* to become a successful magazine about the emerging computer culture. But that didn't work out. Queen Mu ran the advertising department under the pseudonym of Ann Venable, and she tended to get into arguments with potential advertisers. She was also editor in chief, and *Mondo* was forever off schedule, with the issues coming out at best twice a year.

In short order, some gimlet-eyed yuppies showed up and ate *Mondo's* lunch. Thus was born *Wired* magazine. Even though I myself sold a few articles to *Wired* in the early days, I don't much like the magazine. They're kind of big on fawning portraits of the greedhead businessmen who descended like locusts to eat the dreams of Silicon Valley. And I've always had trouble telling their ads from their articles, what with all the gizmo reviews.

As Isabel sometimes remarks when I go off on rants like this: "Bitter much?"

***

Initially I wasn't writing very much in California. I had my hands full with my teaching job, learning computer science, and interfacing with all the new people who were showing up. But I did my best to get a novel going.

In my last year at Lynchburg, I'd begun thinking about writing a historical SF novel involving one of my favorite notions from fringe science: the Hollow Earth. The idea is that our planet is in fact hollow like a tennis ball or like a fisherman's float. A race of people live inside. But how do we get in there? Perhaps through holes in the ocean floor, or perhaps via an immense hole at the south pole.

My special inspiration was Edgar Allen Poe's novel, *The Journey of Arthur Gordon Pym of Nantucket*, which describes a sea voyage to the walls of ice around the Southern pole, with the implication that there is a huge opening to be found there, a great shaft leading into Mother Earth's womb. Wanting this to be true, I reasoned that, even if

Poe had erred about the hole being clearly visible, it might well be hidden beneath a sheet of accumulated snow and ice.

My old friend Gregory Gibson, in his capacity as antiquarian bookseller, sent me some nineteenth century sailing narratives, and a fine twenty-volume edition of the collected works of Poe . I pored over these, coming to identify with Eddie. Poe wrote of being possessed by an imp of the perverse, who impelled him to do deliberately alienating and antisocial things—which described my punk attitude to a tee.

While in Lynchburg, my expanding researches led me to the rare book room in the library of the University of Virginia, where I found writings about John Cleves Symmes, Jr., who began proselytizing his doctrine of the Hollow Earth in 1818. Symmes lived in Newport, Kentucky, and he styled himself the Newton of the West. He was too busy lecturing—or too sly—to publish any books under his own name, but I found a nonfiction *Symmes' Theory of Concentric Spheres*, and a novel, *Symzonia: A Voyage of Discovery*, which are purportedly written by Symmes' followers. My feeling is that, as the books speak so very highly of Symmes, he either wrote them himself or collaborated heavily.

In California, I started work on my novel, *The Hollow Earth: The Narrative of Mason Algiers Reynolds of Virginia*. It's about a country boy who leaves his farm, travels down the James as a stowaway in a bateau, accompanied by his dog Arf and his old companion Otha, now an escaped slave. They meet Edgar Allan Poe in Richmond, and they travel onward to Antarctica and to the Hollow Earth.

I wasn't sure how to light up the inside of the Hollow Earth, a land which I called Htrae. If you put an Inner Sun in the center, then it seems like everything would fall up into the sun. One day when I was walking around San Francisco with Marc Laidlaw, I found the solution.

It was a new science toy called a plasma sphere, on display in a New Age shop. By now nearly everyone's seen these one of these things—it's a hollow glass ball with an electrode in the center. Branching lines of electrical discharge reach out from the electrode to the outer surface, and if you move your fingertips around on the sphere, the glow lines trail after them. *That's* the way to light up the Hollow Earth! Have great aurora-like streamers of light reaching from the Central Anomaly to the inhabited inner

surface of Htrae.

The writing went slowly. I find it hard to keep my novelistic momentum if I only have a spare hour here and there in which to write. The only extended patches of free time that I had were during the school vacations—especially in the summer—but often we'd want to take family trips then, taking road trips around California or flying to visit Sylvia's father and brother in Geneva.

When my first August in California came to an end and the fall semester loomed, I thought of the early sailing ships trying to reach the fabled southern continent of Antarctica. Sometimes they'd overstay the brief polar summer, become iced in, and spend the dark, howling winter hunkered in their vessels, hunting seals for food.

Repeatedly iced in by my teaching duties as I was, it took about three years to finish writing *The Hollow Earth*. When I was done, I used the hoaxing Poe-like expedient of pretending that *The Hollow Earth* was a manuscript that I'd found in that rare books room at the University of Virginia.

To this day, I get occasional emails from readers taken in by this. They wonder why I haven't done anything to help mount an expedition to retrace Mason's steps. One guy even assumed that since *The Hollow Earth* was just an old public-domain manuscript that I'd edited, it was okay to post a page-scan of my book on the web!

My kids liked hearing me talk about the Hollow Earth. Once when we were on a cross-country skiing vacation at Lake Tahoe, I pointed out to Isabel the blueness of the light that seemed to emerge from the holes our ski-poled made in the snow.

"Proof that the Earth is hollow!" I told her.

"As if more proof were needed," she responded cheerfully. "When will they *see*?"

Oh, one more thing. There was an article about my novel in the San Jose newspaper, and a bum came by my office to tell me some news.

"The sun is cold and hollow. That light you see overhead is just the interaction of some special rays from the sun with our upper atmosphere. I used to be a very famous surfer, you know. Look."

He pulled out a page torn from an encyclopedia with a grainy picture of someone on a wave.

"That's me. Inside the Hollow Sun."

***

Things really got complicated after I met John Walker at the Hackers Conference. Walker happened to be a founder and the CEO of a booming Sausalito corporation called Autodesk, and he asked me if I'd like to come work for him. Autodesk had a big surplus in the bank, and Walker wanted to explore some radically new kinds of software products.

As it happened, one of the computer science students at San Jose State had gone over the edge and mass-murdered seven people at the lab where he worked. Richard Farley. I'd in fact sat next to Farley in the assembly language class that I'd audited during my first semester of teaching. He was a real asshole, always arguing with the teacher over picayune points that made no sense, and sleazing all over any women students who committed the error of sitting near him. Farley's rampage had made me start wondering whether San Jose State was paying me enough to be associating with these kinds of people. If I could go out industry and make some real money—why not?

So when Walker and one of his software engineers, Eric Lyons, showed up at my house with a computer to show me a new Mandelbrot fractal zoom program they'd written, I decided to pursue finding work at Autodesk. The job offer came through in the fall of 1988.

Fortunately, San Jose State liked the idea of having faculty go out and work in industry for awhile. It was, after all, by far the best way for a computer science professor to pick up new skills. Whatever you know about computers is continually becoming obsolete, and the only people who stay abreast are the commercial software engineers. So the math and computer science department agreed to let me go on half-time leave, which I later increased to full-time leave.

At that time, Autodesk's core business was a product called AutoCAD, an electronic drafting program used worldwide by architects and industrial designers. But Walker didn't want me to work on that. Instead he was starting a small Advanced Technology Division, headed by Eric Lyons, and, for the moment, me and one or two other guys.

My first project was to produce some cellular automata software with Walker. He

was an insanely talented programmer. He worked at the level of a grand master in chess, or at the level of a mathematician at the Institute for Advanced Study. Over Autodesk's one-week-long Christmas break, Walker wrote an assembly language program that eliminated any need for a special card such as a cellular automaton machine I'd been carrying around.

My role was to create some sample CAs for our new software to run, and to write a manual explaining it all. I got deeply into it, and finished this over the course of several months. When we were done, we'd produced a slick, boxed software package called *CA Lab: Rudy Rucker's Cellular Automata Laboratory*, which sold for about $50. In those days, some people were actually willing to buy software of this kind. I did demos of it at a number of computer trade fairs, always having to parry that same old question, "What's it good for?"

We sold a decent number of copies, and Walker had the idea that we could develop a whole line of software packages for hackers to enjoy. These packages were meant to be like books, but interactive, illustrating new aspects of science. Walker wanted to call the line the Autodesk Science Series.

The second package in the series was *James Gleick's Chaos: The Software*, which lets the user play with some of the programs mentioned in Gleick's best-selling book *Chaos*. Creating this program was a lot harder for me, as this time Walker didn't step in and write the hard part of the code. Instead I worked with another Autodesk programmer, a knowledgeable and irascible guy called Josh Gordon. Truth be told, my own programming skills were still pretty rudimentary, and Josh was never shy about telling me this. Really, I was in over my head. But somehow we struggled to a conclusion and shipped this second product, too.

Later, on my own, I'd write a third science series program called *Artificial Life Lab*, which would be published not by Autodesk, but by a low-end company in the North Bay—who never paid me all the money they owed.

The three programs are all long out of print by now, but you can download them for free from my website, www.rudyrucker.com. In searching my site, note that eventually we had to change the name of *CA Lab* to *Cellab*. The robotic greedheads who run some boring company called Computer Associates were threatening to sue us for

infringing on their sacred trademarked initials CA. As if cellular automata hadn't been around much longer than them.

As Autodesk was located in Sausalito, some seventy miles north of where I lived, I only went there physically about once a week. The rest of the time I'd stay in touch via email, which was something brand new to me.

I quickly learned some painful lessons about email such as: Never write and send a message when you're angry or, even worse, drunk. And don't send the message to everyone in the company. And especially don't use curse words. Fortunately, hackers tend to be resilient and forgiving types. As Walker once put it, "Don't worry too much about flaming me. I have thick scales."

Going up to Autodesk was always a kick. Some days it would feel like grabbing hold of a live electric wire with a million volts coursing through it. They always had the latest software and hardware, and the engineers were weird and smart, with awesomely wild plans.

Sometimes after work I'd visit with some spacey fans who lived in Mill Valley. One day they gave me a large marijuana plant, live and growing in a big pot that I could nurture in my back yard. I'd gotten a maximum new Mac computer from Autodesk that same day as well, along with Stephen Wolfram's brand-new computer algebra software, *Mathematica*. *And* thanks to my fat new salary, I'd bought myself a peppy red Acura. Driving home across the Golden Gate Bridge that day with all my goodies, I was like, "*Yeah!*" It was one of those rare moments when everything comes together.

I took to listening to CDs of environmental sounds on the long drive home. Like—I missed rain so much that I'd play a CD of a thunderstorm. I had other nature CDs too: a rain forest, a blizzard with a banging shutter, and a walk along a brook in a meadow followed by a ride in a sailboat. My mind would drift and I'd think about computer programs—not as code, but as patterns of shapes and connections, sort of like the way I'd formerly thought about infinite sets.

Things were always changing at Autodesk. By the time I stopped working there, the Advanced Technology division employed about twenty or thirty people. As well as my little Science Series programs, they'd set up a virtual reality lab.

We had sets of Jaron Lanier's new VR goggles, which held a little TV screen for

each eye, also some stretchy, optical-fiber-equipped Datagloves that tracked the position of each finger joint, and created images of your hands in the virtual world that the goggles were showing you. I wrote a demo that immersed the user in a flock of artificially alive birds that were continually wheeling and regrouping around the user's position in cyberspace. Rather than making them look like actual birds, I made the birds look like three and four dimensional polyhedra that I called topes—and thus my demo was called Flocking Topes.

The lab's goal was to develop a VR operating system to be called Autodesk Cyberspace®. They'd picked this name on their own, and without asking me about it. My old cyberpunk writer friend William Gibson was a little annoyed by this development. After all, he'd *coined* the word cyberspace, and now Autodesk wanted to trademark it? When I saw Gibson at a San Francisco virtual reality fair called the Cyberthon a few months later, he half-jokingly threatened to trademark the name of Autodesk's original virtual reality programmer, a talkative hipster named Eric Gullichsen.

Although sales of our *Chaos* program were even better than *CA Lab*'s had been, the profits from these relatively low-priced packages were negligible compared to Autodesk's income from their flagship product, AutoCAD. And Autodesk Cyberspace® was shaping up to be a dud. And then the company's stock price dropped.

Autodesk got a new CEO called Carol Bartz, and she closed down the Advanced Technology division. The company offered me the option of moving to Michigan and working on postmodern mathematical methods of describing curves in space, but I couldn't face leaving California. And so I was out of my software engineering job.

I had the spring semester in which to finish the code and the manual for my *Artificial Life Lab* project. Autodesk had gladly granted me the rights to this package, they didn't care about at all. They were, like, "Don't let the door hit you in the ass on the way out."

I hacked pretty hard that spring, and got the program working. The best part of it was a colony of virtual ants that I called "boppers," like the robots on my *Ware* novels. By way of testing out my new material, I gave a talk on my boppers program at a Silicon Valley company called Interval.

The manager who'd issued the invitation struck me as a vain blowhard. He wanted to bend my ear about some fundamental contradiction in mathematics he thought he'd discovered, when all he'd really done was to have a sloppy stab at some ideas that occur to everyone who ever writes a thesis in mathematical logic.

"I'm no mathematician," he'd begin his declamations with feigned humility. I wanted to yell, "I can see that you're not!"

How is it that guys like that end up being managers, while the smart people are the peons? While we talked, some poor guy who'd applied for a job as a hardware tech was off in a corner assembling a balsa wood model airplane. This was supposed to be a dexterity test to see if the guy was qualified. What an obnoxious thing to do to someone at an interview.

The MacArthur prize-winning chaos theorist Rob Shaw had a research spot at Interval at this time. I'd always admired Shaw, he'd tried to use chaos theory to beat the roulette wheels in Vegas, and, in a more academic vein, he'd written a famous monograph called *The Chaotic Dynamics of a Dripping Faucet.* He looked more like a hippie or a biker. The very first time I'd encountered him, he'd been sitting next to me on a plane to Las Alamos, and I'd thought he was a carpenter. He'd been doing this odd calculation with a pencil on a matchbook cover—it looked like long division, and he seemed to be doing it wrong. Later, when I realized who he was, Shaw had informed me he'd been computing the square root of two in binary notation, to see if the sequence of zeroes and ones in the answer would appear chaotic.

After my talk on my virtual ants, I went up to Shaw's office with him to hang out. He showed me a virtual stream of water that he'd designed, and some nice artificially alive insects. He gave my virtual ant program his blessing.

"That's a wild piece of code, Rudy."

In the fall I headed back to teaching full-time at San Jose State. I was glad the department had kept my position open for me.

It was little weird to be teaching yet again. Everything felt slow and dull compared to the scene in the Autodesk research labs. I was back to grading tests and homework programs, back to worrying about the ratings the students gave me on their evaluations, back to worrying if I was ever going to get tenure.

Attending a department party, I visualized myself as a rabbit caught in a snare, struggling against the tightening wire noose around my neck. I'd learned from having pet rabbits in Lynchburg that, when frightened or upset, rabbits can in fact make a sound. In my head at the faculty party, I was going, "*Wheenk, wheenk, wheenk!*"

Head trips like that cheer me up. They make the world more like a novel. In fact I became so fond of the word "wheenk," that I'd begin using it a technical lit-crit sense to mean, "strong and touching emotions felt by a character in a work of fiction." And then, if some story I was writing seemed too cold and scientific, I could remind myself in shorthand to, "Put in more wheenk."

A couple of months after I returned to teaching, President Bill Clinton passed through Los Gatos—he and Hilary were having dinner with some tech execs in a restaurant here. My family and I were standing on the sidewalk as the Clintons' limo tooled by—with Carol Bartz riding in there with them.

"Carol!" I yelled, leaning out into the street. "I want my job back!"

The people around us laughed. They understood.

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While I was still at Autodesk I'd started work on *The Hacker and the Ants*, a transreal novel about my experiences as a software engineer who's working with virtual reality and artificially life programs.

The hero of my tale, a hapless programmer named Jerzy Rugby, becomes embroiled in a plot cooked up by his boss and by an evil realtor. Some virtual ant programs settle into the powerful computer chips embedded in people's TVs, and the ants turn every TV show into computer graphics. Jerzy Rugby is charged with treason. But in the end he wins out.

The boss in *The Hacker and the Ants* was loosely inspired by John Walker himself. Fortunately Walker has a good sense of humor. He was quite fond of my book, and like many other hackers, he thought it offered a uniquely realistic glimpse into the Silicon Valley of the 1980s.

But Walker didn't like that the boss character dies in my last chapter, so he wrote and posted a phantom extra chapter on his own website. In Walker's version, my boss character turns out to have faked his death, and is now free to explain to the awe-struck

Jerzy Rugby what my novel's machinations were *really* about. It's funny.

My writing hit a slow spot then and I wouldn't finish another novel for about three years. My bad habits were slowing me down and my duties at San Jose State were ramping up—as I became a more established member of the department I was expected to teach harder courses, to advise more students, and to attend more committee meetings. With the age of fifty coming up on me, I still didn't have tenure—my checkered career had delayed any decision—and now I wanted finally to close the deal.

I put most of my energies into learning the object-oriented languages C++ and Java, and into figuring out how to teach Windows programming and the principles of software engineering. I began developing a framework of extendible object-oriented code to make it possible for my students to write complete videogames for their semester projects. To my mind, games are one of the most interesting areas in computer science, combining nearly every aspect of the field.

The reason I wrote the framework—which I called the Pop framework after my father—is that I wanted to make it possible for my students to bypass some of the difficulties in programming so as to quickly achieve a certain level of artistic self-expression. I wrote up a fresh iteration of the framework and the accompanying notes every semester, and sold printed copies of the notes through the campus bookstore. Eventually I'd end up publishing a final version of my notes as a textbook called *Software Engineering and Computer Games.*

I'd started out with two dimensional games, but along the way I figured out how to extend my software framework to three-dimensional worlds. I wrote the 3D code over a couple of weeks, in what Walker calls a "bloodlust hacking frenzy." I was so excited and drinking so much coffee, that my heart was palpitating in my chest. I considered going to the hospital, but I went SCUBA diving with brother Embry on Grand Turk Island instead—after many years in Louisville, he and his wife had moved back to the Caribbean. As quickly as an hour after I left my computer behind, I was fine.

It's hard to communicate just how exciting and addictive computer programming can become. It's akin to the experience of playing a videogame, but more intense and creative. As a hacker, you're able to reach down into your artificial worlds at very deep levels. You can add in anything at all if only you can visualize it clearly enough. What

makes the work especially fascinating is that unexpected things may emerge, happy accidents of the interacting computations, and you can capitalize on these new quirks to create previously undreamed of features.

On the cellular automata front, I somehow talked the Electric Power Research Institute into a grant that released me from some of my teaching duties so I could work with small teams of students to create some new software for cellular automata. I wanted the colors to be smoother and less blocky, so I was putting a continuous range values into my cells. I named my new software CAPOW, an acronym for Cellular Automata for POWer simulation.

Our program would never be very useful to any electric power engineers, but the images were gorgeous. They were really and truly like oil-glob light-shows now, far more beautiful than anything I'd been able to achieve before. Even better, I found some CA rules that could spontaneously grow screens of lovely, throbbing paisley. These rotating patterns—called Belousov-Zhabotinsky scrolls among biochemists—resembled lichen on rocks, pairs of eddies behind an oar, cross-sections of mushroom caps, fetuses, and many other naturally occurring shapes. The scrolls have a pleasing way of nesting within each other—think of little whirlpools on the rim of a bigger one.

Over time I learned to see nested scrolls everywhere, even within my thoughts. More and more often, I spent my evenings at my computer screen, eternally tweaking my programs.