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THE ARTFUL INTELLIGENCE OF CAL'S KEN GOLDBERG HAS MADE HIM A DUAL PLAYER IN HI-TECH ROBOTICS AND WEB-BASED CONCEPTUAL ART. BY KARA PLATONI

FIE ON DIFI

Sen. Feinstein tried to gut law that had Chevron on the hook.

CITYSIDE | 9

STICKY PAST

Cinnabon memories contest simply too tempting to resist.

FOOD FETISH | 44

LONESOME LP

First novels, now solo albums. 'Tis the month of creative spew.

MUSIC | 57

Remote Control

Web-piloted humans, telegardens, robots that paint -- it's all in a half-day's work for Cal engineering whiz and conceptual artist Ken Goldberg.

By Kara Platoni

Back before people started sorting each other into "left-brain" and "right-brain" types, humanity loved a well-rounded nerd. These were guys like Aristotle (philosopher, zoologist), Leonardo da Vinci (artist, engineer), and Ben Franklin (inventor, statesman), who were equally at home with the physical sciences and the world of arts and letters. They were good at everything, and that was cool.

But the age of the polymath eventually ceded to the modern era of the überspecialist, where scholars are under pressure to do one thing and do it well. Such is the division between arts and sciences that many of the world's brightest minds rarely share a campus, much less a common technical language or funding source. It's not antipathy or even lack of curiosity. Nonetheless, the humanities and sciences have become like awkward adolescents at the junior high prom, staring at each other across the gym, waiting to see who has the guts to venture across the floor and ask someone to dance.

UC Berkeley professor Ken Goldberg not only keeps crossing that gymnasium floor, he has pretty much set up camp at half-court. There are not many people who can pull down half-million-dollar awards from the National Science Foundation for cutting-edge engineering research, and also be invited to show at the Whitney Biennial, a revered exhibition hosted by Manhattan's Whitney Museum of American Art. There are even fewer who accomplished both with robots.

By vocation a professor of industrial engineering and computer science, by avocation a pioneer of Internet-based robotic art, the 44-year-old Goldberg maintains two résumés, two sets of students, two kinds of scholarly publications, and two fan bases. There are undergrads in his database-design classes with no clue their professor has a life beyond advanced number crunching, and there are grad students who have moved across the country to collaborate with Goldberg on his art projects. He describes the constant switching between his two modes of thought as a sort of perpetual cognitive dissonance -- albeit an enjoyable one. "I can be the most optimistic gung-ho engineer one day and then be the very cynical critical artist an hour later," he says. "I kind of go back and forth. There's never this synthesis, but I like that. Sometimes I feel creatively just drained and then I can go work on a research paper or work on a problem that's equations."

But straddling the two worlds has its challenges. Goldberg's colleagues, for one, haven't always known what to make of his double life; nor, in fact, has he. If the engineer's impulse is to embrace technology, and the artist's is to critique it, then what happens when you are both?

If there's a fitting point of origin for a robot artist, it's a steel-mill town like Bethlehem, Pennsylvania, where Ken Goldberg grew up.

He was the sort of toddler who would beg his mom to stop the stroller at construction sites, and later the sort of kid who would spend happy solitary hours building model rockets and cars and drawing plans for hundred-room mansions filled with launch pads and swimming pools. Professors and artists often have a

Bart Nagel



Ken Goldberg

Bart Nagel



Goldberg's tele-actors took instructions from the public via the Internet.

Bart Nagel



Goldberg has emerged as a pioneer in the seemingly disparate art and engineering worlds.

Courtesy of Ken Goldberg

bit of the showman in them, and Goldberg tapped into his at an early age. He loved practicing magic tricks, and would go off to perform at other kids' birthday parties wearing a magician's outfit.

His parents had both dabbled in art -- his mom was a painter and his dad ran an art-poster business in college -- but switched over to the more practical fields of elementary education and metallurgy, respectively. His father struggled to run a small chrome-plating business, and the family was always in difficult financial straits. The elder Goldberg taught his son how to build circuits at his lab bench, and would take him into his shop on Sundays to help fix whatever was broken. But Goldberg's parents also raised him with an appreciation for the arts, and took him on frequent trips into New York City to see the museums and buildings. From boyhood, Goldberg idolized the work of Frank Lloyd Wright, particularly the singular combination of engineering prowess and architectural beauty that is Fallingwater, a home almost impossibly enmeshed in a waterfall.

When Ken started thinking about going into art or architecture himself, his parents were firm: Get an engineering degree first. "My family was that second-generation immigrant family -- it was like that was your meal ticket, you can always get a job," Goldberg recalls. Not that the lad was particularly averse to the idea -- he looked up to his grandfather, a family legend who'd moved to California and founded a successful circuit manufacturing business. "He was my hero," Goldberg recalls. "I wanted to go off and make lots of money and live in Beverly Hills."

The young man duly enrolled at his parents' alma mater, the University of Pennsylvania, which offered a dual degree in electrical engineering and economics through its Wharton business school. Once there, however, Goldberg found himself overwhelmed by all the educational options. Philosophy, sociology, hanging out with the art kids -- "I wanted to do *everything*," he says.

Goldberg's junior year abroad at Scotland's University of Edinburgh, which gave him a chance to travel Europe and scope the international museum scene, only took him further afield. At some point, a friend who understood his dilemma handed him a copy of C.P. Snow's *The Two Cultures*, in which the physicist-turned-novelist posited a culture clash between scientists and artists. Scientists, Snow wrote, were essentially optimists, rooted in their belief that problems can be solved through technology. Artists, he wrote, were pessimists who sought to reflect the tragedy of the human condition through their work. "It totally made sense," Goldberg recalls. "I was trying to wrestle with these two interests. That was a real battle that year -- I was torn."

So which way to turn? He'd already signed up for two courses, one in art theory and one on engineering principles. He needed a tiebreaker, and accidentally found one while cruising a class-recruitment fair. There was a little desk with a little placard bearing a simple phrase: robotics and artificial intelligence. This was unusual -- robotics classes usually aren't open to undergrads, which was why Goldberg hadn't taken any back home. So he enrolled.

For Goldberg, robotics provided a middle ground between engineering and art, a kind of moving sculpture, equal parts elegance and ingenuity. By nature, Goldberg is an observer, both of the mechanical world and of people. He exudes a sort of friendly curiosity, and his relationship with machines seems to be one based primarily on wonder. People have always been fascinated by the idea of the humanlike machine, he points out, from the myth of the golem to Frankenstein's monster, and it's clear he's no exception. "Machines are often graceful," he says. "If you watch construction workers or planes taking off there is a lot of grace in these large machines, and a robot in particular can make really minute and delicate moves."

By the time Goldberg returned to the United States, business school had pretty much lost its sheen. Meanwhile, during the young man's absence, his father was diagnosed with leukemia, and passed away the following year. Goldberg decided right then he wanted to be an academic, not a businessman. "I had seen that he was an entrepreneur and started a company and gone that route, and it was a very difficult path for him," he recalls. "I think when I saw him literally die I knew I wanted to go in a different direction."

The following year, Goldberg signed onto Carnegie Mellon University's doctoral program in robotics. It was his first chance to swim with the big fish of the robotics world, and to merge his art and engineering impulses. His earliest project, in 1987, was to simply attach a brush to a robot arm and program it to paint. Part of the idea's charm was



Goldberg's TeleGarden morphed from a Web-based robotics exercise into a social experiment.



In Goldberg's live Tele-Twister project, the online public voted on which limb went where.

Details

Who / What:

Ken Goldberg

News Category:

Technology

the jarring novelty of watching an inherently emotionless machine undertaking one of the most glorified forms of human expression. "People expect to see a robot welding or grinding, and to see it painting was sort of counterintuitive," Goldberg says. The robot's very first result, *Untitled*, was a simple triangle inked in cobalt blue, demonstrating that even a machine can't always produce perfect brushwork.

The campus gave Goldberg his own gallery exhibition. His engineering colleagues found the project amusing, he recalls, yet nobody viewed robot art as a career move -- Goldberg's dissertation ultimately described a new mathematical theory of orienting parts in space. By the time he finished his Ph.D program, the University of Southern California was offering an assistant professorship in the computer science department. It didn't quite promise the cushy life of an electronics magnate with a house in the hills, but did Goldberg want the position? Yes, he did.

Although his new job involved robots and computers, Goldberg became acquainted with the campus art gallery's curator in his first week at USC. Los Angeles is a place famously obsessed with its water supply, and it didn't take long for this anxiety to creep into Goldberg's artwork. For his next piece, *Power and Water*, painter Margaret Lazzari created a series of panels showing power lines and the building of the Los Angeles aqueduct, and Goldberg programmed a robot to paint a border of oranges, a symbol of the California lush life. This time, the novelty of a painting robot wasn't enough -- the machine's imperfect rendering of the same orange over and over suggested a larger point about the fragility of the hidden infrastructure that makes modern life possible.

Around this time Goldberg ran across another book that would change his life. This was *Art and Physics* by Leonard Shlain, a Mill Valley surgeon who lacked a background in either subject but had undertaken the book out of sheer frustration after bringing one of his daughters to an art museum and discovering that he couldn't explain why some of the more modern pieces qualified as great works. The surgeon was simultaneously struggling to get a grasp on quantum mechanics and the idea that a particle could be in two places at once. "It occurred to me that art became inscrutable at the precise moment that physics became impenetrable," Shlain says. "So I wrote *Art and Physics* about how artists have anticipated the great ideas of physics using art as a metaphor, just as physicists have interpreted them with equations. ... Visionary art has a clairvoyance we have yet to understand."

Cubism, Shlain wrote, seemed to presage ideas about a fourth dimension, not to mention modern graphic techniques that show us an object from multiple points of view -- think of TV ads that display a car from a dozen angles in rapid succession. Likewise, Surrealism dealt with time distortion in an age when the theory of relativity was in its infancy.

Perhaps most important to Goldberg was that, contrary to Snow's view that artists and scientists were opposite-minded, Shlain argued that they worked to illuminate the same concepts and thus weren't so different after all. "He was able to bring a fresh eye to both modern art and modern physics to discover links that are not at all obvious," Goldberg says. "His specific insights were elegant and very new to me, and I shared his conviction that the two fields were deeply related."

Still, Goldberg might have gone on painting with robots indefinitely were it not for a development that, if not exactly predicted by the Cubists, was arguably anticipated by modern sci-fi writers like William Gibson. It can be hard to remember a time before the Internet existed as a gigantic forum for swapping MP3s and helping geeks get dates, but in the early 1990s, even faculty members at big universities such as USC mostly thought of it as a convenient way to swap files. It was the students, Goldberg says, who were really enthusiastic about its graphic capabilities, and who got him thinking about it as a new creative medium. Even so, Goldberg wasn't sure what to make of this new presence. "No one was thinking of it, and then, boom, there it was," he recalls. "It was like science fiction at that point -- a little bit unreal."

It was also way primitive by 2005 standards. Take the first Webcam: XCoffee was simply a camera trained on a hallway coffeepot in a computer lab at the University of Cambridge so that late-night programmers could see if a refill was available. Quentin Stafford-Fraser, one of the department's alumni, described its technical specs this way: "The image only updated about three times a minute, but that was fine because the pot filled rather slowly, and it was only grayscale, which was also fine, because so was the coffee."

The idea nevertheless caught on quickly: Webcams were easy to use and appealed to people's inner voyeurs. Soon there were zillions of cameras through which bored cubicle dwellers could watch their bored counterparts at work, or porn-star wannabes could invite the world into their bedrooms.

While most everyone in the emerging field of telepresence -- the ability to experience things from a remote location -- was concentrating on applying video and sound to the Internet, Goldberg was thinking about the next

step. What if, instead of simply watching a faraway scenario, you could actually participate? "I could see that once you had that ability to trigger a camera remotely it wasn't too hard to move something, to actually change the remote environment instead of just observe it," he says.

Remote-controlled devices were nothing new, of course. But Goldberg was the first to realize that a robot could be connected to a Web interface as easily as a camera could. This idea was somewhat radical -- robots were generally expensive, sophisticated machines, and the only people allowed to access them tended to be professionals. Putting a robot online would cede control to anyone with a modem and a mouse. As a proof of concept, Goldberg and his students began working in 1994 on what they called the Mercury Project, the world's first "telerobot." While that may sound imposing, the project was actually pretty adorable. People could log on to a live video feed of a sandbox filled with buried artifacts, all related to a certain mysterious book. Using a mouse, they could manipulate the camera and blow sand aside with a robotic device that released puffs of compressed air. After excavating tiny hidden lanterns and magnifying glasses, these cybersleuths were asked to guess which book the props referred to. In 1,200 pages of guesses, only one visitor got it right: Jules Verne's *Journey to the Center of the Earth*, a story chosen for its classic sci-fi-ness. But the volume of traffic attained was remarkable -- Web surfing was still a new habit, after all; Netscape and Yahoo had just launched, and most people's connection speeds were agonizingly slow.

Goldberg next launched the Telegarden, a Webcam trained on a soil-filled planter ten feet in diameter. Rising from its center, like a specter from the grave, was a delicate white robot arm. This time users wouldn't simply blow dirt around: They would use the arm to plant a seed, water it, and, over the course of many months, watch it grow. Goldberg and his students conceived the Telegarden as a sly critique of how the Internet was spawning a *convenience now* attitude. "It was about slowing down and being a bit contemplative -- you can't accelerate nature," he recalls. "We had fast computers and networks and everything was going at top speed. We wanted to hold up nature and say, 'This hasn't changed in millions of years.'"

Together, the two projects were something of a revelation to others working in telepresence. Eric Paulos, who was studying robotics at UC Berkeley and would later become one of Goldberg's collaborators, recalled their novelty at a time when other Web projects were focused on transferring things like sound files or pictures. "The idea that you could sit at your desktop and click on things and that suddenly it's not just a hard disk at the other end, but that you're literally moving earth -- *that* was an interesting notion," Paulos says.

It also raised some issues. "The obvious debate is, how will you handle all these people you don't know coming in and doing things?" Paulos asks. He points out that today's Internet users are accustomed to cooperative online projects -- for example, there's Wikipedia, the online encyclopedia that allows self-policing users to edit or delete others' entries at will. But in 1995, letting thousands of strangers play a game without rules seemed a much bigger gamble. Would people wreck the garden? Would it die of neglect? "This project was something like an experiment," Goldberg says. "As a good engineer or scientist, you want to come in saying, 'I don't know what is going to come out of this; I'm not going to be biased.'"

There were certainly small disasters: People planted hundreds of seeds in a space only big enough for dozens, and others accidentally flooded the garden by writing buggy watering programs. Yet the project flourished far beyond what Goldberg had imagined. Even when the garden had to be uprooted and replanted, people kept coming back and developing relationships through the site's chat boards, which soon had little to do with the garden at all. Special interest groups formed -- the "Telegarden beard society," for example -- and telegardeners met on vacations and held their own conference. Two of them eventually married. The project even attracted a permanent groundskeeper, electronics engineer Hannes Mayer, who lives near the Ars Electronica Center in Austria, where the garden resided for most of its nine years. Mayer launched a companion chat site called Telegarden.org, which is still going strong even though the garden went offline last year. "Many friendships which developed in the early days of the Telegarden are still continuing today," Mayer reports proudly.

Goldberg thoroughly enjoyed how his innovation had morphed into a social experiment, and he was fast learning how much he liked hopping between his technical and artistic sides. He describes the switch as a pleasant, almost physical sensation, not unlike the mental pop you get from looking at one of those optical illusions: Now you see the vase. Now you see the faces. Now you see the vase again.

He also was discovering that engineering and art shared a core value: originality. "In research there is very little value in redoing something that someone else has already done, even if it's fascinatingly interesting," Goldberg says. "The same thing is true in art. You can do the coolest thing in the world, but if someone else already did it, it's too late."

Yet there were clear differences. Success in engineering is based on accuracy of results, while artistic success often relies on the more nebulous qualities of coolness and buzz. While Goldberg easily avoided the frumpier trappings of professordom -- no battered Volvo, no tweed jackets, not even a passing affection for sci-fi -- he struggled to master the unspoken rule of art hipsterdom: *explain nothing*. "It ran against my grain as an engineer and as a professor, because you're constantly getting up and trying to explain things," he says a little sheepishly. "I understand now that you can't explain your artwork. If you explain it too much it kills it, it sort of steals that role from your viewer. It's like a magic trick -- people should be like, 'Wow, how did you do that?'"

Meanwhile, pressure to play down his artistry was coming from another source. Some of Goldberg's USC colleagues gently suggested that his projects, although interesting, weren't the best use of his time since they wouldn't help him get tenure or raise his standing as a researcher. Goldberg responded by going a little underground. "I kept doing shows but I didn't talk to the faculty about it," he recalls. "I kind of liked it -- like I had a stealth life. I had my job and what I was going to be evaluated on was my technical publications and my research, but that was separate from the artwork. That was okay because in my mind there were two kinds of modes of thinking, two creative spaces, and I was happy to separate them. I wasn't like I was hiding it, but it wasn't on my résumé and when I came up for evaluation I never mentioned those things. I started keeping two résumés -- an artist one and an engineering one."

Goldberg wasn't finding Los Angeles socially conducive, either. Then, during a 1994 sabbatical, he visited San Francisco, where the Internet phenomenon was kicking into high gear. "There was a huge buzz up here," he says. "Netscape was just coming out and HotWired was going online and this place was exploding. It was phenomenal. Artists involved with the Net would get together and have these massive dinner parties and people were sharing ideas and code and there was this huge groundswell of excitement. I didn't want to leave."

UC Berkeley happened to have a position open in its Industrial Engineering and Operations department. Did Goldberg want it? Why, yes, he did.

Scientists have to be open to unexpected results from their experiments, and soon after starting at Cal, Goldberg prepared to face his biggest unexpected result yet. When he first launched the Mercury Project, Goldberg had received an e-mail complaining: "I don't believe this is real. It would be easy, at least conceptually, to fake the entire site." Similar queries had poured in about the Telegarden, and Goldberg was floored by all the skepticism. Mercury participants, for example, would argue about whether a watch buried in the sandbox was really keeping time. "We initially felt offended, because, my goodness, I poured my heart and soul into many late nights getting these things working," recalls Paulos, who was fielding similar questions regarding his own work. "But stepping back from the whole thing, we thought, what if we did fake it -- does it matter?"

This sort of philosophizing eventually led Goldberg to edit *The Robot in the Garden*, a collection of essays about telepistemology -- knowledge of things at a distance. It also gave his artwork a new direction. "I started really wanting to push that anxiety, to create projects that specifically were ambiguous about their status," he says.

In 1996, Goldberg and Paulos teamed up for *Legal Tender*, a project designed to toy with people's credulity. Visitors to this "telerobotic laboratory" were shown two \$100 bills, one real and one counterfeit. After registering on the site, people would be assigned a small section of one of the bills, and told they could do "tests" by staining, puncturing, abrading, or burning it. Participants would then be warned that defacing money is a federal crime, and asked if they wanted to proceed. "I wanted to raise the bar and make people hesitate and consider that what they were doing had some implications -- that they weren't living in a purely abstract world," Goldberg says. "This physical act of burning and smoke and all the charred remains -- that's such a tangible thing rather than just bits in a computer." Ultimately, 90 percent of the users opted to burn their bits of the bill, although, perhaps to dodge liability, nearly all claimed they didn't believe it was real.

By the late '90s, others in the Bay Area were taking the idea of physical consequences to a whole new level, most prominently San Francisco-based Survival Research Laboratories, which has mingled art, technology, and abject fear since 1978. While Goldberg was busy exploring telepresence through the genteel metaphors of gardening and archeology, SRL guys, including Paulos, were doing it by making things blow up real good. Their experiments in Web-controlled "tele-obliteration" included, among other things, an air launcher that let remote Web users fire Coke-sized cans filled with cement and an explosive charge. There was also the "pitching machine," which spat out six-foot lengths of two-by-four with such force that the boards often exploded into splinters on impact; and a claw-armed track robot let loose on Market Street, which pestered pedestrians and caused traffic to come to a halt.

Goldberg, also interested in giving his telerobots a stronger real-world presence, decided his next step was to

move them into social situations such as conferences and gallery openings. After considering the daunting technical obstacles of developing a robot that could navigate buildings and converse with people, Goldberg decided the ultimate robot would be a person executing instructions from the Internet via wireless audio and video. This "tele-actor" would be controlled by a cybermob that would vote on what he should do and where he should go. (In one experiment, the tele-actors played Twister, and individuals voted on which limb went where.) Paulos designed a series of helmets that could relay instructions to tele-actors on the go and provide video from their perspectives.

The concept made flesh some of the more disturbing implications of the master/slave relationship inherent in robotics. Theoretically, tele-actors were free to disobey, or at least to interpret directions -- when told to drink a glass of water, a tele-actor might chug it or sip it. But there were awkward moments such as the time voters tried to make a female tele-actor enter a men's bathroom. The project also had a surreal moment of self-realization during one year's Webby Awards, where a tele-actor was slated to interact with the master of ceremonies, news anchor Sam Donaldson. When Goldberg explained his novel concept to Donaldson -- that the tele-actor would wear an earpiece, and people far away would collectively decide what she should do -- Donaldson interrupted: "Wait a minute," he said. "That's what *I* do."

While Goldberg's art reacts to technological innovation, he's done plenty of inventing himself. Among his six patents is a "Kinematically Yielding Gripper" to align parts during manufacture, and an algorithm that holds manufactured parts steady during machining or inspection. During the dot-com boom, Goldberg was involved with several startups -- one developing a remote-control device that would let people "bookmark" information they saw on television; another designing a system of code to update Web sites automatically. (Java got there first.) The National Science Foundation honored him in 1995 with a half-million-dollar, no-strings-attached Presidential Faculty Fellowship, which Goldberg used to fund his work on automated manufacturing techniques. This year, the Institute of Electrical and Electronics Engineers made him a Fellow, and he is now working with UCSF and Johns Hopkins to develop ways of "steering" needles during surgery so that they can be inserted into tissues more accurately for biopsies or to administer radiation to tumors.

Even some of his Internet projects have led to innovation. In 1998, Jester 2.0, a joke-recommending Web site he'd worked on was featured in Wired News and got more page hits than it could endure. Goldberg's solution was to develop and patent a ranked-recommendation system similar to algorithms Amazon and Netflix now use to suggest products to customers.

But more often it was the other way around, with technological advances leading to new art projects. After 9/11, for instance, manufacturers made such leaps in video-surveillance technology that Goldberg and his students sought to take advantage. Dezheng Song, then a doctoral candidate in industrial engineering who'd moved cross-country to study with Goldberg, says he and his mentor wanted to focus on the "collision course" between these new technologies and privacy rights. "It's desirable to have a camera with high resolution that sees things clearly at a distance, and also to have a camera that records things, but if you put these two things together it becomes troublesome," Song points out.

Goldberg's group decided to stir up a little trouble themselves. They mounted a high-resolution video camera above Cal's Sproul Plaza -- they deliberately chose the birthplace of the Free Speech movement -- and set up a Web page that let people capture images from the feed and post the pictures on the site for comment. The *Demonstrate* project was to be a public self-portrait -- "the public taking pictures of the public," Goldberg says -- but also a test to see how students would react to the online espionage. Would they complain? Mug for the camera?

In fact, they did nothing. The lack of outrage spoke to how accustomed we've become to being watched. Moreover, the kinds of the images the camera captured -- students studying, sleeping, walking dogs -- said even more about the banality of campus life. In a world obsessed with so-called reality shows, actual reality is awfully boring.

Sometimes, whether you'd consider Goldberg's work art or science would depend on what you're reading. Take *Ouija 2000*, which debuted in 1999 at the height of Y2K phobia. This was the professor's riff on the craze for séances and the fascination with the subconscious that accompanied the turn of the previous century. People logging onto the site were shown a Ouija board located in Goldberg's lab. As an eerie bell chimed, participants were instructed to place their mouse directly in front of the screen and rest both hands on it as though it were the game planchette. Yes/no questions about what might happen in 2000 -- deaths of famous people, likelihoods of coups and earthquakes -- popped up onscreen. The computer program then averaged the players' mouse movements, and floated the planchette over the lab Ouija board to reveal the collective answer. Fun and a little creepy, the game made it into the 2000 Whitney Biennial.

Yet despite the artistic recognition, some people undoubtedly knew *Ouija 2000* only as a technical paper called "Vector Averaging for Collaborative Control," which described how the planchette was made to move over the board. "We were talking about interfaces and networking and different packet sizes and the metrics and algorithms we were using to compute, because in the engineering world it wouldn't really be appropriate for a technical paper to talk about artistic intent," Goldberg says. "Neither do art viewers want to view equations. When I gave a talk at one art school afterwards, they said, 'We loved the art, but why did you put the equations up?'"

Another episode of Goldberg's artist-versus-scientist internal struggle had a happy ending: In 1997, he had gone to hear Leonard Shlain, the man who had convinced him it was possible to be both, read at a gallery in North Beach. Shlain's daughter Tiffany, a digital filmmaker and founder of the Webby Awards, happened to be along to hear her dad's speech. "At the end of the talk, an incredibly intelligent man asked a provocative question and I turned around," she recalls. "I think that was when we fell in love."

They were married the following year.

Goldberg's basement lab at Cal is a sort of boneyard where past projects have gone to die, or at least be recycled. It has the standard robotics lab features -- bank of computers, undergrad absentmindedly doing homework at a paper-strewn table -- plus a good deal of nonstandard bric-a-brac such as old robot painter arms and spy cameras and canvases filled with oranges and power lines.

It's a good place to get a feel for what Goldberg is up to next, which has a lot to do with a five-foot scaffold standing in the middle of the room. This tower will one day be fitted with a camera and used to spy on black bears breaking into parked cars in Yosemite National Park. After spending several years seeing how humans respond to technology, Goldberg is now turning to the natural world. He's also updating an older project called *Mori*, which converts the movement of a seismograph on the Hayward Fault into an onscreen squiggle and digital rumbling. Goldberg hopes to make that rumbling a bit more musical because next April, on the centenary of the 1906 quake, he's staging a show at the SF Opera House in which a ballerina will improvise a dance to it. "I want to use earthquakes as a starting point," he says, "but I want to go beyond the earthquake and talk about the Earth as a force, how connected it is to gravity, how it connects us to each other and to the past."

Goldberg also is working on his first film project, a short documentary with his wife that will explore modern Jewish identity through the Barbie doll. It's an outsider's view on the ultimate insider, he says -- after all, Ruth Handler, the inventor of the ultra-WASPy icon, was Jewish. The film, which debuts December 3 at the Herbst Theatre in San Francisco, is the couple's second collaboration -- the first is their two-year-old daughter Odessa.

It's fitting that Goldberg is moving on to new things. After all, some of his pioneering ideas about telepresence have become so mainstream that they're practically self-parodies by now. There have been Web sites touting the opportunity to hunt live animals with a mouse click, or ones that feature live naked girls willing to obey your remote command for a fee. Sites such as SubservientChicken.com, in which a guy in a gigantic chicken suit will obey a surprisingly long list of typed-in commands, raise the same real-or-Memorex question as the Telegarden -- for the record, Subservient Chicken is prerecorded, and also is a subtle advertisement for Burger King's TenderCrisp Chicken Sandwich. Perhaps creepiest of all, scientists in Japan recently unveiled the first true remote control for humans, a headset that can "steer" people by sending an electric current through their inner ear -- the beginning, perhaps, of an era of tele-actors who lack free will.

Is Goldberg's art really this good at predicting the future of technology? If you ask Leonard Shlain, who otherwise makes no bones about how he considers his son-in-law the best Renaissance man since da Vinci, he'll slyly repeat Marcel Duchamp's old maxim: Beware wet paint. In other words, it's too early to tell.

But never mind the copycats, says Song, who is now a computer science professor at Texas A&M University, where he is investigating how to introduce telerobotic control to smaller platforms, like cell phones. Goldberg doesn't really like a crowd. "If people catch on, he will switch to a different plan," Song says. "That's his style. He won't do what other people do."

It's perhaps a sign of the times that when Goldberg came up for promotion to full professorship at Cal in 2002, faculty members advised him to put the artwork on his résumé this time. "In the last couple of years they've asked me to play a bit more of a role as an intermediary" between different departments, he says. "There are new centers on campus where they really want to foster that kind of interaction," Goldberg adds, such as CITRIS, the Center for Information Technology Research in the Interest of Society, which is sponsoring his bear-watching project.

He still keeps two separate résumés, though, and enjoys the friction and disruption he gets from bouncing between worlds. Even if his double life is no longer clandestine, Goldberg manages to stay largely below the radar. As he taps at a computer, talking about his plans for the *Mori* ballet, the engineering student who has been doing his homework seems to be looking around the lab as though seeing it for the first time. His glance goes from the Power and Water paintings, to the leftover *Demonstrate* camera to the bear-watching tower, and ultimately settles on his professor. "You're a little bit of an artist," he says finally, in a voice that sounds both perplexed and pleased with this revelation. Then he seems worried that he has said something offensive. "A *little* bit," he emphasizes reassuringly.

Goldberg just smiles.