

**NEXT FRONTIERS: INVENTIONS**

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**INVENTIVE SPIRITS:** In Next Frontiers, Danny Hillis at work

**NEXT FRONTIERS:** A Brainiac  
Inventor Gets *Really*  
Creative by Steven Levy .....**48**



# The Mind Of an Inventor

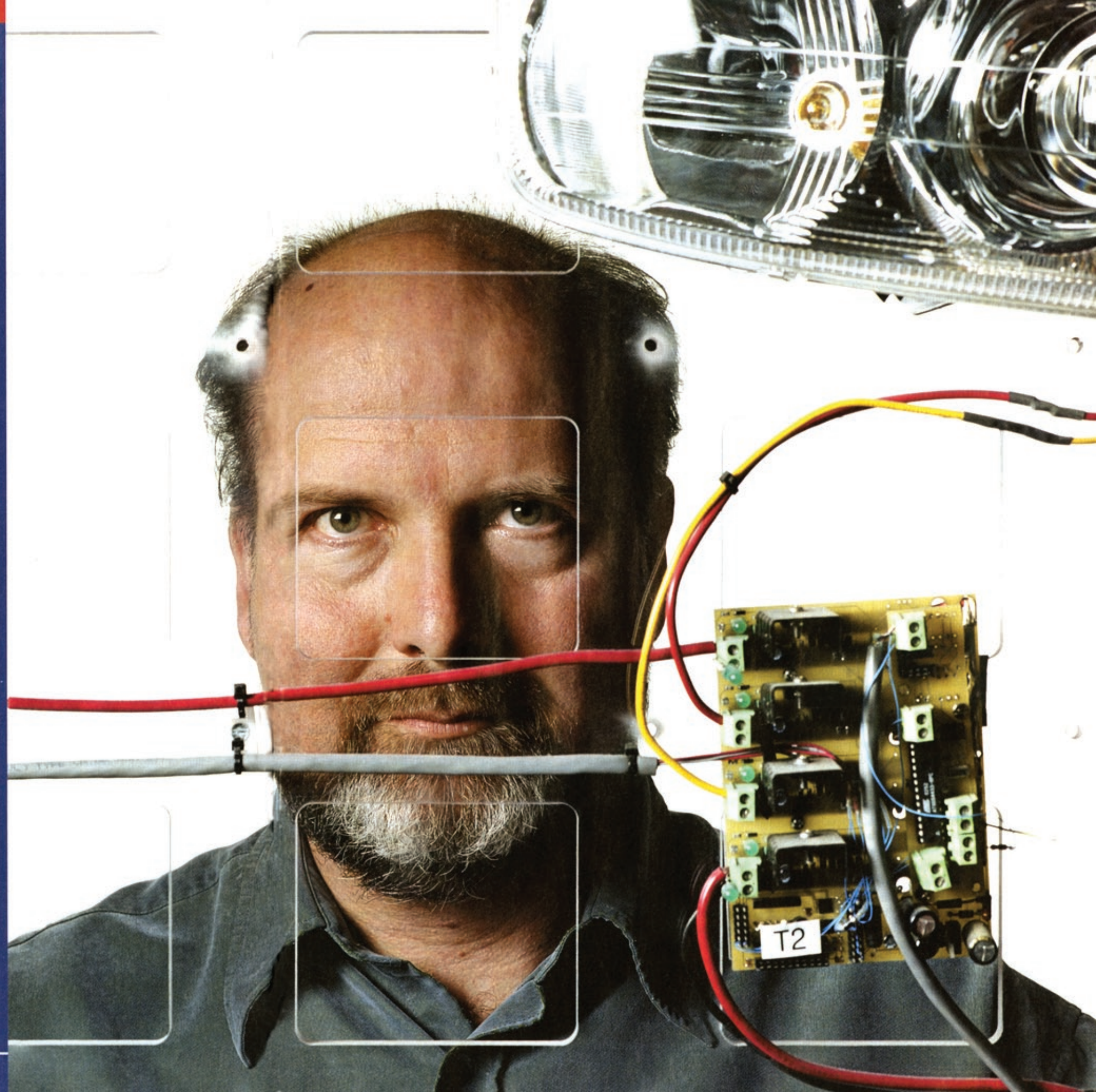
He built his first computer as a child. In his 20s, he had moved on to supercomputers. Now Danny Hillis is thinking of bigger things.

BY STEVEN LEVY

**A**RE INVENTORS BORN, OR ARE THEY MADE? Danny Hillis, who can't remember a time when he wasn't trying to make mind-blowing stuff, comes at the question, as usual, from an unexpected angle: *potential* inventors are *un-made*. "In some sense, every kid is inventive," he says. Without encouragement, a child's gleeful penchant for experimentation becomes endangered. "Kids invent things all the time until they get to school and adults tell them they shouldn't be wasting their time doing silly stuff," says Bran Ferren, Hillis's partner at Applied Minds, a company that invents amazing things for corporations like General Motors and institutions like the United States government.

**HOT WIRED:** For Hillis, invention is a lifelong passion. And he's very good at it.

Fortunately for Hillis, his approach to the world is as fresh and playful as it was in the fourth grade, when he decided to build a robot out of paint cans, motors and light bulbs. The only difference is that his inventions are now aimed at starting new businesses, sustaining our soldiers and finding effective chemotherapy drugs.







### Touch Table

A tabletop display that shows any point in the world—in stunning three dimensions.

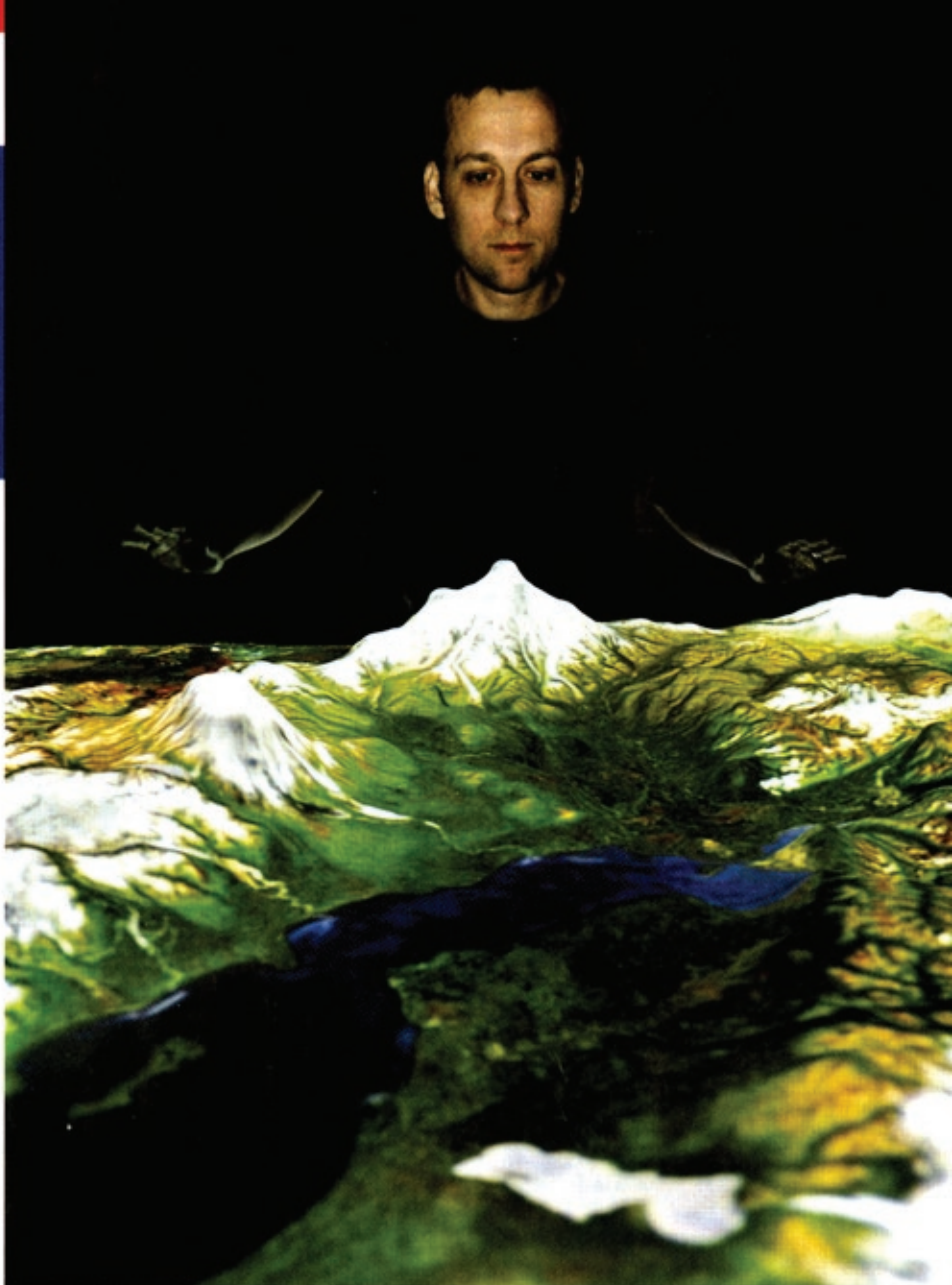
**The secret:** Underneath the surface are thousands of pins that rise to replicate terrain.

"When people talk about Danny," says his friend Nathan Myhrvold, former head of Microsoft's research division, "they invariably wind up using the term 'childlike wonder.'" At 49, Hillis is clearly an adult: he's a corporate executive and entrepreneur with a high government security clearance and a family of his own. But Hillis has never had to put out an APB for his inner child.

This becomes clear as soon as one crosses the threshold of Applied Minds, which sprawls over five flat buildings in an industrial area of Glendale, Calif. Behind an ordinary reception area, a door opens to a small room with only a red phone booth that could have been a prop in an Austin Powers movie. Hillis picks up the handset. "The blue moon jumps over the purple sky," he says, a twinkle in his eye acknowledging the corniness of the process. The wall behind him opens up to what geeks hope to see when they go to heaven: a vast room packed with brainiacs at work and exquisitely bizarre gizmos, ranging from a 13-foot skeleton of a robot dinosaur to a gleaming outback vehicle loaded with more communications gear than the trailers outside "Monday Night Football." It's a virtual museum of the future that rambles over several buildings.

At every turn, there's something to make your mouth hang open. Here's an array of data-display screens that looks like Han Solo's cockpit. There's a room populated with architectural mock-ups of "podules," fully wired instant buildings designed for stealthy government agencies (that's a picture of Donald Rumsfeld running a meeting in the full-scale version of the model sitting beneath it). Another area looks like Albert Einstein's chop shop, stuffed with half-disassembled Cadillac Escalade SUVs hooked up to exotic telemetry. Oops! Almost stepped on a six-foot-long robotic snake, slithering on the floor with scary fidelity to a pit viper.

Then you enter the darkened room with giant illuminated "touch tables." The surface of each is a high-resolution computer display showing a satellite-cam-



era view of the world. By putting your hands on the table and spreading them, you zoom into a region, a city, a neighborhood. You can also slide your hand over the table to expose the view as captured at an earlier time. (It's possible to track, for instance, the progress of an Iranian nuclear facility, which now looks like a barren area but months ago was a giant hole being cleared for an underground complex.) At an adjacent device, called a "2.5-D Display," you can display any point on Earth and get its topographical information. Want to see more? The surface of the table rises—rises!—to create mountains, streams and gullies. In a few seconds there's

a precise, model-train-tablelike model of the actual terrain.

The childlike wonder attributed to Hillis is contagious. His invention factory can make a corporate bigwig or a Pentagon official gurggle with excitement. "You walk in," says one client who has visited Glendale, "and realize that there's nothing not possible."

The more complicated question is what makes a great *inventor* possible. Though Hillis may not be a household word, he's definitely on the radar of those in the top ranks of science, government and business. He holds more than 70 patents, including a ground-

**'You walk in,' says one visitor, 'and realize that there's nothing not possible.'**





breaking disk system for computers, a digital camera and a scheme to prevent forgery. He's won awards in computer science, mathematics and "the spirit of creativity." Nonetheless, he insists that "people tend to overestimate the individual inventor and underestimate the system that makes their inventions real."

If that's so, Hillis is a case where the system worked. He is a child not only of science but scientists: his father was an Air Force epidemiologist and his mother a biostatistician. Based in Baltimore, his family often wound up living in exotic locales like India and the Congo. Wherever they went Hillis tinkered—building things, dissecting them and even blowing them up. As an MIT sophomore he built a computer out of Tinkertoys. But as he



### The MaxiMog

A rugged expedition vehicle loaded with high-tech equipment to perform research in remote areas. Powered by a 'Vette engine.

**Branpower:** The Mog's one of the projects "owned" by Applied Minds cofounder Bran Ferren.

hung out at the school's Artificial Intelligence Laboratory (he actually moved into the basement of its famous leader Marvin Minsky), he became consumed with creating a machine that could think. "I want," he once said, "to build a computer that would be proud of me."

To pursue this goal, he rethought the architecture of the modern computer, whose

"brain" typically consisted of a single processor. Hillis imagined a supercomputer with *thousands* of processors all working together. Not only did this idea of "parallel processing" become his doctoral thesis but, while still a grad student, he started a company based on it, called (what else?) Thinking Machines. Funded in part by CBS magnate William Paley, Hillis's firm succeeded in building ultrafast Connection Machines, the biggest with 65,536 processors—brooding black \$10 million behemoths with rows of flashing red lights. But Thinking Machines, relying heavily on government purchases, failed as a business when the cold war ended.

Hillis embarked on other projects like using evolution to write computer programs and—in a project that he still passionately pursues—building "The Clock of the Long Now," designed to keep time for 10,000 years and, in the process, make observers think more about the future.

In 1996, Hillis joined Imagineering, the research division of Disney, working on a number of projects, including a giant robot dinosaur that could safely mingle with tourists at the Magic Kingdom. (The six-ton creature shifts weight so artfully that if its foot encounters an eggshell, it will back off before the egg cracks.)

Hillis clicked with the head of Imagineering, Ferren, a well-known wizard in combining technology and design skills with a flair for showmanship. In 2000, the duo began Applied Minds. Backed by venture-capital firms Kleiner Perkins (Amazon, Google) Millennium Ventures and private funders, Applied Minds rents its resident brains to key clients. In addition to collecting a retainer, Applied Minds gets to patent its inventions. Managing partner Rob Turfe says that the private company is profitable on the fees alone and will be more so when licensing revenue from patents kicks in.

To get a good idea of how Applied Minds works—as well as to understand Hillis's own creative process—consider the first product created by the company to actually hit the marketplace. It rose out of a three-year collaboration between Applied Minds and the Herman Miller office-furniture company, which was looking to expand into technology. One problem it sought to address was the



# INVENTOR LOGBOOK

Owner of more than 70 patents, Applied Minds cofounder Danny Hillis has been creating cool stuff for decades, including one item he hopes will last for millennia.



**X MAN:** Hillis with MIT friends

## Tinkertoy Computer

While a sophomore at MIT, Hillis and a friend used 10,000 wooden pieces of the classic toy to make a computer that plays tic-tac-toe. It's still undefeated.

## Connection Machine

Hillis broke ground with a supercomputer with more than 65,000 processors running at the same time. It

lack of privacy among cubicle dwellers. Most people would attack the problem by trying to figure out how to muffle the sound. But Hillis zoomed to a starting point he often adopts when trying to come up with something new: identifying the paradox in the problem. In this case, he thought of restaurants. People like them to be noisy, and he figured this was because we like hearing human voices in the background, and because the din creates a degree of privacy for your own conversation.

Here was the paradox: sometimes the clatter of voices is soothing or energizing but other times it's grating. The difference, Hillis concluded, was when you could figure out what's being said. "It's the *meaning* that's distracting and obnoxious," he says. "Not the sound. The melody of the voice is actually



**MY FIRST COMPUTER:** Hillis (center) at India Science Fair

was a big hit among spy agencies and data miners, but his company, Thinking Machines, crashed.

## Robot Dinosaur

Working as a Disney fellow, Hillis helped create Lucky, a giant autonomous beast now stalking Hong Kong Disneyland. It walks so carefully

that if it steps on an egg, it'll back off before breaking the shell.

## Clock of the Long Now

Built to tick once a year and to chime every century, the full-scale version of this clock is designed to run until the year 12,000. Set the alarm.



**FEELING LUCKY:** Dino in China

pleasant." This epiphany—along with his knowledge of cryptology and signal processing—led to his invention: a box that blocks out a cube-dweller's conversation by simultaneously playing a soundtrack of scrambled, meaningless vocal snippets. (Hillis also had the benefit of work done by Herman Miller's R&D division.) Just playing anyone's voice wouldn't bring privacy, because a focused eavesdropper could pick out the user's conversation. But if the soundtrack consisted of a scrambled recorded version of the *speaker's* voice, an actual conversation by that person would be impossible to understand, even by

someone sitting just outside the cubicle. "Your own sounds are the right thing to mask the meaning of your voice," Hillis says. "If you were trying to hide yourself in the woods, the right camouflage would be to tear off the leaves

around you and glue them to you." The result of this is Babble, a shiny black box the size of a paperback that plugs into the phone and has two speakers you put on top of the cubicle. As promised, when the speakers play a scrambled version of your voice, your real conversation can't be understood by someone standing even four feet away. (In tests by NEWSWEEK, no one wanted to stand four feet away, because the chatter from those boxes was anything but soothing.)

Ambient noise problem or not, the Herman Miller company is thrilled. It has start-



**TIMEKEEPER:** 10,000-year clock





**POWER USER:** Senior engineer Ira Lichtman settles in at a typical Applied Minds work area

ed a new company, Sonare, to market the \$395 device. "We're selling to people in health care, to office workers and to people in apartments who think the neighbors are listening to them," says Sonare president Bill deKruif. "It's amazing how many people want more privacy."

Other projects are more ambitious. The collaboration between Applied Minds and another big client—defense contractor Northrop Grumman—shows how our government might benefit from tapping into minds like Hillis's and Ferren's. It turns out, for instance, that two of the biggest problems for soldiers in the field are carrying huge packs with water, communications gear and batteries. Answer: "the mule," a personal trail robot with built-in broadband and the capacity to make water from air, which plods a few feet behind the grunt.

Applied Minds is also working on technology that affords warriors a "god's-eye view" of the terrain—real-time information about what's around the corner or on the other side of the mountain. "Danny and Bran are national treasures," says Gerard (Rocky) Roccanova, VP of Grumman. "We should be very thankful they're not working for Al Qaeda."

General Motors' executive director of R&D, Alan Taub, says that the auto giant is working with Applied Minds to create "360-degree situation awareness" in drivers, going way beyond the familiar feedback (rearview mirror, dashboard lights, etc.) that cars offer. GM may be

rolling out innovations from the collaboration in its cars in not much more than a year from now.

Another project has potential to save lives. One difficulty in treating cancer is that certain drugs are effective only for a small percentage of patients—and there's no way of knowing in advance which people will benefit. Hillis is now working with Dr. David Agus, a cancer specialist at Cedars-Sinai Medical Center, on a way to analyze the millions of proteins in an individual's body to find out which medicines might kill the cancer. "Some

people argue that this can't be done, because there's too much information to process from those proteins, and we don't even know what all the proteins are," says Hillis. "But here's the paradox—somehow your body is making that computation, and your body has sensors to know what the proteins are. So it's really just an engineering problem."

*There's nothing not possible.* Maybe believing that is what makes an inventor. Brewster Kahle, who worked with Hillis at Thinking Machines, says that Hillis's optimism—as opposed to the rigorous skepticism of the pure scientist—makes him "more inventor than scientist."

That upbeat sense of experimentation permeates the giant toy shop of Applied Minds. Prospective employees undergo what could be called a job-interview-in-a-box. Hillis and Ferren have filled a suitcase with a set of obscure tools. The candidate must pull out the objects and either identify them (displaying a sound knowledge of weird stuff, which is good) or brainstorm what it could be (demonstrating seat-of-the-pants creativity, which is even better). "We're perfectly happy if people come up with really good answers that don't happen to be correct," says Hillis.

Most of those hired are like Hillis—well-educated grown-ups who are still, in their hearts, childhood inventors. "We've attracted a set of people for whom this was always the thing they dreamed of doing," says Hillis. Certainly that was his dream. "I wish I had my drawing from when I was 12 years old and was laying out what I hoped would be my invention shop," he says. "Because it corresponds almost exactly to what's here." Born or made, this is where Hillis is meant to be. ■

## Talk to

Steven Levy about inventors and inventions, Thursday, Oct. 6, at noon, ET, at [Newsweek.com](http://Newsweek.com)

**To come up with something new, Hillis often looks for the paradox in the problem.**