

Dream Technologies That Will Change The World



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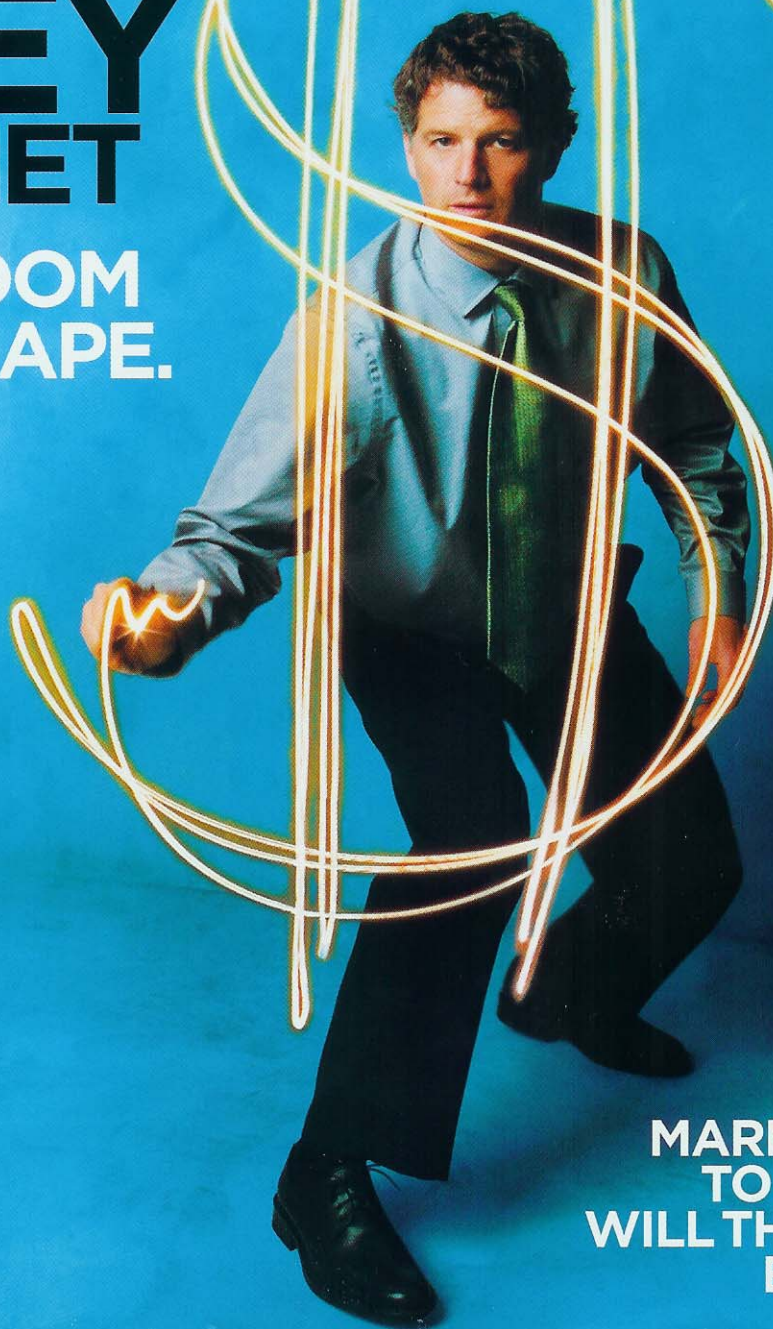
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SIX TECHNOLOGIES THAT WILL CHANGE THE WORLD

Imagine robots that can read your mood and ink-jet printers that can crank out transplantable hearts. The visionaries you are about to meet have not only imagined these things—they're hard at work building them. **By David Pescovitz**



ILLUSTRATIONS BY KENN BROWN

FROM LEFT: ANN STATES; JASON GROW; PAUL CHAUNCEY; BRAD HINES;
JEFF SCIORTINO; ERIC MILLETTE; SKY; TATSUO RODUKO/PHOTONICA

IT AIN'T EASY being a visionary these days. That's especially true in the corporate world, where risk-taking has fallen out of favor.

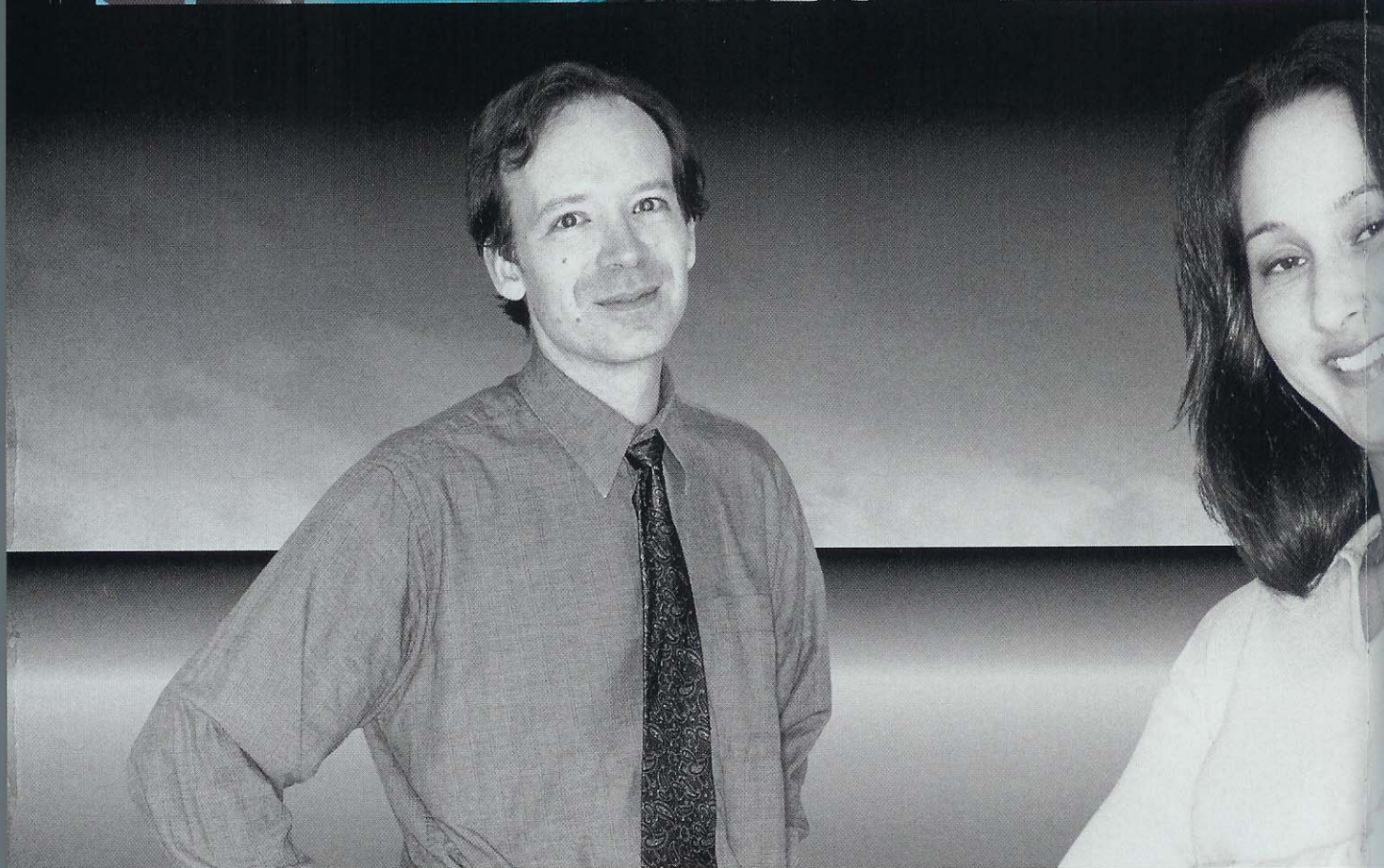
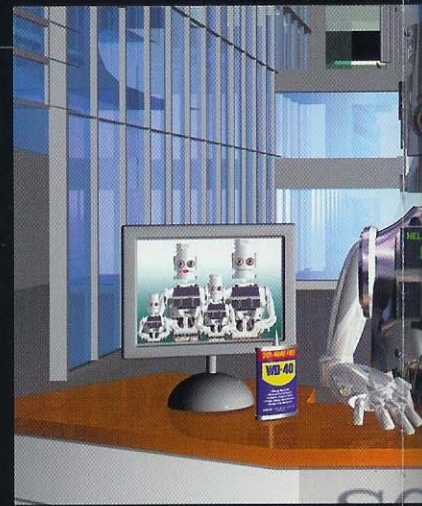
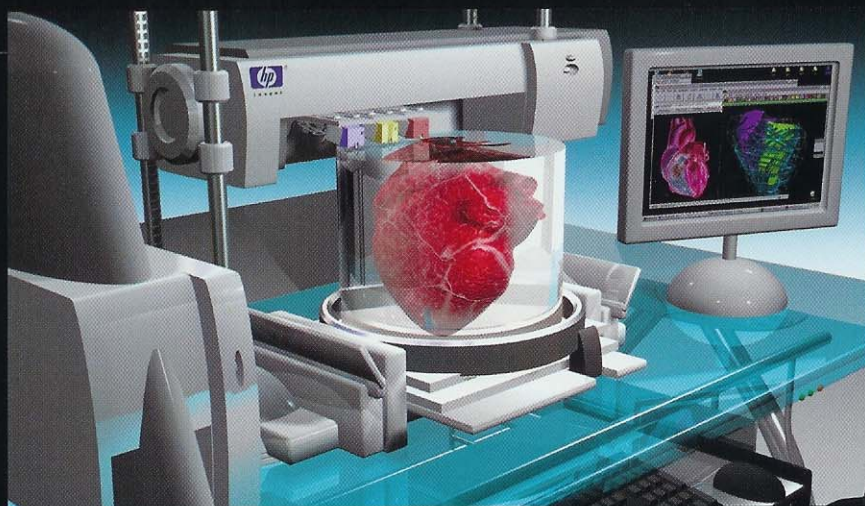
Fortunately, a few companies are still willing to gamble, even if it won't produce profits for the next quarterly report, or many after that. DuPont and Sarnoff, for example, are backing a flexible display screen technology that could one day replace paper. And Raytheon Aircraft is wagering that a safe and relatively affordable supersonic business jet could leave a whole lot of dollars in its slipstream.

But universities are still where the most far-fetched and futuristic innovations develop. MIT is where we found Cynthia Breazeal, whose socialized robots could someday baby-sit for your kids or stand in for you at a meeting. Informed by the diverse disciplines of electrical and mechanical engineering, psychology, human-computer interaction, education, and design, her work benefits from the intellectual cross-pollination that happens so easily in an academic setting. "Sure, you can get access to materials and people from other disciplines at conferences," she says. "But being in an environment where I bump into those people every day and have spontaneous conversations at the coffee machine certainly exposes me to ways of thought that I wouldn't get if I were isolated."

After all, success comes not only from seeing farther than others, but from the ability to refine what you see and make it tangible. Vision followed closely by invention can push us through tough times. Luckily, visionaries and inventors are separate species of the same genus. Visionaries dream. They think about how the world could change. Inventors build. They turn dreams into *things*. The people you'll meet on the following pages are a rare breed. They're inventors, with vision.

Open the gatefold





God's Ink-Jet

VISION: A device that builds human organs and tissues from scratch.

WHY: The originals wear out.

VISIONARY: Thomas Boland, 38.

DAY JOB: Assistant professor of bioengineering at Clemson University.

BREAKTHROUGH: Boland has modified surplus ink-jet printers to squirt out a "bio ink" of cells, growth factors, and degradable gel to form three-dimensional tubes of living tissue. The gel acts as a scaffold for the cells to rest on as they naturally fuse together into the desired form.

BREAKTHROUGH NEEDED: The ability to sup-

ply freshly forged hearts, livers, and kidneys with the essential nutrients they need to survive. Boland's approach would incorporate functional blood vessels right into the organ as it's being "printed."

WHO'S PAYING ATTENTION: Funding comes from NASA; Hewlett-Packard and Canon have both expressed interest in the novel ink-jet application.

QUOTE: "Organ printing will be a great contribution to personalized medical care, since it enables us to potentially build every single fiber of our being. It's a huge step toward the eternity of mankind."

Robots You Can Relate To

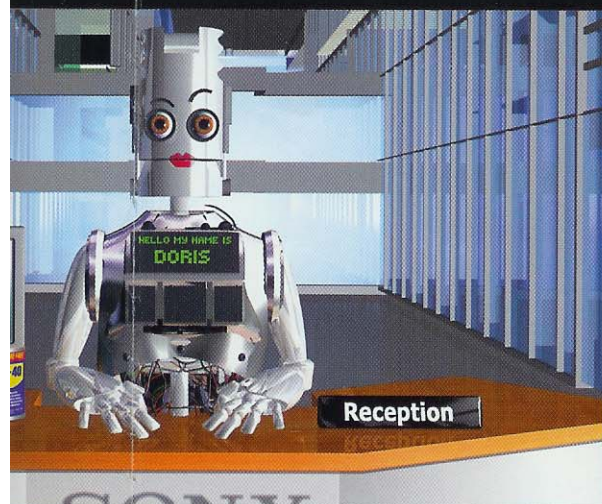
VISION: Machines that interact with people the way people do.

WHY: Sociable robots could teach the young, care for the infirm—even befriend the lonely.

VISIONARY: Cynthia Breazeal, 34.

DAY JOB: Director of the Robotic Life Group at MIT's Media Lab.

BREAKTHROUGH: In 2000, Breazeal created Kismet, a robot head that displays a range of facial expressions in response to natural human visual and auditory cues. Her newest creature, Leonardo, maintains eye contact with its human companions and moves with surreal grace. Thanks to its touch-sensitive artificial skin, the furry, gremlin-like creature actually twitches when you tickle its ears and shyly



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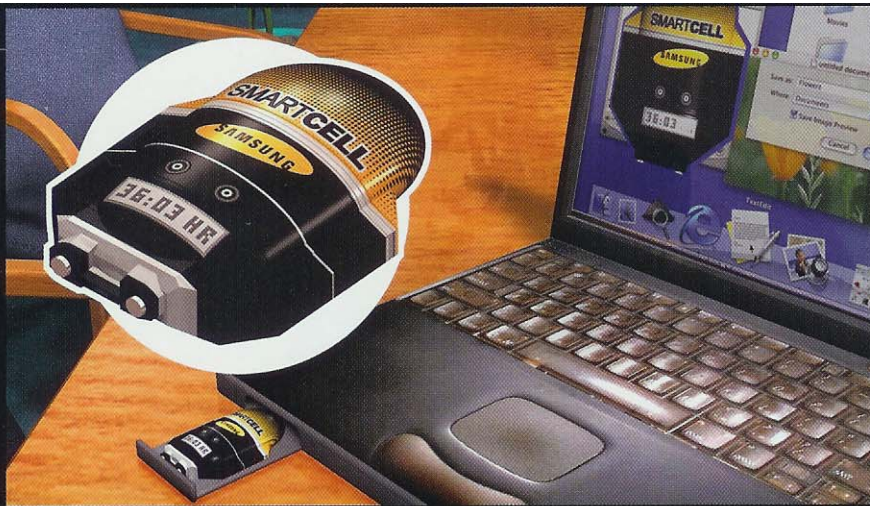
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pulls away if you try to hold its hand.
BREAKTHROUGHS NEEDED: More advanced sensors and actuators, better natural language and gesture processing, and a healthy dose of "theory of mind"—to help the robot interpret the actions of its human companions.
WHO'S PAYING ATTENTION: Hollywood special-effects company Stan Winston Studio is collaborating with Breazeal on Leonardo. Her corporate sponsors include IBM, Intel, Learning Lab Denmark, Lego, Mattel, Nokia, and Sony, all of which are interested in natural human communication interfaces.
QUOTE: "Think of your most beloved robot character in science fiction. That's essentially what I'm trying to build."

The Plane That Does Hong Kong and Back in a Day

VISION: A supersonic business jet.
WHY: High-powered executives want to travel the world and still be back in time for their kids' basketball games.
VISIONARIES: Kimberly Ernzen, 31; Cathy Downen, 33.
DAY JOBS: Manager of the Propeller Aircraft Group (Ernzen) and supersonic research manager (Downen) at Raytheon Aircraft.
BREAKTHROUGH: Computer simulations show that dramatically lengthening a plane's body in proportion to its weight—the six-seat plane is the length of a Boeing 737—and reshaping the wings can quiet the window-shattering double boom that restricts today's supersonic jetliners to transoceanic flights.

BREAKTHROUGHS NEEDED: The designers still have to figure out how to get more miles out of each gallon of fuel. Engine technology needs to minimize takeoff emissions and decibel levels to win over the FAA.
WHO'S PAYING ATTENTION: Backing has come from NASA and the Defense Advanced Research Projects Agency (DARPA). General Electric is working on the engine, and Northrup Grumman did some early development. Boeing, Gulfstream, and Lockheed Martin are also watching.
QUOTE: "The ability to fly from Los Angeles to New York in two and a half hours, or New York to Hong Kong and back in one day, will change the way business is done," Downen says.



All-Day Portable Power

VISION: A fuel cell the size of a marble.

WHY: Conventional batteries are too heavy and drain too quickly to run the portable devices of the future.

VISIONARIES: Paul Ronney, 45; Sossina Haile, 36.
DAY JOBS: Professor of aerospace and mechanical engineering at the University of Southern California (Ronney); associate professor of materials science at Caltech (Haile).

BREAKTHROUGHS: Haile's solid oxide fuel cell (SOFC) is more compact and efficient than the direct methanol fuel cell often hailed as the power source of the future. Ronney's "Swiss roll" heat exchanger circulates the SOFC's intense heat to keep the cell cranking. Together, they could boost cell-phone talk

time to 28 hours and, scaled up, keep a laptop humming for 20 hours on a swig of butane or propane.

BREAKTHROUGHS NEEDED: Haile's working to increase the fuel cell's efficiency while Ronney fine-tunes the Swiss roll design to establish the optimal temperature, gas composition, and flow rate deep inside the device.

WHO'S PAYING ATTENTION: DARPA is funding the research, but electronics powerhouses, including Motorola, Samsung, and Toshiba, and pocket-power startups like Manhattan Scientifics, MTI MicroFuel Cells, and Smart Fuel Cell are watching with interest.

QUOTE: "You could buy [fuel cell] refills at the corner store just like a Bic lighter," Haile says.

Electronic Paper

VISION: Computer display screens as thin and flexible as the page you're reading.

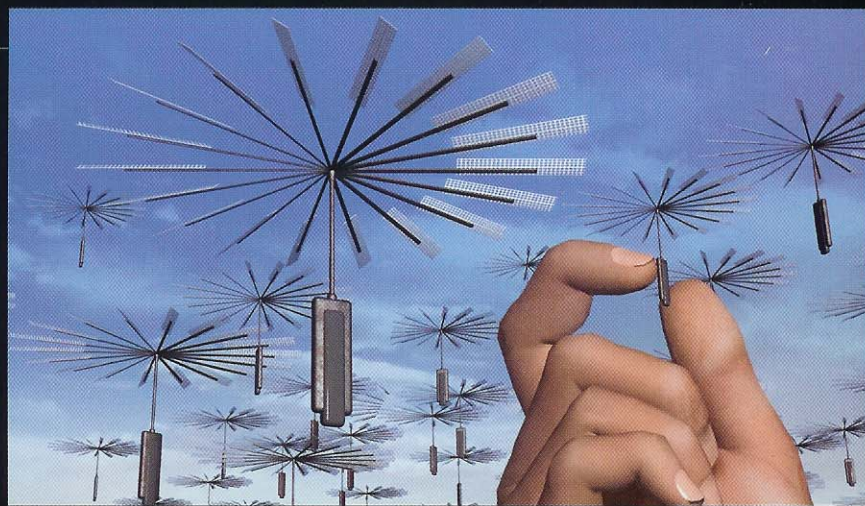
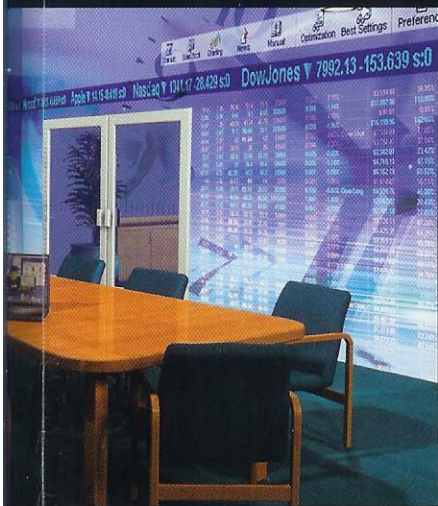
WHY: Wouldn't it be great if the newspaper in your briefcase automatically updated all day long? Or if your breakfast cereal box could play video clips of last night's game?

VISIONARY: John Rogers, 35.

DAY JOB: Professor of materials science and engineering at the University of Illinois at Urbana-Champaign.

BREAKTHROUGH: Rogers and his team have developed organic thin-film transistors (OTFTs), built from carbon-based semiconductors, to control the pixels in active-matrix displays. OTFTs can be printed on a flexible substrate like plastic, which DuPont is developing

to replace the plays. Sarnoff, send video sig
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QUOTE: "Every yourself if a thi
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A Swarm of Sensors

to replace the fragile glass of traditional displays. Sarnoff, meanwhile, is devising a way to send video signals to the new screens.

BREAKTHROUGH NEEDED: There's still room for improvement in the "electronic ink" technologies—organic LEDs, for example—that will convey information at the command of OTFTs.

WHO'S PAYING ATTENTION: Funds come from the National Institute of Standards and Technology. Display-screen big boys Philips, Pioneer, Samsung, and Sony are watching closely.

QUOTE: "Every place you see a screen, ask yourself if a thin sheet of paper would be better. And everywhere you see static ink on paper, imagine information from the wireless Web flowing through it."

VISION: Networks of cheap, aspirin-size sensor robots everywhere.

WHY: Generals need to track troop movements, executives need to follow goods through the supply chain, and conservationists want to track energy consumption, among other reasons.

VISIONARY: Kris Pister, 39.

DAY JOB: CEO at Dust Inc. and professor of electrical engineering and computer sciences at the University of California at Berkeley.

BREAKTHROUGH: Pister and his students created "smart dust motes"—tiny, low-power radios outfitted with microscale sensors. Dust's commercial motes are now just a little bigger than the two AAA batteries that keep them

alive for years at a time. Rather than burning through batteries by constantly transmitting data to a central base station, a mote wakes up just long enough to send its readings to neighboring motes, which pass them along bucket-brigade style.

BREAKTHROUGH NEEDED: The goal is to create mobile microsensors with tinier versions of motes as brains. Pister and his students have created a moving insect-size prototype but have not yet solved all the microelectromechanical challenges that must be overcome before the robot can move.

WHO'S PAYING ATTENTION: DARPA and the entire sensor industry.

QUOTE: "My dream is to make silicon walk."

