



Faux floods destroy Manhattan in *The Day after Tomorrow*.

VIRTUAL WATER WORLD

EVERYONE KNOWS WHAT WATER LOOKS LIKE. BUT SIMULATING IT DIGITALLY FOR the big screen can be tricky and time-consuming. At Digital Domain in Venice, CA, computer scientists Doug Roble and Nafees bin Zafar and their special-effects team have developed software that quickly creates large-scale, high-resolution water animations. Enter initial conditions of depth, volume, shape, and speed, and the software uses advanced mathematics to model a fluid's surfaces, realistically capturing phenomena such as complex currents and water swirling around buildings and people. An early version of the software was used to create the largest water simulation in a film to date: the flood in this summer's *The Day after Tomorrow*. The latest version takes five to 10 minutes to generate each frame—one-third the time needed just a year ago, and with only one-quarter the memory. Roble says the software is now being used to do visual effects in two feature films due out in 2005.

POWER DRUGS

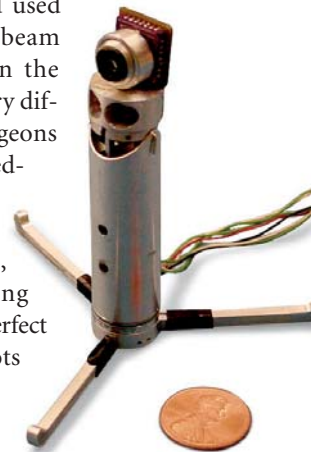
PROBLEMS WITH MITOCHONDRIA—CELLS' TINY energy-producing units—can cause illnesses as diverse as cancer and Parkinson's disease. Volkmar Weissig, a pharmaceutical scientist at Northeastern University, says he's devised the first drug delivery system that can shuttle a drug through a cell to target its mitochondria. Weissig coats drugs in a common antibacterial compound; the positively charged coating is attracted to the mitochondria, which are the most negatively charged parts of the cell. In a recent experiment with mice, Weissig found that tumors treated with the coated version of the cancer drug Taxol grew only half as much as those treated with the uncoated drug. Weissig says he could also use the approach to shuttle DNA to the mitochondria, a possible basis for gene therapy to correct mutations in mitochondrial DNA—which have been implicated in neurological diseases such as Parkinson's and Alzheimer's. A Boston startup company, MitoVec, plans to couple Weissig's technology with several existing cancer drugs and begin testing it in humans in two to three years.



Mitochondria are key targets for drugs.

ROBOSURGEON

ACCIDENT VICTIMS AND INJURED SOLDIERS could be saved at the scene by tiny wheeled robots slipped into their abdomens and controlled by surgeons hundreds of kilometers away. In experiments conducted at the University of Nebraska, the robots carried cameras fitted with light-emitting diodes to illuminate the abdomens of pigs and used radio transceivers to beam back video images. In the field, robots would carry different tools so that surgeons could stop internal bleeding—the main cause of traumatic death—by either clamping, clotting, or cauterizing wounds. "We want to perfect a family of little robots that paramedics can insert into a patient through a small incision," says University of Nebraska-Lincoln mechanical engineer Shane Farritor, who is working with Dmitry Oleynikov of the University of Nebraska Medical Center. Farritor expects finished prototypes within two years.



Camera-wielding robots aid emergency surgery.

TRANSLATION IN MOTION

Your colleague in Germany thumb-types "Wir benötigen fünf tausend Kondensatoren bis zum Dienstag" into her cell phone. Three seconds later and nine time zones away, the translated text pops up on your Blackberry: "We need five thousand capacitors by Tuesday." A system that makes this possible—by melding mobile text messaging and e-mail with the latest in machine translation—will be available to wireless subscribers this fall from New York City-based Transclick. For \$30 per user per month, multinational corporations will be able to install the software on their employees' PDAs and smart phones. Workers will then upload country-to-country text messages or e-mails to Transclick's servers, which render translations using dictionaries customized to their users' lines of business—say, law or pharmaceuticals.

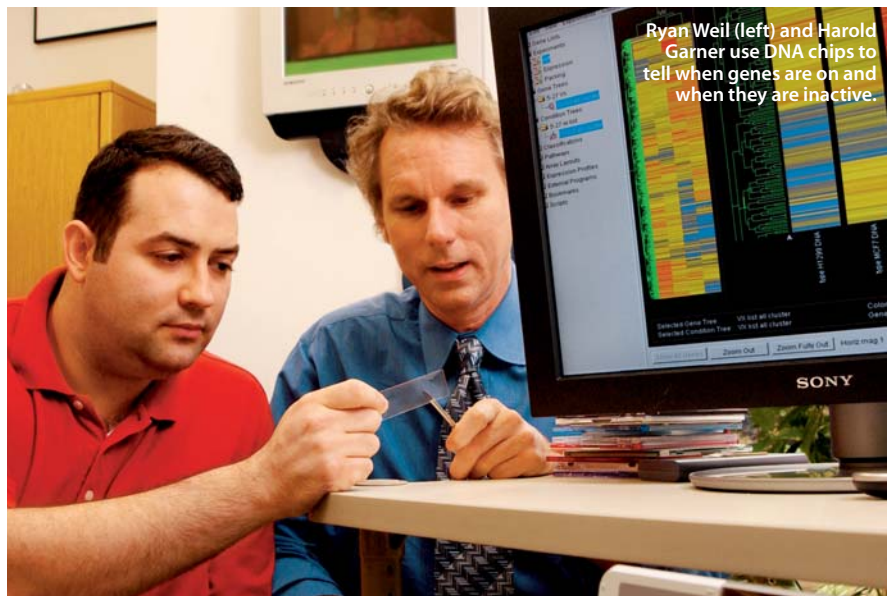
COURTESY OF VOLKMAR WEISSIG (POWER DRUGS); COURTESY OF SHANE FARRITOR (ROBOSURGEON); COURTESY OF DOUG ROBLE (WATER WORLD)

PORTABLE PATHFINDER

FOR MANY PEOPLE WITH BRAIN injuries, mental retardation, or Alzheimer's disease, getting lost or disoriented is a common and distressing experience. At the University of Washington, computer scientist Henry Kautz's team has developed a system that uses cell phones to monitor users' whereabouts and help keep them on track. The phone, equipped with a GPS receiver that gauges its location, communicates wirelessly with a PC running novel artificial-intelligence software. Based on about three weeks of data, the software learns to predict daily behavior patterns, such as which bus a user takes. Then, if the system thinks the user is, say, getting off at the wrong bus stop, the phone sounds an alert and displays a text prompt on the screen—including directions for getting home. Kautz's team plans to do tests next spring, together with University of Washington researchers in rehabilitation medicine. The software could be on the market within two years.



A simple interface helps people navigate to their choice of destinations.



Ryan Weil (left) and Harold Garner use DNA chips to tell when genes are on and when they are inactive.

ALL WOUND UP

FIGURING OUT WHICH GENES ARE ACTIVE AND WHICH AREN'T—IN, SAY, AN organ or a group of cells—is critical for both basic biological research and the development of treatments for diseases like cancer. Researchers at the University of Texas Southwestern Medical Center have developed a way to simultaneously assess, for a given biological sample, the activity of all the genes in the genome, based on how tightly their DNA is wound. DNA spends much of its time coiled up; when a gene is turned on, its segment of the coil unwinds. Biophysicist Harold Garner says he has devised a way to separate coiled DNA from DNA that's "loose and free." His team then uses DNA microarrays to determine which genes are in the open group—and therefore active. The technique could help uncover the secrets of a host of diseases, Garner says. The researchers, for instance, are using it to find out how cancer drugs affect gene activity. "This will allow us to hopefully tune some of those drugs and identify new drugs that may work better," Garner says.

RFID RELIEF

Software that should make it easier for small businesses to adopt radio frequency ID technology—without breaking the bank—is being readied for release by Dallas, TX, startup AirGate Technologies. The latest RFID tags can store product details that let companies track items from factory to warehouse to retail shelf; large organizations like Wal-Mart and the U.S. Department of Defense are rapidly implementing the technology and dragging their suppliers along with them. The problem, says AirGate CEO Michael Sheriff, is that many smaller companies that own multiple brands of RFID readers—one at the warehouse doors, another in the product-label printers, and so forth—and use multiple systems for storing product information can't afford custom software to link them all together. AirGate's one-size-fits-all software, to be unveiled next spring, acts like a universal translator. It's the first system that can take data from any RFID reader and present it intelligibly on a simple Web page or dump it into a database program.

CALL FORWARDING

IN TODAY'S MOBILE SOCIETY, IT SEEMS people are hardly ever around to answer landline phone calls. But software developed at the University of California, San Diego, lets you take those calls on any Internet-connected device. A system devised by Andrew Kahng and Puneet Sharma enables a PC to digitize a phone call coming in on a landline and forward it via the Internet to a Wi-Fi-enabled cell phone, a PDA, or even another computer, so long as it's also running the software. Outgoing calls made from the remote device can also be routed back through the landline, allowing a user to, for instance, avoid long-distance charges. Kahng and Sharma plan to commercialize the technology early next year.



Software turns a PDA into an Internet phone.

COURTESY OF RYAN WEIL (ALL WOUND UP); COURTESY OF ANDREW KAHNG (CALL FORWARDING); COURTESY OF HENRY KAUTZ (PATHFINDER)