JAMES YANG

BIOTECHNOLOGY

Medical Records, Inc.

Firm set to mine Framingham Heart Study

THE UNITED STATES' MOST FAMOUS epidemiological study, the Framingham Heart Study, is about to take a medically promising step that could help in the effort to discover genes responsible for common diseases. But the move is also likely to raise questions about the commercial exploitation of patients' medical records.

Since the Framingham study began in 1948, some 10,000 residents of Framingham, Mass., have been poked, prodded and measured every two years in a massive effort to uncover risk factors for heart disease. The study has been extraordinarily successful, turning up, among other things, the link between cholesterol and clogged arteries. Now, officials at Boston University, which administers the study on behalf of the National Heart, Lung, and Blood Institute, have formed a company to mine the data for genes that contribute to diseases such as dementia, arthritis and the onset of deafness in adults.

Framingham Genomic Medicine plans to spend millions over the next several years to organize the information and begin large-scale DNA testing. "The amount of data ready to be culled out of this study is limitless," says chief scientific officer Fred Ledley.

The demand for so-called "phenotype" data (measurements of an individual's actual physical characteristics) from well-studied populations like Framingham is rising dramatically thanks to rapid advances in genetic technology. "Genetic analysis can be done with an arbitrarily great degree of precision. But you are limited by patient data," says Ledley. "This is the missing link."

In fact, genomic researchers expect they will eventually need medical data on hundreds of thousands, even millions, of people. For that reason, some European governments with centralized health care systems are now casting hungry eyes on their citizenry's medical records. The U.K. Medical Research Council, for instance, is planning a massive study involving more than 500,000 volunteers, and scientists have lobbied the U.K.'s National Health Service to create a genetic database encompassing the entire British population. Similar national databases are under consideration in Italy and Estonia.

So far, however, private companies have taken the lead in creating phenotype databases—a move that's proved both lucrative and controversial. In Iceland, Reykjavik-based deCode Genetics, which got government approval to create a database based on the medical records of that nation's 275,000 citizens, has been accused of violating patient privacy and plundering Iceland's genetic heritage. Despite the criticism, the company has signed a research alliance worth up to $200 million with Hoffman-La Roche, which hopes to use the data as a starting point for new medicines.

The question of who should benefit from a patient's medical records is also at issue in the Framingham study. "We are trying to be very open and proactive with the Framingham population, to get their buy-in and support for what we are doing," says Art Klausner, a partner with Domain Associates in Princeton, N.J., part of a financial consortium that's planning to invest $22 million in Framingham Genomic Medicine. The company plans to donate some of its profits to the Framingham community.

While experts in biomedical ethics say that's a good start, exploiting phenotype databases for commercial purposes remains problematic. For instance, do the consent forms patients sign to participate in such studies include adequate disclosures of how their DNA and tissues will be used in the future? "Privacy drives the concern about these databases. People are fearful that information about genetics could be used against them," says Arthur Caplan, director of the University of Pennsylvania Center for Bioethics. Entire ethnic groups may also be at risk, since genetic research could lead to findings, such as vulnerability to a specific disease, that could stigmatize them. "The very things that make a population good to study also make it tricky," says Caplan.

—Antonio Regalado

TELECOMMUNICATIONS

Light Signals Direct

Local optical networks skip the fibers

The telecommunications business has always involved some risks. But now two of telecom's largest companies are investing in thin air.

Lucent Technologies is spending $450 million on a joint venture with Seattle-based TeraBeam Networks to build communications systems that will transmit light directly between buildings, skipping optical fibers altogether. Not to be outdone, rival Nortel Networks is developing a line of similar equipment with San Diego-based AirFiber. The goal of both ventures: shoot laser beams between medium and large businesses in downtown areas or office parks, providing vastly more voice and data capacity than ordinary phone lines without the expense and delay of laying fiber-optic cable.

The explosion in the Internet means that businesses have an ever-growing appetite for bandwidth. Fiber optics, which can carry data at gigabit speeds, can readily provide that capacity, but less than 5 percent of downtown office buildings are currently "wired" with fiber. New installations take time, and construction costs can be staggering. Ever try digging up the sidewalk in midtown Manhattan?

Don't expect the new technology to replace fiber-optic networks. But for businesses needing from 10 to several hundred megabits per second of bandwidth at one-tenth the cost of installing fibers, it could be a boon. "We don't consider it revolutionary. But it's a useful concept," says Jeff Montgomery, chairman of ElectroniCast, a telecom consulting firm in San Mateo, Calif.


AIRFIBER

AirFiber's optical nodes are positioned on top of a building.

Shooting laser beams through the air between buildings is not a new idea. In fact, laser communication through open air was demonstrated in the early 1960s. But the technique lost out to fiber optics; in earlier systems anything from bad weather to passing birds could interrupt the pencil-thin beams and destroy the line of communication.

The new systems are designed to be more reliable—pigeon-proof. Both TeraBeam and AirFiber use redundant beams, each spread over a larger area, so interruption would require almost complete blockages of multiple large beams. AirFiber arranges an interconnected mesh of rooftop transmitters and receivers, spaced 200 to 500 meters apart, depending on clarity of the local atmosphere; at least one node in the mesh connects to a fiber-optic backbone. Each transmitter aims beams of light at three or four receivers, building up a redundant mesh with multiple interconnections. TeraBeam puts a base transmitter in a strategic window in a building served by a fiber-optic network.

The companies have demonstration systems up and running—TeraBeam in Seattle, and AirFiber in Madrid, Tokyo and Dallas. **—Jeff Hecht**

NANOTECHNOLOGY

Tethered to Silicon

Silicon is at the heart of today's computer microchips. Making faster and cheaper computers means carving vanishingly small transistors into silicon chips—a task that is becoming increasingly difficult and expensive. One potential solution is to use individual organic molecules, which are orders of magnitude smaller than today's transistors, on a silicon surface to do electronic switching and storage.

Making such silicon-organic hybrids, however, poses a very, very small problem—how do you put the molecules exactly where you want them? Electrical engineers at the University of Illinois at Urbana-Champaign have now found a way to attach individual organic molecules to silicon with atomic precision, using the tip of a scanning tunneling microscope.

First the researchers deposit a layer of hydrogen, one atom thick, on the silicon surface; then they use the microscope's tip to pluck off individual hydrogen atoms in a desired pattern. The result, says Joe Lyding, professor of electrical and computer engineering at Illinois, is "a dangling silicon bond [where the hydrogen atom was] that is very reactive." Various organic molecules can then be sprayed on the surface, where they will attach themselves only to the "dangling bonds."

So far, Lyding and his graduate student Mark Hersam have fabricated simple patterns—columns and a V-shape—by spraying on molecules such as buckyballs (a soccerball-shaped 60-carbon molecule that many researchers believe has promise in electronics). Lyding envisions that the technique could eventually lead to hybrid silicon chips with ultrafast molecular switching and storage arrays. But, he adds: "In a sense this is uncharted territory. Nobody has placed individual molecules into atomically precise arrays on silicon before." **—David Rotman**

LEGISLATION

Canada Gets Private

Federal law aims to protect personal information

JAMES YANG

SEND YOUR E-MAIL ADDRESS TO AN online florist, and months later you may well get a marketing plug using—you guessed it—that same e-mail address. That's a troubling development for those concerned about personal information winding up in corporate databases. Canada has taken these concerns seriously, passing legislation to better protect the privacy rights of its citizens. The new federal law, the Personal Information Protection and Electronic Documents Act, mandates rules businesses must follow in collecting and processing personal information; it requires, among other things, that companies obtain an individual's consent for specific uses of data.

Much of the attention to privacy issues over the past year has focused on the Internet, and the opportunity the Net affords business and government to collect extensive information about citizens. But the Canadian law applies to all data collection activities. That means banks and insurance companies collecting data in traditional ways, as well as the latest e-commerce trading site.

"In order for Canada to become a leader in the knowledge-based economy and in electronic commerce, consumers and businesses must be comfortable with the new technologies and with the impact that these technologies will have on their lives," said John Cannis, MP from Scarborough Centre, speaking shortly before the legislation passed the Canadian Parliament this spring. Cannis said the law creates a "level playing field" for all Canadian companies. "The direct marketing industry, information technology companies, telecommunications companies and banks all realize that we need a clear federal legislative privacy framework in Canada. And they recognize that flexible, but effective, legislation will help customers accept electronic ways of doing business and be less expensive for them than self-regulation alone."

The Canadian privacy law was a long time coming, says Ann Cavoukian, Information and Privacy Commissioner for the province of Ontario. The principles incorporated into the legislation date back to 1995, when the Canadian Standards Association passed a voluntary privacy code; it called for companies to explain why information is being collected in the first place, obtain consent from the consumers, ensure accuracy of the collected data and provide safeguards against accidental disclosure.

The legislation essentially makes the voluntary code a law. "For companies that haven't been doing anything," says Cavoukian, "it will represent a fair amount of work at the beginning. For the first time, they will have to think about what is the primary purpose of the data collection, and then obtain the consent of their customers to use the information for other purposes."

Cavoukian argues that it's time for the United States to consider similar legislation. Currently, U.S. policy relies almost exclusively on self-regulation to protect consumer privacy. That only works, she says, if there is a "demonstrated commitment on the part of the businesses" to protect privacy. Looking over her country's southern border, she says drily, "I haven't seen this."

—Simson L. Garfinkel

AEROSPACE

Space Plane Grounded

Far from being ready for space, NASA's billion-dollar space plane, a critical transitional craft in replacing the Space Shuttle, is in deep trouble. The maiden test flights of the X-33 hypersonic plane were scheduled for the middle of this year. But NASA now says the prototype will not fly until at least the end of 2001.

NASA

The wedge-shaped X-33 is a prototype of a vehicle NASA hopes will replace the Space Shuttle.

Indeed, if the critics have their way, the X-33 may never leave the ground. At congressional hearings in April, House space subcommittee chairman Dana Rohrabacher criticized NASA's strategy for replacing the Space Shuttle. "By resisting the philosophy of build a little, test a little, NASA had put all of our cheap-access-to-space eggs in one fragile technology basket."

The X-33 has been an ambitious—and controversial—project from the start. The plane, being built by a NASA-Lockheed Martin partnership, is meant to demonstrate the feasibility of "single-stage-to-orbit" (SSTO) technology. If the X-33 proves the credibility of the SSTO strategy, the technology could be used in a privately funded spaceship, Venture Star, to replace the Space Shuttle.

At stake is more than just a suitable replacement for the Space Shuttle. The X-33 will be NASA's first new space-related flight test program in two decades. And many observers are watching to see whether the sometimes beleaguered space agency has any technology magic left.

—James Oberg

BIOMEDICINE

Cures on Hold

Scarcity of stem cells blocks biomedical progress

Nearly two years after the isolation of human embryonic stem cells promised to change the face of medical research, progress is still on hold due to scientists' limited access to the cells. Private companies are restricting use of their supplies, and government initiatives to provide the cells to academics remain stalled by abortion politics.

ES cells, believed to be capable of turning into any kind of tissue, are derived from human embryos. A law prohibiting federally funded researchers from performing embryo research has left most academic scientists effectively barred from working with ES cells, although the National Institutes of Health has recommended that researchers be able to use existing ES cell lines. A bill pending in the U.S. Senate would allow researchers to derive new ones as well. Critics of the research are opposing both measures.

This game of political football has left the research community in a bind, with few good options for getting the cells. Although the University of Wisconsin (where ES cells were isolated in 1998) has created an institute called WiCell to distribute ES cells, scientists that come knocking are being asked to sign an agreement with "unacceptable and ridiculous"

STEPHEN SHEFFIELD

strings attached, says Harvard University embryologist Doug Melton. Not only does WiCell demand commercial rights to any discoveries made, but also reserves the right to terminate research at any time with 90 days' notice.

"The agreement holds the Sword of Damocles over your research," says George Daley, a biologist at MIT's Whitehead Institute. Unable to find an acceptable source of ES cells in the United States, both Melton and Daley have turned to a university group in Israel that's begun distributing the cells.

But because such trafficking still leaves most U.S. researchers out in the cold, several private medical charities are now gearing up to fund sources of ES cells that would be widely accessible. The Juvenile Diabetes Foundation has funded a researcher in the United Kingdom to derive stem cells. In a closed meeting in early April, leaders of the Howard Hughes Medical Institute (HHMI), the nation's largest biomedical not-for-profit, discussed the role the foundation should take in pushing ES cell research forward. According to people who attended the meeting, HHMI leaders discussed the idea of funding two or three centers to derive ES cells. These centers would be located in different parts of the country to ensure that one or more survive the wrath of pro-lifers in the state legislatures.

While biomedical researchers would welcome the entry of HHMI, many say it wouldn't be enough. Larry Goldstein, an HHMI-funded investigator at the University of California, San Diego who has been lobbying both Hughes and the government to let ES cell research progress, says privately funded research is moving forward, but only in the shadows, without proper public supervision. "Scientists with private funding are proceeding to the best of their ability. It's a mistake to think that if the government doesn't fund this work it will stop it in its tracks," says Goldstein. "There needs to be public input. To lose that voice would be wrong." **—Antonio Regalado**

METEOROLOGY

Taming Tornadoes

During an average year in the United States, some 800 tornadoes injure more than a thousand people. A California physicist believes it is possible to use blasts of microwave energy from a satellite to diffuse developing tornadoes before they can wreak their damage.

Bernard Eastlund, president of Eastlund Scientific Enterprises in San Diego, Calif., proposes using microwaves to heat the cool, rainy downdrafts that form a tornado. According to modeling by Eastlund on supercomputers at the University of Oklahoma's Center for Analysis and Prediction of Storms, about 100 million watts of energy added to the descending air column could disrupt a downdraft that otherwise might spawn a tornado.

Federal Emergency Management Agency (FEMA) physicist Paul Bryant, an expert on tornadoes, thinks Eastlund's idea is practical. "He's got a good concept and has demonstrated in computer models that you can arrest a tornado," Bryant says. Bryant, who is FEMA's adviser to NASA on its efforts to mitigate natural disasters, says the International Space Station would be an ideal vehicle for an initial test that would involve diffusing developing waterspouts over remote sections of ocean.

Not everyone thinks that's a great idea. Dan McCarthy, a tornado expert at the National Oceanic and Atmospheric Administration's Storm Prediction Center in Norman, Okla., cautions that diffusing tornadoes might open a meteorological Pandora's box. "I'd be real careful in trying," McCarthy says. "You may set off another area of thunderstorms elsewhere." **—David Graham**