

take more than tinkering to rout Rayleigh. Paul Kwiat, a physicist at Los Alamos National Laboratory in New Mexico, suspects that the difficulty of creating bright beams of entangled light will limit the usefulness of the technique. "But it's good to have people think about these things," he adds.

—CHARLES SEIFE

## POPULATION GENETICS

### Estonia Prepares for National DNA Database

**TARTU, ESTONIA**—If a nation's most valuable resource is its people, then how precious are its people's genes? For this tiny Baltic state, the opening bid lies somewhere between \$100 million and \$150 million. That's how much money Estonia expects to raise for a project, set to begin next year, that would compile DNA profiles and health information on 75% of the country's 1.4 million citizens. Officials hope that the database will not only allow researchers to track down disease genes and improve health care but also boost Estonia's budding biotechnology sector.

Last month the Estonian parliament began considering a bill to regulate the collection of genetic information and database research, and observers predict quick passage. "I expect the final approval before Christmas," says Minister of Social Affairs Eiki Nestor. The next step would be a \$1 million test of the concept on 10,000 volunteers.

With a pilot project possibly only a few months away, scientists held a meeting here last month for a global audience of colleagues and venture capitalists. "At this point we are interested in ideas and perspectives," says Jaanus Pikani, chair of the Estonian Genome Foundation (EGF), which began organizing the project last year (*Science*, 12 November 1999, p. 1262). Prospective investors who attended the meeting think that Estonia should have little trouble finding backers. "Once a legal structure is in place," says Todd Morrill of Venture Merchant Group in Walnut Creek, California, "success [will depend] on getting the pilot project under way."

Estonia hopes to chart a course different from that of a similar, but controversial, Icelandic project (*Science*, 30 October 1998, p. 859). In January, Reykjavik-based deCODE Genetics received an exclusive license to run Iceland's health-sector database for 12 years,

a proprietary lock on the country's health records that allowed deCODE to raise nearly \$160 million in a stock offering last July. Critics have complained, however, that the project requires individuals to opt out rather than making the company obtain informed consent ahead of time for health profiles. DeCODE is now negotiating the issue with the Icelandic Medical Association.

Another issue involves the use of the databases. The information in the Icelandic project will be maintained anonymously, meaning that donors will not have access to their own information. By contrast, data and DNA samples in the Estonian project will be identifiable through a coded system. But it will belong to a nonprofit state-controlled foundation, and donors must give their informed consent for its use. If donors change their minds and want out of the database, their samples can be destroyed.

"Valuable lessons from the well-known Icelandic project have been learned," says University of Montreal law professor Bartha Maria Knoppers, chair of the Human Genome Organization's International Ethics Committee. She believes that the Estonian effort is "the more responsible approach, because it allows citizens to see what research

is done with the information they donate. People want to know." She says it's also important that the project educate the public on the information that is available after health data and DNA are analyzed.

Estonia's decision to make the genetic data accessible to donors themselves means that donors someday may be able to take preventive measures against diseases to which their DNA places them at risk, or receive medical

treatments tailored to genetic deficiencies. "The potential for a return for the health care system is substantial," says Thomas Caskey, CEO of Cogene BioTech Ventures in Houston, Texas, and former president of the Merck Genome Research Institute.

Participants in the pilot project will fill out extensive health questionnaires and give blood for genotyping. If all goes well, says Pikani, "we can move on to the major effort within a year." Genotyping would be done on 1 million people over 5 years, using single-nucleotide polymorphism markers, and medical information would be updated continually.

That prospect makes disease gene-

hunters salivate. Topping the most wanted list are genes that contribute to major killers such as diabetes, heart disease, and Alzheimer's. The large sample size may allow scientists to home in on genes involved in diseases triggered by the interplay of genetics and the environment, says Max Baur, a medical statistician at Bonn University. "The success of the Estonian project," he says, "hinges on high-quality medical data, good genotyping, and good data handling."

Companies are now talking with the Estonian government about how they might support—and profit from—a government-owned venture. Although the database will belong to a nonprofit foundation formed by the EGF and the Ministry of Health, a for-profit subsidiary will have the right to sell access and information. "I believe there will be interest, but investors will have to know exactly what they [are] buy[ing] into," says Greg Lennon of Veragene, a genomics consulting firm in Maryland. Estonia plans to strike limited, nonexclusive deals that would, for example, allow a company to mine the database for clues to one or more diseases and receive intellectual property rights to treatments derived from its research. Access to data would be given to public researchers at no cost or for a handling fee. Estonian Prime Minister Maart Laar, a big supporter, is aiming for a balance between private and public involvement. "The important thing is that ownership [be] properly regulated," he says.

Estonian scientists predict that the project will be a boon to the country's embryonic biotech industry. Much of the massive genotyping, for instance, must be done in Estonia, as DNA samples cannot be exported without a special license from the Ministry of Health and Social Affairs. At the same time, "the database will boost research and make it possible for local scientists to attract funds from outside," says Andres Metspalu, head of molecular diagnostics at Tartu University, who came up with the initial concept.

The idea of collecting and storing a nation's health data and genetic profiles has sparked surprisingly little discussion in Estonia. "It has been hard to have a debate with no real opposition around," observes science editor Tiit Kändler of *The Estonian Daily*. One reason, he and others suggest, is the country's eagerness to become a player in the world economy and to wipe away all vestiges of its Soviet past. There is much talk that the country needs to find its own Nokia, the phenomenally successful telecommunications giant that lifted the Finnish economy. Says Andrus Kaldalu of Tartu's Asper Biotech, "There is a feeling that biotech could be it."

—LONE FRANK

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**Booster.** Andres Metspalu sees databases as a boon to research.