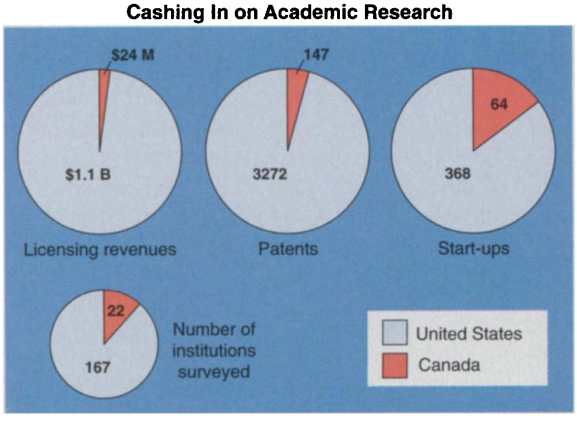
some form of permanent funding program in next year's federal budget. The government also vowed to revive a promise to double outlays by 2010 for the three federal granting councils and to support training of more graduate students.

In return, the Association of Universities and Colleges of Canada (AUCC) agreed to "a doubling of the amount of research performed by universities and a tripling of commercialization performance" over the same period of time.

Cashing In on Academic Research



Southern advantage. U.S. universities generally do more to commercialize research than their Canadian counterparts do.

The parties must still iron out how to measure growth in academia's contribution to the economy. Canadian universities now lag well behind their U.S. counterparts on standard measures, such as licensing revenues, because of Canadian industry's reduced capacity to make use of new knowledge and technology, says Association of University Technology Managers president Janet Scholz of the University of Manitoba in Winnipeg (see graphic).

University leaders seem satisfied with both the terms and the overall symbolism of the arrangement. "Because we're starting a bit lower, tripling [of commercial activities] is realistic," says Claude Lajeunesse, president of Ryerson University in Toronto. "It will require very, very strong commitment from researchers. But once they understand that this is not a threat to their freedom or their research and that, rather, it is something that will help them pursue new areas and, in a sense, be more relevant, then the vast majority will say this is good."

"No doubt there will be a lot of discussion about the appropriate benchmarks" for measuring commercial performance, says AUCC vice chair Peter MacKinnon, president of the University of Saskatchewan in Saskatoon. "The amount of money spent, the amount of licenses that could be expected to result, patents, and start-ups: All of these things would be relevant."

Several administrators note wryly that tripling commercialization output shouldn't prove too great a challenge, given that the current base is so low. They also don't anticipate the need to change current rules that generally assign intellectual property rights to individuals rather than the institution, as recommended by the national Advisory Council on Science and Technology (*Science*, 30 April 1999, p. 726).

The government won't penalize individual universities that fall short, Rock says, because the promise applies in the aggregate. But neither will it allocate funds to help universities hire or train staff to promote research findings to business. However, universities may choose to use a portion of the monies allocated for so-called indirect costs to promote commercialization.

Before the promise becomes reality, Rock must successfully negotiate with other government factions seeking massive hikes in funding to rejuvenate the national health care system, retool the military, and honor environmental commitments from Canada's embrace of the Kyoto protocols. But Rock believes that he will have an easy sell to his Cabinet colleagues. "How are we going to be able to afford all this? The answer, of course, is innovation," he says. "If you innovate, if you increase productivity and competitiveness, your economy performs better, more people are employed, the revenues increase, and you're able to afford to do more."

–WAYNE KONDRO

Wayne Kondro writes from Ottawa, Canada.

GENETICS

Venter Gets Down to Life's Basics

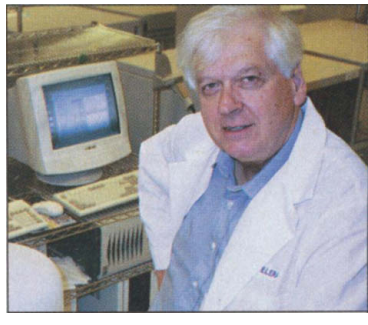
Never shy about his aims, DNA sequencer J. Craig Venter Jr. announced this week that he has won a government grant to design a novel form of life. The U.S. Department of Energy's science office has awarded his group $3 million over 3 years to "develop a synthetic chromosome," the first step toward making a self-replicating organism with a completely artificial genome.

Venter also announced that he has recruited molecular biologist Hamilton O. Smith, a 1978 Nobel laureate who has worked with him on many sequencing projects (including some for their ex-employer, Celera Genomics) to head up a 25-person scientific team at Venter's new outfit, the Institute for Biological Energy Alternatives in Rockville, Maryland. The purpose of the experiment, Venter says, is to develop an efficient but rigidly controlled organism that can carry out specific tasks, such as removing unwanted carbon or toxic materials from the environment or producing hydrogen for fuel.

Several years ago, Venter, Smith, Clyde Hutchison, and others at The Institute for Genomic Research in Rockville began trimming a small organism's DNA to create a "minimal genome" that would still sustain metabolism and replicate. This team showed in 1999 how the minute genome of *Mycoplasma genitalium* might be truncated to about 300 essential genes and still reproduce (*Science*, 10 December 1999, p. 2165). Venter now wants to put his minimalist concept to the test: "We took a couple of years off to sequence the human genome" at Celera, he says, "and now we're back" working on the minimal genome.

Others have modified existing organisms to carry out environmental tasks. But Venter says he wanted to start from scratch because "we don't want [an organism] that can adapt. We want something that's truly robust, but—if it got out of a specialized environment—we wouldn't want it to last 5 seconds." He's also interested in the fundamental challenge of discovering the essential genes needed to support life: "That's the main reason we're doing it."

The project raises ethical challenges, however, as Venter acknowledges. Several years ago he commissioned a review headed by ethicist Mildred Cho of Stanford University to weigh the risks of creating new life forms. The panel concluded that there were no showstopping moral issues but recommended strongly that public authorities review the risks of environmental contamination and the possibility that this technology might be used in biological weapons. One member of that panel, bioethicist David Magnus of the University of Pennsylvania in Philadelphia, says that 1999 report (*Science*, 10 December 1999, p. 2087) was "prescient" in warning about bioweapons. "We ought to be talking about these risks now and developing the means to control the technology" if it works, says Magnus.



Team leader. Nobelist Hamilton Smith is joining Venter's new institute.

The biggest obstacle, according to Hutchison, now at the University of North Carolina, Chapel Hill, will be fitting the minimal genome with a working cell structure. This, he says, will be "technically quite a challenge." Indeed, even Venter acknowledges that it might prove impossible. But when it comes to evaluating Venter's implausible goals, Magnus advises: "Never bet against him."

–ELIOT MARSHALL

CREDITS: (TOP TO BOTTOM) SOURCE: ASSOCIATION OF UNIVERSITY TECHNOLOGY MANAGERS, 2000 SURVEY; MARTY KATZ