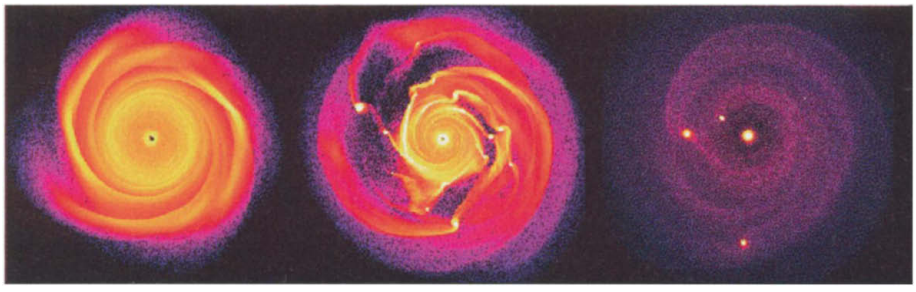
forming—perhaps through random fluctuations—that is massive enough to pull in more gas, which could then pull in even more gas, leading to a runaway collapse into a planet. Such a gravitational instability mechanism had long appeared to require a disk 10 times as massive as expected. In 1998, astrophysicist Alan Boss of the Carnegie Institution of Washington revived gravitational instability by simulating gas clumping in a disk of reasonable mass, but he couldn't show that the growing clumps would survive to become planets.



Easy birthing. In a simulation, gas collapses on itself in less than 1000 years to form planets.

Astrophysicists Lucio Mayer and Thomas Quinn of the University of Washington, Seattle, and their colleagues decided to throw more computing power at the gravitational instability problem. Using a model that they had previously built to study galaxy formation, they simulated a swirling gas disk with a million particles—10 times the number used in earlier efforts—orbiting a protosun. Run for several weeks on a massively parallel supercomputer, the model achieves an extra margin of realism, thanks to its inherent ability to automatically increase resolution where it counts the most: where mass is concentrating to form planets.

After just 1000 years of simulated time, the runaway process had produced planets: The model's disk had clumped, clumps had merged, and two or three planets had emerged that bore some resemblance to the 100-plus gas giants found so far around other stars. The simulated planets had masses of two to 12 times that of Jupiter, orbited at between three and 20 times Earth's distance from the sun, and moved in elongated orbits. But the model's planets showed little sign of moving inward, as many extrasolar planets have presumably done. Nor does the model help explain the rounded orbits found in one solar system—our own.

The new modeling "is a very important step forward for the disk-instability mechanism," says Boss. "It shows that it is plausible that clumps could survive long enough to become gas giant protoplanets." But not even Boss thinks that disk instability is home free. "One has to be a little cautious," notes Durisen. Properly accounting for all the forces that work against gravity—including internal heating—must await future modeling, he says. Starting simulations with a realistic amount of instability is difficult, adds dynamicist Jack J. Lissauer of NASA's Ames Research Center in Mountain View, California; he thinks these runs started with far too much. And these simulations are "like a lab experiment that needs confirmation," says Durisen. It seems the gas giants will be glaring down a while longer.

–RICHARD A. KERR

CREDITS: (TOP) L. MAYER ET AL.

CANADA

Universities Promise More Tech Transfer

TORONTO—Canadian university administrators hope they haven't struck a Faustian bargain. In return for a promise by the government to double research funding and create a permanent fund to pay the overhead costs of conducting federally funded research, universities have agreed to do a better job of turning academic research into commercial products. The deal gives each side something it badly wants, at a price both sides appear willing to pay.

The terms of the quid pro quo were announced here last week, at the National Summit on Innovation and Learning. The event, held despite a nationwide snowstorm, gave more than 500 members of Canada's academic, business, and financial elite a chance to offer final comments on the government's ever-evolving blueprint for doubling federal research spending (*Science*, 15 February, p. 1211). The doubling would raise the R&D budget to $9.2 billion by 2010.

Industry Minister Alan Rock says that the tradeoff, part of a proposed Framework Agreement on Federally Funded Research, marks the first time that academia has formally acknowledged its responsibility to generate economic wealth. "I wanted to commit them [academic institutions] in principle to a link between public funding and economic outcomes," he says.

At the core of the deal lies a government promise to roll a "one-time" allocation this year of $125 million for overhead costs associated with publicly funded research into

ScienceScope

To the Rescue French archaeologists are once again vowing to defend laws requiring digs prior to construction projects. Jean-Paul Demoule, president of INRAP, France's institute of "rescue archaeology," called on the group's 1500 members to go on strike this week to protest changes proposed by Parliament.

In 1997, the archaeologists took to the streets to successfully campaign for stricter enforcement of rescue archaeology laws and better funding from developers (*Science*, 7 February 1997, p. 746). Under the current rules, which require builders to negotiate dig payments on a case-by-case basis, archaeologists conducted about 4000 surveys this year. But lawmakers in the National Assembly and the Senate have recently added amendments to two bills that would loosen the requirements. If passed, Demoule says, the changes "would create chaos ... and throw a number of specialists out of work."

The Chirac administration opposes the amendments, saying it wants to complete a planned review next year before proposing any changes. Parliament must act on the matter by year's end.

Pulling Rank The National Science Board is about to tell scientists competing for big new research facilities exactly where they stand. Responding to an order from Congress, the oversight body for the National Science Foundation (NSF) agreed last week to assign a numerical ranking to each big project that it wants to fund. That's a big change from its previous policy of neutrality, which generated a growing backlog of projects deemed worthy of support and uncertainty about which ones the board preferred (*Science*, 14 September 2001, p. 1972).

"The new list will rank projects at the same time they are approved by the board," says Anita Jones, head of the board panel that drew up the new policy. "And that list will be public." Jones says the board also hopes to keep the list of approved projects as short as possible—"just a bit more than we think we can afford to do at any one time."

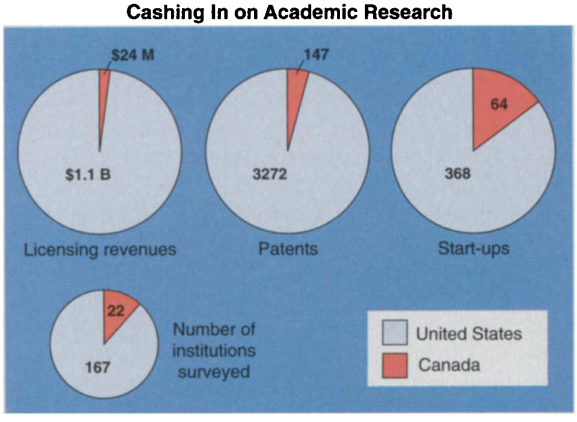
The board reforms are consistent with a bill Congress passed this month (H.R. 4664) reauthorizing NSF programs. It strengthens the board's ability to manage big projects with the goals of lowering costs, improving efficiency, and making the process more transparent.

Contributors: Dan Ferber, Andrew Lawler, Barbara Cassasus, Jeffrey Mervis

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

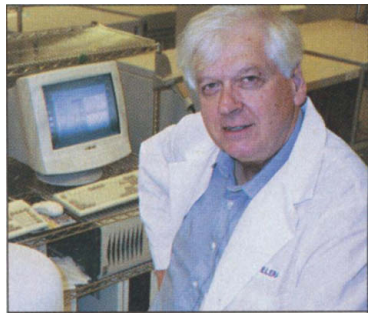
Never shy about his aims, DNA sequencer J. Craig Venter Jr. announced this week that he has won a government grant to design a novel form of life. The U.S. Department of Energy's science office has awarded his group $3 million over 3 years to "develop a synthetic chromosome," the first step toward making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