—at least in the roundworm. On page 686, neuroscientists Oliver Hobert, Oscar Aurelio, and David Hall describe a new family of proteins that help keep the wiring of the worm's nervous system tangle free.

Scientists have spent decades teasing apart the complex signals that guide axons—the long extensions that allow neurons to communicate with distant cells—to their correct destinations and help them make the right connections. But the discovery of a separate, later-acting maintenance mechanism is "really quite surprising," says neuroscientist Joseph Culotti of the Samuel Lunenfeld Research Institute at Mount Sinai Hospital in Toronto. Developmental neuroscientist Barry Dickson of the Institute of Molecular Pathology in Vienna says the find makes sense. "You don't just have to make sure you wire up the nervous system properly in the first place, but you also have to make sure that the wires don't get tangled up as the animal grows and moves about," he notes.

Hobert and Aurelio of Columbia University and Hall of the Albert Einstein College of Medicine, both in New York City, did not set out to look for the worm's maintenance molecules. Rather, they were examining the expression patterns of unknown genes in the so-called immunoglobulin superfamily, several members of which are known for their roles in neural development. Six genes stood out in the screen. They appeared on the scene later than others—in the larvae and the adult, after the upheaval of embryonic development is complete. "They're expressed after all the excitement is over," Hobert says.

The genes, which the team dubbed the *zig* genes, are expressed in a neuron called PVT in the larval worm's ventral nerve cord. This neuron plays a central role in the nervous system's development. It has an axon that is among the first to blaze a trail through the developing worm. The axon extends the entire length of the worm's body and secretes proteins that help guide other axons to the correct place in the growing nervous system. But most developmental biologists assumed that the neuron's guidance tasks were complete once the worm reached the larval stage.

The timing of the appearance of these newfound guidance-like molecules prompted the team to question that assumption. Aurelio used a laser to kill PVT neurons in early-larval-stage worms. When he examined the animals' nervous systems 2 days after surgery, he found that in nearly a third of the treated worms, axons had wandered across the worm's midline to the wrong side of the nerve cord.

To check whether the *zig* genes keep axons in place, the team examined a strain of worms that lacks *zig-4*. In those worms, the team found, development is normal during the embryonic stage, but once the worm develops into a larva, a subset of axons wanders across the midline—resembling the aberrant axons in the surgically treated worms.

It seems the molecular restraints of the ZIG proteins might be crucial during the early larval stage, when the worms' movements might jostle the still-fragile alignment of axons: When the scientists placed larval worms lacking PVT on a substance that paralyzes them, they observed no wayward axons. Hobert isn't sure what *zig* genes do in the adult worm, but he suspects that they keep axons in place in other parts of the body.

Dickson predicts that similar maintenance molecules will turn up in other animals—perhaps even in humans. "It could be that this only applies to a few axons in the worm nerve cord that are in particular danger of being jostled about as the worm writhes along," he says. "But you can bet it is going to be a lot more general than that. If keeping the wires neat and tidy matters for a worm, it's going to matter for higher animals, too."

–GRETCHEN VOGEL

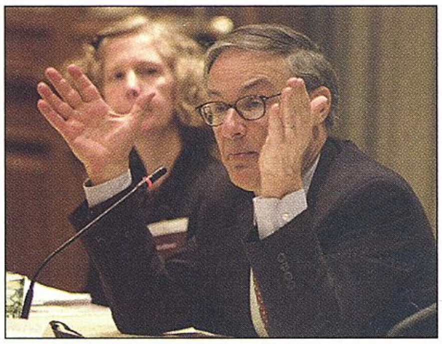
HUMAN CLONING

Report Backs Ban; Ethics Panel Debuts

Cloning and stem cells are once again on the nation's front burner after a 4-month hiatus in the aftermath of 11 September. Last week the National Academy of Sciences (NAS) released a report* calling for a legal ban on human reproductive cloning, and the president's new Council on Bioethics held its first meeting.

The academy panel, led by adult stem cell researcher Irving Weissman of Stanford University, confined itself to scientific and medical issues raised by reproductive cloning. It concluded that the high rate of abnormalities and other problems with animals cloned since Dolly the sheep was in 1997 indicate that such an effort in humans

* *Scientific and Medical Aspects of Human Reproductive Cloning*, National Academies (www.nap.edu/catalog/10285.html)

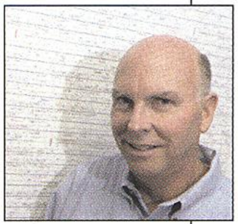


Ethical choices. Chair Leon Kass holds forth at the council's first meeting.

CREDIT: (TO TO BOTTOM) LESLIE E. KOSSOFF/AP; RICK KOZAK

ScienceScope

Overboard Scientist-entrepreneur J. Craig Venter (below) made another big splash this week: He abruptly quit Celera Genomics in Rockville, Maryland, the company he created less than 4 years ago with a goal of sequencing the human genome. The parent firm, Applera Corp. of Norwalk, Connecticut, issued a terse note on 22 January saying that Venter had "stepped down as president" but would "continue his affiliation" as chair of Celera's scientific advisory board. He will have no management authority, however. One visitor to Celera's corporate suite reports that Venter's photos and memorabilia have already been removed. Celera's stock dropped about 6% on the day of the announcement.



Venter could not be reached for comment. But an Applera release says that Venter intends "to spend more time fulfilling my role as Chairman of the Board of the Institute for Genomic Research (TIGR)," a nonprofit research center in Rockville founded by Venter in 1992. TIGR's president, Claire Fraser, is Venter's wife.

Applera chief executive Tony White explained in a telephone interview that Venter and other company officials concluded "just within the last week" that it was time for Venter to leave. "For several months," White explained, "we've been wrestling with the problem" of how Celera could become a "really serious drug discovery and development company." There was no falling-out with Venter, White adds: "I'm not saying I couldn't work with Craig. We made a strategic decision to pursue a business strategy, and implicit in that decision is that you've got to have the right kind of people in charge."

White says that heated discussions within Celera about the release of the company's mouse genome data had "nothing to do with" Venter's departure. There was "a discussion between Craig and a few members of our board of directors," White said, and the board approved the release.

Venter's departure marks the end of a contentious and highly competitive era in human genome sequencing, in which Venter confounded his critics by producing a draft in record time. But his departure may be a sign that the sun is setting on the reign of the gene kings.

much as nine times the fusion output of the corresponding doughnut tokamak, according to Masa Ono of the Princeton Plasma Physics Laboratory, a co-leader with Peng of NSTX. What's more, it's "simpler and smaller engineering construction," says Sykes.

Although the performance achieved by these first attempts is promising, "they are quite a long way off from a reactor," says Cordey. The spherical tokamaks must increase their temperatures 10-fold to reach that in JET and ITER—about 150 million degrees Celsius—while still keeping the plasma stable, he says. Sykes worries that such a small spherical machine may require impossible power densities when working as a real reactor. ITER remains the main focus for fusion researchers. Delaying or rejigging this $4.2 billion project "would be a big mistake," says Cordey. The hope is to develop ITER and spherical tokamaks in tandem. "It may be that after ITER, when utilities want to build a fusion power plant, they find that the spherical tokamak is a more economical way of doing it," says Sykes.

–ANDREW WATSON

Andrew Watson is a writer in Norwich, U.K.

HIGH-ENERGY PHYSICS

Atom Smasher Probes Realm of Nuclear 'Gas'

"Oh, that this too too liquid nucleus would evaporate." If Hamlet were a nuclear physicist, he might be feeling a bit more cheerful. Strange as it may seem, atomic nuclei do sometimes act like liquids, and when blasted apart at high enough energies they can sizzle into gas. Now scientists working at Brookhaven National Laboratory in Upton, New York, have charted the conditions under which gold nuclei make that leap, information that might help unravel the secrets behind the birth of a neutron star.

The work builds on a model that physicists cooked up in the 1930s to explain the fission of uranium. A neutron striking a nucleus more than 200 times its mass doesn't just knock off a chip or two; it splits the nucleus neatly in two. Physicists realized that the uranium nucleus is behaving like an oversized drop of water. When it is struck by a neutron, the nucleus oscillates, stretches out, and then blurps into two roughly equal parts (throwing off a few smaller fragments, such as neutrons, in the process). "Everyday garden-variety nuclei behave like a liquid," says Victor Viola, a physicist at Indiana University, Bloomington. "It's a very successful description."

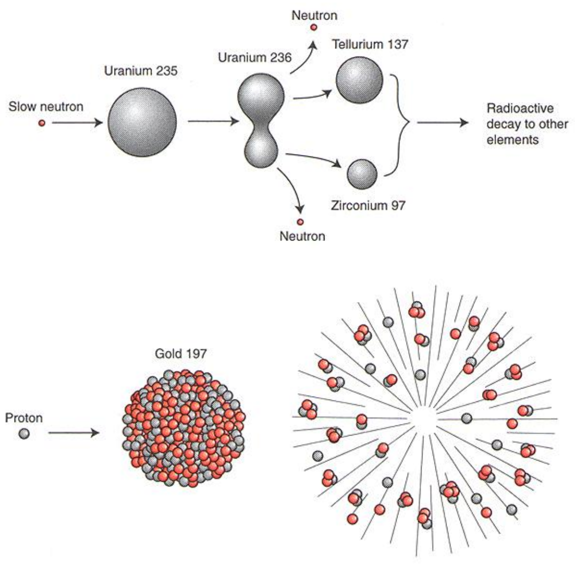
Viola and colleagues decided to take the liquid analogy one step further by determining the nucleus's equation of state—the relations between pressure and temperature that govern when the nucleus behaves like a gas and when it behaves like a liquid. At Brookhaven, they shot protons, pions, and antiprotons at thin gold foil, adding energy that brought the gold nuclei to a boil. Meanwhile, a device called the Indiana Silicon Sphere (ISiS)—a beach ball–sized sphere studded with 450 detectors—kept careful track of the size and energy of the particles that flew off.

The physicists analyzed the readings in two different ways. The first starts with the distribution of the sizes of chunks that fly out of the nucleus. "In boiling water, you don't get individual water molecules coming off," says Viola. "You get dimers, trimers, tetramers. The temperature of the vapor is related to the relative numbers of those clusters." By comparing the energy added to the nucleus (hence its "temperature") with the relative abundances of fragments, the physicists figured out the properties of the nuclear "liquid," including its critical temperature: the point above which the liquid phase can no longer exist, which they calculate at about 7 million electron volts (MeV). The second analysis directly models the breaking and making of nuclear bonds and comes up with a slightly higher critical temperature, slightly above 8 MeV.

"I do think it's a really nice piece of work they've done," says Joseph Natowitz, a physicist at Texas A&M University in College Station, who thinks that physicists will resolve the discrepancy once they get a better grip on how the nucleus expands and breaks up after the collision. "I have some ideas."

Even though wrinkles need to be ironed out, the results have given

ILLUSTRATION: C. SLAYDEN



Steamed. Physicists gave liquid-drop model of fission (top) a new twist by "evaporating" gold nuclei (bottom).

ScienceScope

Bioweapons Cleanup The United States and Uzbekistan are close to finalizing plans for a $6 million cleanup of a former Soviet bioweapons facility. The effort is aimed at preventing terrorists from harvesting live anthrax spores from a secret dumping ground.

For nearly 60 years starting in the 1930s, the Soviets released anthrax, plague, and other weaponized pathogens on Vozrozhdeniye (Resurrection) Island in the middle of the Aral Sea. In 1988, at the end of the Cold War, weaponeers buried tons of a particularly potent strain of powdered anthrax at the site, mixing the bacteria with bleach in steel drums to kill it. But several years ago testers found that some of the anthrax is still alive, and water diversions from the shrinking Aral Sea have since opened a land bridge to the once isolated island. Fearing that terrorists might try to harvest ready-made bioweapons from the site, U.S. officials agreed in October to pay for destroying the anthrax and a nearby testing facility.

Next month, U.S. experts—including researchers at the Department of Energy's Sandia National Laboratory in Albuquerque, New Mexico—are expected to meet with Uzbeki authorities to work out the details, Richard Tucker of the Monterey Institute of International Studies last week told a briefing organized by the Carnegie Endowment for International Peace in Washington, D.C. One possible approach, researchers say, is to soak the 11 burial pits with a strong antibacterial solution.

Backtracking The Jones Institute for Reproductive Medicine, which drew heavy criticism last summer when it revealed it had fertilized donated human eggs solely for the purpose of generating stem cells, has changed its priorities. Last week the institute, a private clinic that is part of Eastern Virginia Medical School in Norfolk, announced that it won't be generating any new human stem cell lines.

The reasons are partly political, according to Roger Gosden, the institute's new scientific director. After a state lawmaker recently introduced legislation that would have criminalized the creation of embryos for research, "my scientific priorities had to become public," says Gosden. The bill was withdrawn, but Gosden says the institute hopes to secure federal funds that can't go to research involving the controversial embryos. The institute will now focus on animal studies to identify molecules involved in reprogramming a cell's nucleus so that it will revert to a primordial state.

Contributors: Eliot Marshall, David Malakoff, and Constance Holden