Science & Society

Nuclear secrets: What's been stolen?

Agents of the People's Republic of China have stolen classified information on every missile warhead in the current U.S. arsenal and at least one—the neutron bomb—that this country has not yet deployed. China's efforts to acquire these secrets were aided by lax security at the five nuclear-weapons labs of the Department of Energy (DOE) and decades of poor-to-nonexistent counterintelligence to protect nuclear-weapons data.

Those are the principal conclusions of a 6-month bipartisan investigation of a committee chartered by the House of Representatives. Chaired by Christopher Cox (R–Calif.), the committee issued its unclassified findings on May 25 in three volumes.

The committee began the investigation last year after officials found that two U.S. satellite manufacturers had given technical guidance to China's space program after it failed in three attempts to launch commercial U.S. satellites. Since shared information could aid another nation's military readiness, U.S. law requires a State Department license before a company can release data to foreign nationals from some countries, including China. Neither company had sought such a license.

Cox said that the companies' help led to advances in the Long March rocket—"the workhorse" of China's military space-launch program—and may have improved China's ability to deliver long-range ballistic missiles.

The bulk of his committee's report, however, focuses on thefts of nuclear technology, mostly from DOE's national laboratories, discovered during the investigation. What the thefts entailed—weapons, blueprints, or just conceptual designs—remains unknown, notes committee member John M. Spratt Jr. (D–S.C.).

However, after its report was completed, the committee learned that China had had a chance to steal "legacy codes"—mathematical equations that model explosions from measurements during actual weapons tests. If China indeed obtained these equations, Spratt said, its military will need fewer bomb tests to model and build advanced thermonuclear weapons.

China wouldn't have been able to use legacy codes or related data if the United States hadn't relaxed controls on its exports of high-performance computers, Cox notes. In 1996, China had virtually no such computers. It obtained about 430 from the United States in just the first 9 months of 1998, and by December it had more than 600.

The House science committee, responding to the report, forwarded a bill that would ban from DOE's laboratories any foreign visitors from "sensitive countries," such as China. —*J.R.*

DOE responds to Cox report's charges

"There is no evidence of a 'wholesale' loss of information" due to China's theft of nuclear secrets, says Department of Energy Secretary Bill Richardson. "In fact," he told reporters last week, "there are [only] three confirmed instances of theft—one in the late 1970s, one in 1984–85, and one from 1984–88." However, acknowledging that serious security problems have existed within DOE, especially at its labs, Richardson said a sweeping new counterintelligence program has been developed.

Since borrowing 35-year veteran Edward J. Curran from the FBI last year, DOE has expedited its security improvements. On the basis of recommendations by counterintelligence experts enlisted by Curran, the national labs have installed new computer "firewalls" to curb data theft, begun tougher screening of foreign scientists, and started administering periodic polygraph tests to all scientists in sensitive positions. Richardson is also recruiting an experienced counterintelligence staff headed by a "czar" who will report directly to him.

Says the energy secretary, "We are addressing the problems of lax security that has spanned 3 decades." Despite the Cox report's claim that DOE's security remains marginal, "we think the problem has been corrected," says Richardson. —*J.R.*

Materials Science

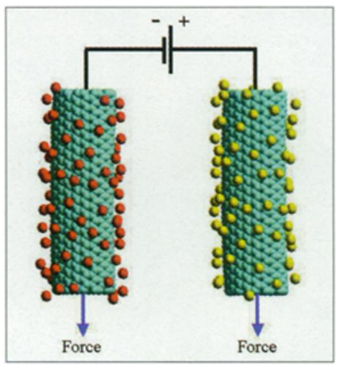
Nanotube strips deliver muscle power

As animals rely on muscles to move their bodies around, so machines use devices known as actuators for their motions. Now, an international team of researchers has created an actuator that uses carbon nanotubes to mimic muscle fibers. Someday, engineers could incorporate these artificial muscles into robots, aircraft control systems, and sensors, the group says.

Like natural muscles, these devices turn electrochemical energy into mechanical movement. The researchers stick two thin films of matted nanotubes, which they call buckypaper, to double-sided Scotch tape. When they immerse this simple device in saltwater and apply a voltage, the coated tape curves. Reversing the voltage bends the strip in the opposite direction.

Applying a voltage changes the number of electrons in both sheets, causing the nanotubes to expand. However, the nanotubes on the side of the tape that gets positively charged stretch out more than those on the side where negative charge builds up. As a result, the strip bends.

The nanotube actuators work at lower voltages and can generate higher forces than devices made from other materials can, says Ray H. Baughman of AlliedSignal in Morristown, N.J. He and his team report their findings in the May 21 SCIENCE. Ultimately, their goal is to make an actuator for microscopic machines out of a single nanotube (SN: 7/26/97, p. 62). —*C.W.*



Applying a voltage to carbon nanotubes (blue-green, tape between them not shown) causes them to stretch. In a salt solution, sodium (red) and chlorine (yellow) ions collect on the tubes. Then, a higher voltage can be applied, leading to more expansion.

A new route to a superhard material?

For years, scientists have tried to synthesize beta-carbon nitride, a material predicted by theorists to be harder than diamond. Most attempts, however, have ended in frustration, and claims of success have encountered skepticism from outside observers (SN: 7/11/98, p. 28).

Now, Peter Kroll and Roald Hoffmann of Cornell University have explored the feasibility of a new way to make beta-carbon nitride. They argue, using theoretical computations, that squeezing a soft polymer containing the right ratio of carbon and nitrogen could yield the elusive material. A previously unknown form, which they call lambda-carbon nitride, should appear as well. They report these conclusions in the May 19 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY.

Kroll says the new calculations indicate that the polymer will compress into dense networks under high pressure. Whether the final material will be as hard as everyone expects is unclear.

Researchers at the Technical University of Darmstadt in Germany have made the soft polymer but have not yet put it under high pressure. The Darmstadt group "is still trying to synthesize [the polymer] without major impurities," says Kroll.

The Cornell theorists "propose a rather clever approach to the synthesis of hard [beta-carbon nitride] solids," says Yip-Wah Chung of Northwestern University in Evanston, Ill. "Of course, the proof is in the pudding," he remarks.

The method will work only if beta-carbon nitride is more stable under high pressure than other carbon-nitrogen structures. He also suggests combining this technique with others. For example, synthesizing the polymers on a template could guide the atoms into the desired structure. —*C.W.*