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## news

# Make Robots Not War

### Some Scientists Refuse to Get Paid for Killer Ideas

by Erik Baard

September 10 - 16, 2003

As American warfare has shifted from draftees to drones, science and the military in the United States have become inseparable. But some scientists are refusing to let their robots grow up to be killers.

Clusters of scientists shut the laboratory door on the military half a century ago in reaction to the horrors of atomic bombs, and again decades later in disgust with the Vietnam War. But today such refuseniks are rare and scattered—in large part, they say, because so many of their colleagues doing basic research are addicted to military money.

"I would rather the military run out of reasons to keep existing, and I don't want them to have any credit for something I have accomplished—which they clearly would if they gave me the money," says Steve Potter, a neuroscience researcher in Atlanta whose astonishing robotic creations would make a 21st-century general drool—if the general could get his hands on them.

Imagine a swarm of robots seizing control of the airspace and waters of a besieged port city while amphibious automatons roll up the shoreline to knock out pockets of resistance. The attack is brilliantly coordinated, and each of the robots is an astonishingly effective killer because it learns faster and has more flexible responses than any mere machine. The secret? At its core are real animal neurons—living brain cells—wired into

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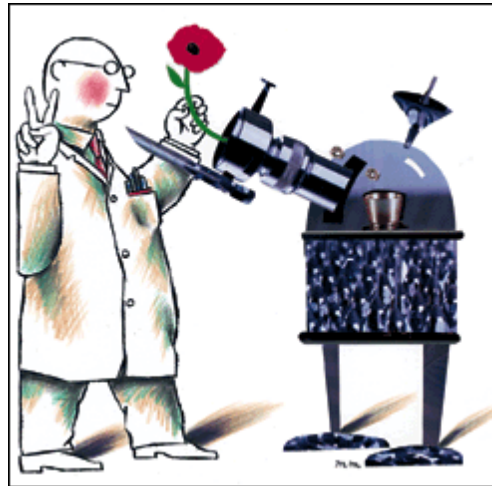


illustration: Matthew Martin

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"Freewheeling Zealots": DARPA, the Dark Star of Defense" by George Smith

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advanced circuitry.

Potter's team at the Laboratory for Neuroengineering, shared by Emory University and Georgia Tech, might be best able to deliver on that wild vision. He's already created the Hybrot, a machine controlled by rat neurons sealed in a patented dish spiked with micro-electrodes. You can actually see those cells growing more complex and hairy with dendrites as they learn and interact with the outside world. The work could spawn an entirely new class of adaptable robot combatants. But there's a hitch: Potter won't take a penny from the military. Sure, the Department of Defense might crib from his published research, but Potter wants to grasp new knowledge without bloody hands.

Technological dominance already equates to short-term military victory, and in coming years advanced technologies could also more tightly secure occupations against guerrilla warfare and terrorism like what we see in Iraq today. Or at least top brass and congressional leaders alike are betting heavily on that belief.

On August 19, the American Association for the Advancement of Science (AAAS) reported that the U.S. House of Representatives '04 budget would pump \$126 billion into federal research, \$8.4 billion over '03—90 percent of that increase is specifically earmarked for the Defense and Homeland Security departments. Moreover, with that many dollars chasing (and tempting) researchers in fields like robotics and nanotechnology, the perception is that it's almost impossible to forgo military support and still remain competitive.

"I think because there's so much military funding in robotics, compared to other kinds of computer science or arts and sciences, that you're going to have a reaction. You're going to have people take this attitude," says Illah Nourbakhsh, a well-known roboticist at Carnegie Mellon University who also snubs military financing. "But there are so many more people in robotics who do take the money."

The push comes from George W. Bush himself. "We must build forces that draw upon revolutionary advances in the technology of war," he told navy graduates.

Some of the most visible fruits of this emphasis are forecast in a Pentagon planning paper, "Joint Vision 2020." One third of U.S. combat aircraft will be unmanned by that year, the report predicts. Ground and sea forces will also rely heavily on robots. Earlier this year the navy and marines held their biannual Kernel Blitz exercise off the California coast, deploying robotic submarines paid for by the Office of Naval Research (ONR).

VOICE in the News

Wayne Barrett will participate in a panel "The Media & The Mayor" at New School University's Milano Center on March 15 at 6 pm

"Operators will be assisted by decision aids that allow them to focus on the operational art of war, leaving the implementation details to the unmanned element of this synergistic blend of man and machine intelligence," testified Tony Tether, director of the Defense Advanced Research Projects Agency in testimony before the Senate Subcommittee on Emerging Threats and Capabilities, part of the Committee on Armed Services. DARPA has been raked over the coals lately for outlandish programs like Total Information Awareness and the terrorism gambling ring, but it also boasts of military technology programs that spun off benefits to daily life like the Internet and the Global Positioning System. It can invest in research for the long term when private companies are eyeing the next financial quarter, so its programs are more ambitious than any on earth. (See related story, page 40.)

"DARPA's goal," Tether said, "is to create chips that reason and adapt, enable smarter sensors, and achieve human-like performance." One of the far-out initiatives DARPA funds is called Brain Machine Interfaces, and both DARPA and ONR supported work that led to monkeys being able to control robotic arms by using brain signals coursing through probes implanted in their heads.

But the Hybrot's creator, Potter, has a slip of paper stuck onto his bulletin board that would prove a major buzz kill. Slightly paraphrased from Australian philosopher John Passmore, by way of Carl Sagan, the note reads: "If a scientist or a philosopher accepts funds from some such body as the ONR, then he's cheating if he knows his work will be useless to them, and must take responsibility for the outcome if he knows it will be useful."

"ONR has for a long time supported this kind of research," Potter says, "and Sandia National Laboratory offered me money." The military's reach is wide: Sandia is a Department of Energy facility, but the bulk of its work concerns nuclear weapons and military technology. Potter recalls of his contact with Sandia officials: "They said, 'Here's some thousands of dollars because we think what you're doing is cool.' I said, 'Thanks, but no thanks.' And I get told of grants that would match my work, but I check them out and say, 'No, sorry, it's DARPA.' "

Potter chooses instead to work with funding from the National Institutes of Health, the National Science Foundation, and other foundations and civilian groups. He says much of his thinking was shaped by his experiences with the Jet Propulsion Laboratory at the California Institute of Technology, best known currently for its feel-good, and scientifically important, robotic probes en route to Mars and Saturn.

"I came out of Caltech, which runs the Jet Propulsion Laboratory, and my father spent his life at JPL. A lot of my attitude comes from that experience—seeing all of their cloak and dagger stuff going on there,"

Potter says. "Like one thing my dad worked on was side-looking radar. At the time they said, 'We're going to use this to map Venus,' which they did. And now it's used to steer cruise missiles."

And how exactly might Potter's own work be used in a weapons system? "I don't want to answer that question—and discourage you from trying to guess because that is helping the enemy, in my opinion," he fumes. "I will hold you personally responsible for the consequences if you do."

Few scientists share Potter's passion and uncompromising stance. When asked if colleagues in his field refuse military money, Nobel laureate for medicine Richard Roberts says, "No one immediately comes to mind. On the rumor mill you'll hear about these things, but I don't know of any specific instances. Most people in the biological sciences, if they come across polluted money, would probably try to use it anyway—in some way try to make themselves feel good about using Department of Defense money."

Says physics Nobelist Steven Weinberg, "A lot of people did it [refused military money] 30 years ago during the Vietnam War, but I don't know of anyone doing that today."

Perhaps the rarity of Potter's stance indicates a general support for Bush policies, but it also might speak to the complete saturation of science by military money, along with a little cynicism. Even the much ridiculed Star Wars program didn't turn scientists into the kind of conscientious objector that Potter has become. Physicist Peter Zimmerman, a consultant on science issues for Senate Democrats (according to *Physics Today*), opposed the Strategic Defense Initiative, the missile shield favored by Republicans. But he says, "I always advised friends to take the SDI money and do some useful physics with it instead of seeing it wasted."

Certainly there are laws and codes prohibiting scientists from developing biological weapons, and just recently four activist groups circulated a pledge at an AAAS meeting in San Francisco asking that researchers refrain from "the design, development, testing, production, maintenance, targeting, or use" of weapons of mass destruction, or any research that might be used by others toward those ends.

But some of the most exciting emerging technologies, drawing both new talent and increased military funding, aren't so clearly offensive. There are vast areas of gray, much like what Potter's father found himself in.

Emily Hamner is a recent Carnegie Mellon University graduate who now works as a full-time research assistant on the Personal Rover Project, making low-cost autonomous robots at the Robotics Institute there. Her boss is Nourbakhsh, but she says, "I didn't join Illah's lab specifically for

its lack of military funding, but I'm glad that I'm not working on a 'killer robot.'

"If I was trying to choose whether or not to accept a job sponsored by the military I think I would have to base that decision on the specifics of the project. If I felt the benefits of the technology developed would outweigh the potential harm, I might work on the project. If I was going to be training a shooting robot to recognize human targets, for example, I don't think I would take the job. I enjoy robotics, but if the only way to make enough money in robotics was to work on such a project, I would rather find a job in a different area of computer science."

But final uses of such basic science are never all that clear. As Tether himself cooed, "One of the most exciting things about DARPA is our work on technologies whose exact military *uses* are not clear, but their *usefulness* is. This is part of what makes being the DARPA director such a fun job."

Part of the reason University of Texas at Austin computer scientist Benjamin Kuipers stopped taking military financing is that he's seen colleagues wind up in places they'd never imagined themselves.

"DARPA and ONR and other DOD agencies support quite a lot of research that I think is valuable and virtuous," he says. "However, there is a slippery slope that I have seen in the careers of a number of colleagues. You start work on a project that is completely fine. Then when renewal time comes, and you have students depending on you for support, your program officer says that they can continue to fund the same work, but now you need to phrase the proposal using an example in a military setting. Same research, but just use different language to talk about it. OK. Then when the time comes for the next renewal, the pure research money is running a bit low, but they can still support your lab if you can work on some applications that are really needed by the military application. OK. . . . Then for the next round, you need to make regular visits to the military commanders, convincing them that your innovation will really help them in the field. And so on. By the end of a decade or two, you have become a different person from the one you were previously. You look back on your younger self, shake your head, and think, 'How naive.' "

The dilemma stretches back until at least the immediate aftermath of World War II. Some nuclear physicists walked away from the new atomic weapons program, but in time drifted back. According to Robert Jungk's 1958 book, *Brighter Than a Thousand Suns: A Personal History of the Atomic Scientists*, program director General Leslie R. Groves later remarked, "What happened is what I expected, that after they had this extreme freedom for about six months their feet began to itch, and as you know, almost every one of them has come back into government

research, because it was just too exciting."

This isn't just about having access to technological candy. In some fields young researchers may feel compelled to play ball with the Pentagon, because no one else has the resources to bring their futuristic visions to life. Even space exploration, often seen as a peaceful endeavor, has always been bonded tightly with the military. DARPA started as a space agency, and the Jet Propulsion Laboratory started as a military program. The final crew roster of the ill-fated Columbia shuttle is revealing: Six of the seven were military officers (one with Israel's forces) and the seventh, Kalpana Chawla, researched as a civilian the airflows surrounding the marines' Harrier attack aircraft.

While the shuttle routinely performs secret military missions, several scientists note that some universities and individuals won't work on classified projects because they want their data available for peer review. But Federation of American Scientists policy analyst Steven Aftergood observes, "I don't know of anyone who just won't accept Department of Defense funding. In many fields, and for many people, there's no alternative. There are all kinds of areas of technology development only the DOD will fund. At a time when money is tight, most people don't have the luxury of categorically excluding an entire agency funder."

For example, DARPA is the second largest supporter of nanotechnology, after the National Science Foundation, according to Mihail Roco, director of the National Nanotechnology Initiative.

While it may be possible to carve out a rewarding technology career without Pentagon support, Kuiper concedes that he had to switch from cognitive maps to A.I. in medicine because, like Potter's father, "I found that the only funding agency that was interested in supporting my research wanted to build smart cruise missiles."

But didn't those very missiles, with their high-tech guidance systems, dramatically reduce civilian casualties compared with other bombing campaigns in history? In addition, much Pentagon research is truly defensive. "A chemical and biological agent detection system is the kind of thing you want in the New York subway system so that first responders know what they're dealing with, and isolate it and save lives," says Captain John Hobday of ONR, which has a \$2 billion science and technology program. "And how is artificial blood or a blood clotter anything but defensive?"

Clearly much of the military research is geared toward weapon making. But is that categorically wrong? Many people would be hard-pressed to draw moral equivalence between U.S. troops and some of their foes—the bombers of the UN HQ in Baghdad, or the Taliban. Kuiper and Potter are avowed pacifists; most are not. Though Kei Koizumi, director of the

AAAS R&D Budget and Policy Program, worries about cuts in other sciences, like climate studies, he admits that "the current set of priorities for federal R&D is understandable considering recent events."

Stanford University Nobel laureate in physics Douglas Osheroff was part of the panel investigating the Columbia disaster. His eyes were also the third pair to see into the center of the Milky Way—courtesy of the U.S. Air Force. As an undergraduate he was part of a group that peered into the heart of the galaxy by using infrared wavelengths, which can penetrate obscuring dust. But he's no naive rube. "Really, what we were doing was creating a bright background template to differentiate incoming ICMS," he recalls. "The work was very valuable scientifically and good for the country and defense. I think there's nothing wrong with that kind of research."

Potter is unmoved even though times have changed and the big spenders at the Pentagon aren't pouring money into the dubious scheme of Mutually Assured Destruction.

"Surprise, surprise, it is different," he says. "Not different enough for me. Just think about the sheer magnitude of what hundreds of billions of dollars we spend on military efforts could do if spent on, for example, building schools in countries that need them, or creating diplomacy centers like the Carter Center, or informative research and practical solutions like those of the Union of Concerned Scientists."

Or on robots built to help people, not kill them.

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