Cleaning toxic sites by helping nature take its course

Sean Selman
Institute Communications and Public Affairs

Research conducted at Georgia Tech has revealed a new approach for cleaning sites contaminated by toxic solvents — using nature’s own bacteria to do the job.

Investigators led by Assistant Professor Frank Loeffler in the School of Civil and Environmental Engineering have isolated a bacterium they named BAV-1 that can be used to clean toxic sites and prevent cancer-causing substances from reaching drinking water supplies. His finding was cited as one of the “Top 100 Science Stories of 2003” by the editors of Discover.

Loeffler, a microbiologist who maintains a courtesy appointment in the School of Biology, said the BAV-1 bacterium occurs naturally and appears to present no health risks to people and wildlife. During a multi-year process, Tech doctoral candidate Jianzhong He was able to isolate the bacterium from samples taken from a polluted site in Michigan.

That area, called the Bachman Road site, had been polluted with tetrachloroethene (PCE) and trichloroethene (TCE), both common solvents that had seeped into the local groundwater. Using a process called bioremediation — the use of microbes to clean up contaminated environments — Loeffler’s group stimulated the growth of BAV-1 in the surrounding area and monitored the results.

“It turns out that BAV-1 consumed the toxins as a food source, leaving behind only non-toxic by-products once it’s finished,” Loeffler said.

As reported in the scientific journal Nature, researchers found that the bacteria had cleaned the site of poisonous solvents within six weeks, proving that bioremediation can be used to rid toxic sites throughout the country of potentially life-threatening substances.

The problem
Sites contaminated with chlorinated compounds such as PCE and TCE abound in the United States and many other countries due to the wide use of the solvents through the decades — for example, at dry-cleaning operations. The solvents also are widely used as metal-degreasing agents, especially at military installations.

For many years, disposal of this type of industrial pollution went unregulated, and the solvents were simply dumped or washed away near the sites where they were used. Cleaning up these sites is critical if authorities are to prevent the toxins from entering underground aquifers, which are used throughout the country as a source of drinking water.

Loeffler’s research group studies the fate of pollutants in the environment, with the goal of identifying microorganisms — germs or bacteria — that eat and degrade dangerous chemicals naturally.

“Generally, bacterial degradation means detoxification and, hence,
Doctoral student wins top British fellowship

First to be selected in the field of computer science

Elizabeth Campbell
Institute Communications
and Public Affairs

S
omewhere between his hobbies of scaling sheer cliffs, traveling the world and swing dancing, Georgia Tech computer science doctoral candidate Gabriel Brostow learned enough about computer vision not only to get a Ph.D. from the College of Computing, but also to win one of only two Marshall Sherfield Fellowships awarded to American science and engineering students to study at a British university. He is the first computer science or engineering student selected since the award was created in 1998.

“The opportunity to work with another group of leading scientists in my field at the conclusion of my Ph.D. will be a welcome time of productivity and adjustment of my own long-term research objectives,” said Brostow.

The Marshall Aid Commemoration Commission offers up to two post-doctoral fellowships in science and engineering, in addition to the 40 Marshall Scholarships for undergraduates to pursue graduate studies. The intention is to build long-term contacts and international links between the United Kingdom and the United States in key scientific areas.

Brostow, on track to complete his doctorate in May, plans to spend the year at the University of Cambridge.

Computer vision initially started as a sub-domain of artificial intelligence but has grown to include numerous researchers focusing on medical imaging, machine learning, forensics, robotics and graphics. The field borrows from and contributes to these core areas and is rapidly expanding due to the use of computer-controlled video cameras. Brostow’s own research has broad appeal since it can be employed in security and biomechanical applications as well as other areas.

Brostow came to Georgia Tech in 1997 to pursue a master’s degree in human-computer interaction, an interdisciplinary program coordinated between the College of Computing, the School of Psychology and the School of Literature, Communication and Culture. His thesis adviser, Associate Professor Irfan Essa, convinced him to stay for his doctorate.

“In the last few years Gabe has proven himself to be an able researcher, mastering many technical areas, and a great motivator, working with many students on a variety of projects,” said Essa. “He has been involved in several research projects with me, where he has taken the lead and also recruited others to work with him. When I saw the announcement of the fellowship, which asked for ambassadors to the United Kingdom to represent the United States and their research field, I had no hesitation in recommending him.”

Though he has research positions with IBM, Microsoft, and Industrial Light & Magic, Brostow’s long-term plans are to return to academia.

A new sport at Tech: trolley tracking

Melissa Moore
Auxiliary Services

If you’re looking for a Tech Trolley to take you to Technology Square and want to know its estimated time of arrival, wonder no more.

Earlier this month, the Office of Parking and Transportation introduced its global positioning system through NextBus Information Systems Inc.

Georgia Tech students, faculty, staff and visitors wanting to ride to and from Technology Square are using the system to better utilize their time and productivity.

“Students can plan their time easily,” said Bob Furniss, director of Parking and Transportation. “They can leave the College of Management, decide if they want to stop at Starbucks or even if they have time to pick up a sandwich at one of the shops before riding back to campus.”

The Web site links the visitor directly to a map that shows the trolley route from the Campus Recreation Center to the Midtown MARTA station and all stops in between.

“Visitors can position their computer cursors over the trolleys on the map and watch the trolleys move as they reach their stop and start over with the countdown to the next stop,” said Alan Ware, alternative transportation coordinator for Parking and Transportation.

This new system is just one of Auxiliary Services’ programs geared toward providing the most up-to-date services available to the campus community.

“This year has really been booming with new programs and facilities,” said Rosalind Meyers, associate vice president of Auxiliary Services. “This global positioning system falls in line with the opening of our new Health Services building, the new Barnes & Noble @ Georgia Tech, six new retail outlets and the Technology Square parking garage.”

To find the Tech Trolley and determine its location, visit www.parking.gatech.edu.

Georgia Tech is a unit of the University System of Georgia.
committe to identify a permanent director by July. Additionally, Karen Tucker, serving as the interim director of the Language Institute, is replacing Charles Windish, who recently retired. Tucker has been an instructor at Georgia Tech for 16 years and is handling the day-to-day operation of the Language Institute until a permanent director is named.

In the fall, GLCC settled into its new high-tech space in Technology Square, and its information technology infrastructure enables Georgia Tech to be a leader in education pedagogy and the delivery of distance education, and to expand its international outreach, says Wepfer.

“GLCC’s new branding slogan is, ‘Warm Hospitality, Cool Technology,’ and we truly strive for both,” Wepfer said.

Personal enrichment
In March the GLCC kicks off its new Tech2Nite courses, a series of adult education classes designed for both the Georgia Tech and Atlanta communities. The spring series examines the relationship between technology, communication, art, business and culture. For six weeks, faculty and staff from Georgia Tech as well as industry professionals will teach topics such as business plan development, digital photography, buying real estate, plan development, digital photography, teaching topics such as business plan development, digital photography, communication in English for both a business and academic environment. The Language Institute (LI) offers language instruction for non-native speakers of English. Courses help students improve their oral and written communication in English for both a business and academic environment. The Global Learning and Conference Center at Technology Square is Atlanta’s most technologically advanced conference center offering more than 32,000 square feet of meeting space and is certified by the International Association of Conference Centers.

DLPE’s organizational structure:
Distance Learning provides delivery, services and support for the instruction of working professionals in several of Georgia Tech’s master’s degree programs.
Professional Education provides marketing and logistical services to faculty and administrators for Georgia Tech’s non-credit open-enrollment short courses, conferences and sponsored courses.
The Language Institute (LI) offers language instruction for non-native speakers of English. Courses help students improve their oral and written communication in English for both a business and academic environment.
The Global Learning and Conference Center at Technology Square is Atlanta’s most technologically advanced conference center offering more than 32,000 square feet of meeting space and is certified by the International Association of Conference Centers.

Bioremediation, cont’d from page 1
bacteria can be of great help to eliminate toxic waste in the environment,” Loefller said. “A single handful of forest soil typically contains more bacteria than people who exist on earth. Many different types of microbes exist, and we try to find those bacteria that detoxify pollutants by collecting samples from contaminated environments, which we then transport to the laboratory for study.”

Eventually, such studies will help people, government and industries to fully exploit the natural potential of the microbial world in coping with the wastes produced by our societies, Loefller said.

“The BAV-1 organism is not the only microbe out there that can help,” he said. “There are different organisms that target different kinds of contaminants. We specifically look for bacteria that detoxify chlorinated solvents. This BAV-1 is a promising candidate, but there are others out there, too.”

Two options
In the case of BAV-1, once Loefller’s group realized it was present and consuming PCE and TCE at the Michigan location, they wanted to find out how they might use it to speed up the process and detoxify the whole site. During the course of their investigations, the group identified two processes that would work: bioaugmentation and biostimulation.

In situations where BAV-1 already is present in the soil of a contaminated site — as it was at the Michigan site — bioaugmentation can be used to encourage its detoxifying activity. This is done by providing bacteria what they need most to reproduce and spread — food and nutrients.

At other contaminated sites where BAV-1 isn’t present in the soil, it can be added to the environment through bioaugmentation. In this process, the BAV-1 bacteria are grown off-site in large vessels. Once the bacteria are thriving, they then are sent to a site and injected into the ground.

At the test site, both processes worked, although it appears the bioaugmentation technique took longer to accomplish the job, Loefller said.

The future of BAV-1 and bioremediation
According to the U.S. Geological Survey, cleanup up existing environmental contamination in this country alone could cost as much as $1 trillion. Bioremediation stands to play a significant role in that effort because of its potential cost savings.

Simply put, bioremediation allows site clean-up to occur in place, without government agencies or businesses having to spend huge sums of money to remove soil and contaminants, or to restore a site that was heavily disturbed during the typical remediation process.

Loefller and his group have shown that bioremediation can be a successful option. Still, much remains to be learned about how microorganisms interact and perform in different hydrologic environments, he said, and about what type of bacteria might do the most good in a variety of clean-up scenarios.

IN BRIEF:

Alumnus to advise on human space exploration
Edward C. (“Mac”) Aldridge Jr., a 1967 inductee into Georgia Tech’s Engineering Hall of Fame, is to lead a new panel that will advise NASA administrators and President George W. Bush regarding future manned missions to the moon and Mars. Aldridge, who earned his master’s degree in aerospace engineering from Georgia Tech in 1962, was chosen last week to direct the Commission on the Implementation of U.S. Space Exploration Policy, a new panel that will advise NASA on the long-term implementation of the president’s new vision for space exploration.

President Bush outlined that new vision in a Jan. 14 speech, committing the United States to a long-term human and robotic program to explore the solar system, starting with a return to the moon that will ultimately enable future exploration of Mars and other destinations.

Prior to the Challenger disaster in 1986, Aldridge trained to be a payload specialist aboard the Space Shuttle. His mission was canceled, however, and he later was appointed by President Ronald Reagan to be secretary of the Air Force. He retired from the U.S. Department of Defense in May 2003.

Volunteers wanted
The Office of Success Programs — a division of Student Affairs — is seeking qualified volunteers to teach a section of the freshman seminar GT1000. According to Paddy Pennington, who coordinates the program, individuals should have worked at Tech at least one year, have a master’s degree and have two hours per week to teach and meet with team leaders. For more information, call 894-1970 or visit www.successprograms.gatech.edu.
Call Carol Heller, 894-1939.

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in the LeCraw Auditorium.

and CEO of Encore Wire and Cable, at 4:30 p.m.

Speaker Series welcomes Vincent Rego, president and CEO of Encore Wire and Cable, at 4:30 p.m. in the LeCraw Auditorium.

Faculty/Staff Development

Jan. 30

The Office of Environmental Health and Safety hosts a six-hour course in defensive driving tech-
iques. There is no cost to attend. Call 385-0263 for

Feb. 3

The Office of Organizational Development hosts a one-day class in "Business Writing Skills." To regis-

Contact for more information, visit www.iac.gatech.edu/poetry.html.

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