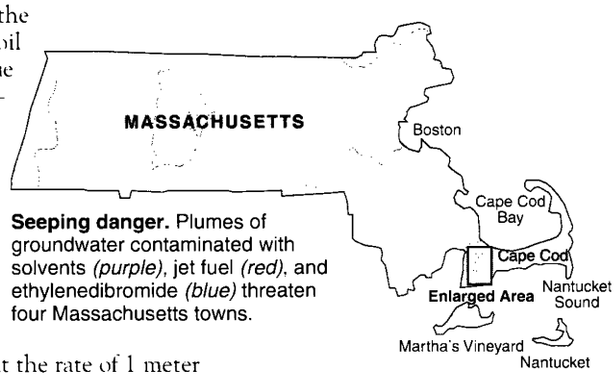
ENVIRONMENTAL REMEDIATION

Building a Wall Against Toxic Waste

BOSTON—Beneath the pine forests and sandy soil covering the picturesque Massachusetts peninsula of Cape Cod, 10 plumes of cancer-causing chemicals are rushing underground toward water wells in four towns. The plumes, leached from fuel dumps and other sites at a nearby military base, are moving at the rate of 1 meter every 2 to 3 days. They long ago forced the shutdown of a well that supplied 25% of the municipal water for the town of Falmouth and today are within 300 meters of another public well in Bourne. Standing between this contamination and the 67,000 townspeople of Bourne, Falmouth, Mashpee, and Sandwich, scientists hope, will be a wall.

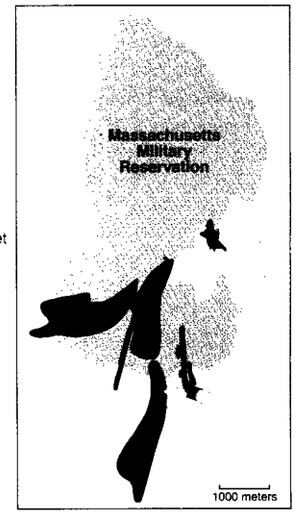


Seeping danger. Plumes of groundwater contaminated with solvents *(purple)*, jet fuel *(red)*, and ethylenedibromide *(blue)* threaten four Massachusetts towns.

The wall is an experimental decontamination system that researchers are about to test for the first time on a large scale, and it's attracting the attention not just of beleaguered locals but of scientists nationwide. This fall, Robert Gillham, a hydrologist at the University of Waterloo in Ontario, Canada, intends to erect a "reactive wall": a bunker of iron filings intended to react with the toxic molecules of trichloroethylene (TCE), tetrachloroethylene (PCE), and other chemicals that make up the plumes and break them down.

Environmental scientists "are really excited that this technology is going to the field," says David Burris, an environmental chemist at Florida's Tyndall Air Force Base. As an alternative to costly pumping stations, "there's tremendous interest in this demonstration among remediation experts," says Paul Marchessault, the Environmental Protection Agency's restoration manager at the contaminants' source, the Massachusetts Military Reservation (MMR). "This way you don't have to pay to get the water out of the ground—it just flows through the wall, and you monitor to make sure all the contaminants have been removed."

Paying to get water out of the ground would be an expensive proposition. The Defense Department has plans to build a network of pumping and treatment stations at MMR, but the stations will have to operate for at least 20 years, at a total cost topping $250 million. So reactive walls could save millions. "This could revolutionize the way we treat chlorinated contaminants in groundwater, not just at military sites but worldwide," says Ed Pesce, manager of the MMR restoration project.



SOURCE: HAZARDOUS WASTE REMEDIAL ACTION PROGRAM

The walls operate on a simple principle. Steel sheets pounded several meters into the ground funnel groundwater into a small opening filled with a mixture of sand and iron filings. "Iron's cheap, and it releases the electrons that are necessary for the reduction of many chlorinated compounds," explains Gillham. As water flows through the iron, a corrosion reaction strips chlorine atoms from contaminants like TCE and PCE, breaking them down into harmless ethene and ethane gases.

There are still some unanswered questions about the technology, and once MMR officials decide which of the 10 plumes to try and decontaminate, researchers can begin using the field test to answer some of them. One question, Burris says, is whether the iron can dechlorinate organic compounds like TCE and PCE without letting toxic intermediate products, such as vinyl chloride, slip through the wall. In an above-ground test of the Waterloo system at an industrial site in New Jersey earlier this year, effluent water contained vinyl chloride at concentrations two times higher than federal drinking-water standards allow. But with a longer "strainer" in Cape Cod, Gillham thinks the iron will have enough time to break down even these intermediate products before they flow out the other side.

Because of its simplicity and cost-effectiveness, a reactive wall that achieved complete dechlorination would be "the Holy Grail of environmental remediation," says Paul Tratnyek, an organic chemist at the Oregon Graduate Institute of Science and Technology in Beaverton. At the rate the Cape Cod plumes are moving, residents and scientists alike hope this grail will be more attainable than the original.

–Wade Roush

GLOBAL CHANGE RESEARCH

From Russia With Love: U.S. Cloud Data

When Kremlin spymasters were using satellites to keep an eye on the United States during the Cold War, they probably gave little thought to the scientific value of the data they were collecting. But atmospheric scientists believe Russia's intelligence archives may contain a treasure-trove of information useful for global change research by providing a long-term record of cloud cover over the United States. These researchers are anxious to get a look at the Kremlin's picture files—and they may soon get their chance.

Under an agreement worked out last month by U.S. Vice President Al Gore and Russian Prime Minister Viktor Chernomyrdin, U.S. and Russian officials are considering opening their once top-secret archives to climate researchers in both nations. Although the United States has recently declassified some older spy satellite data and Russia has been selling some pictures taken from its spacecraft, there has not been a comprehensive exchange of the data between the two countries on the scale envisioned by the new agreement. And the two countries may even go a step further: Gore and Chernomyrdin also discussed trading more current spy satellite data to help warn of natural disasters. A team led by National Oceanic and Atmospheric Administration (NOAA) chief James Baker and V. I. Danilov-Danilyan, the Russian environment minister, is now working out the details of the exchange.

The cloud-cover record, stretching back to 1965, is of particular interest to American scientists. "It could be very valuable," says Tom Peterson, a research meteorologist at the National Climatic Data Center in Asheville, North Carolina, who has already been cooperating with Russian scientists in comparing data on evaporation rates in the two countries over the past 45 years. "If you are looking at global change, what's happening with clouds is certainly very important." Global change researchers say they are only now starting to grasp the enormous effect clouds have on heating and cooling the Earth. But a lack of long-term data hampers

efforts to model those effects.

The Russian data could provide a consistent look at the extent and kinds of cloud cover over the last 30 years, provide insight into the effects of pollution on cloud formation, and serve as a check on ground observations, Peterson says. There is no comparable data set in the United States, U.S. officials say. And the amount of Russian data, says Baker, is immense. "They have warehouses full of it," he told reporters on 20 July. In addition to the satellite data, there are data sets from aircraft and ships. Given the constraints on the Russian science budget, however, it's not clear whether U.S. data will provide similar benefits to Russian climate researchers.

But exchanging old data is just the first step in the cooperative effort, Baker says. The more ambitious goal is to share current data from spy satellites that could provide warnings about volcanic eruptions and insight into earthquakes. "There is real interest in this on both sides," he adds, predicting that "hopefully we can do this within the next year."

But to meet that rapid timetable, formidable obstacles must be overcome. The National Reconnaissance Office, which operates the U.S. spy satellite network, does not even share its current data with U.S. civilian agencies such as NOAA. And both nations would have to agree on ways to provide the data without revealing the full extent of their capabilities. A joint statement on the initiative notes that the exchanges should be done "without jeopardizing the national security interests of either side." This might mean, for example, fuzzing high-resolution pictures, NOAA officials say.

Baker says he is confident the two sides will be able to reach at least initial agreement on data exchanges by December, when Gore and Chernomyrdin meet again for their biannual meeting on economic and technology cooperation between the two countries. If they are successful, U.S. and Russian scientists could soon be seeing their own lands in a new light: as portrayed in photos taken by their former enemy.

–Andrew Lawler

COLLABORATIVE RESEARCH

Japan Picks First Centers of Excellence

TOKYO—In a significant departure from its usual pattern of funding academic science, Japan's Ministry of Education, Science, Sports, and Culture (Monbusho) last week awarded a total of $21 million to six university-based research groups deemed capable of developing into world-class "centers of excellence" in fields ranging from cosmology to economics. The awards, which cover the first of 5 years of funding, mark the launch of a new program designed to encourage universities to focus their resources on areas where they can make significant contributions. Eventually, Monbusho hopes to expand the program to fund 25 groups on the cutting edge of their fields.

In the past, Monbusho's research money has gone to large institutes with broad research agendas, such as the Institute for High-Energy Physics in Tsukuba, or small groups typically consisting of one full professor and one or two associate professors and assistants. The recent grant, however, aims at teams in between these two levels, thereby addressing a criticism university researchers have long aimed at the current system: that it makes it difficult to assemble large academic teams to work on a scientific problem. "This program's biggest impact will be in enabling a number of researchers in closely related areas to come together to focus on one research theme," says neuroscientist Kenji Sobue, a professor at Osaka University Medical School who will be leading a group studying signal transduction and its role in cell growth, differentiation, and death.

In Sobue's case, the nine Osaka University Medical School researchers in the group have been working together informally for 3 years, but the new grant will enable them to form a more cohesive team that Sobue says will be "internationally competitive." At the University of Tokyo, cosmologist Katsuhiko Sato says his grant to form a research center focusing on the early universe will bring together nine astrophysicists and elementary particle physicists who previously "were in their own little areas."

Makoto Kinoshita, deputy director for science in Monbusho's Science and International Affairs Bureau, says Monbusho didn't specify how large the groups should be. The aim, he says, was to encourage groups to form "spontaneously and voluntarily." As it turned out, however, the scientific research groups all number between nine and 12 researchers, and all draw their members from the same university. In contrast, a group led by Konosuke Odaka, professor of economics at Hitotsubashi University, which is planning to assemble a database of historical and current economic statistics for all of Asia, boasts 41 members from 14 universities. International participation in all the groups is being encouraged and will be supported by the Japan Society for the Promotion of Science fellowships.

Three selection committees—one each for humanities and social sciences, physical sciences, and life sciences—sifted through 194 proposals in a two-stage evaluation process before whittling them down to the six announced last week. Akito Arima, former president of the University of Tokyo and now head of the Institute of Physical and Chemical Research, says the evaluation process was open—something of a contrast to the way some other Monbusho programs are funded. Arima, who served on the physical sciences evaluation committee, says he was also encouraged by the quality of the proposals. "There is a lot of very good activity out there," he says.

In addition to considering the importance of the proposed research theme and the track records of the participants, the selection committees took into account the amount of additional support promised by the university. Sato says his group at the University of Tokyo will be getting additional space, as well as funding for equipment and research expenses, from the university.

The grants announced last week are just one part of Monbusho's centers of excellence program. It is also dividing $62 million this year among 46 of the established larger research institutes to further strengthen what are already viewed as internationally recognized programs. And Monbusho hopes to select an additional five or so university-based groups in each of the next 4 years. "We can't promise that we'll get the funding," Kinoshita says, "but we expect to."

–Dennis Normile

GROUNDBREAKING GROUPS

Research Theme	Lead Institution	Research Leader
Compilation of integrated long-term economic statistical database for the trans-Asian region	Hitotsubashi University	Konosuke Odaka
Probing the early universe	University of Tokyo	Katsuhiko Sato
Ultraparallel optoelectronics	Tokyo Institute of Technology	Kenichi Iga
Molecular chirality	Nagoya University	Ryoji Noyori
Regulation of higher order biological systems	Kyoto University	Shigetada Nakanishi
Signal transduction in cell growth, differentiation, and death	Osaka University Medical School	Kenji Sobue