DEFENSE CONVERSION

'Greener' Military Pays Off For Civilian Scientists

When oceanographer Walter Munk wanted to extend his efforts to use underwater sound waves to measure variations in ocean temperatures across thousands of kilometers, he took the idea to two agencies—the Office of Naval Research (ONR) and the National Science Foundation (NSF)—that had supported his original project. He got a polite brush-off. Neither ONR nor NSF—the largest civilian source of funding for oceanography—had the tens of millions of dollars needed to design, build, and deploy the state-of-the-art receivers, transmitters, and other specialized technology Munk needed.

But the 75-year-old Munk, a professor at the Scripps Institution in La Jolla, California, and a prominent figure in the field, wouldn't take no for an answer. He searched for alternative sources of support and eventually found a godfather: a brand-new, little-known federal program called the Strategic Environmental Research Defense Program (SERDP). Created in the fall of 1990 at the prompting of then-Senator Al Gore (D–TN) and Senator Sam Nunn (D–GA), SERDP is intended primarily to help the U.S. military begin tackling the multibillion-dollar environmental legacy of the cold war—cleaning up its hundreds of polluted military bases and weapons facilities. But the program is also a potential gold mine for environmental researchers because Gore and Nunn directed it to spend part of its funds applying military assets to broad environmental questions such as global warming.

"I always thought of it as a way to milk this huge defense budget," says Will Happer, a Princeton physicist who until May was director of the Department of Energy's (DOE) Office of Energy Research and a member of SERDP's governing council. "It's always been sort of hidden, but it deserves to get more discussion." Indeed, its size alone should get some attention: Since 1991, Congress has given SERDP a total of $346 million, and its budget for the fiscal year that begins on 1 October may reach $200 million. Although only a portion of those funds will be spent on global change research, SERDP can potentially make a huge impact in fields such as oceanography, where the typical ONR or NSF grant is less than $100,000 a year, and NSF's annual budget for all investigator-initiated ocean sciences research is slightly more than $100 million.

This new program is just one large slice of a growing "peace dividend" to scientists paid out by military assets built and deployed to fight the cold war. The Navy, for example, has recently provided researchers access to its $15 billion underwater surveillance system built to detect enemy submarines. Marine biologists are now relying on its sensitive ears to track migrating whales (*Science*, 30 July, p. 549), and geologists are using it to home in on underwater volcanic eruptions.

GENERAL ELECTRIC

The big picture. Researchers hope to use the Air Force's over-the-horizon radar system for environmental monitoring over a vast area.

Well-kept secret. SERDP was set up as a joint effort among the Department of Defense (DOD), DOE, and the Environmental Protection Agency. Projects are eligible for SERDP funding if they use technology or facilities owned by the military and if they are of interest to one of these three agencies (see box). It is run by a part-time executive director, Col. Robert Oswald, whose official job is head of research for the U.S. Army Corps of Engineers.

SERDP's administrative structure makes it nearly invisible to scientists outside the military research community—the ocean acoustics program, for example, is run out of ARPA's Nuclear Monitoring Research Office, which searches for evidence of underground nuclear testing around the world. But the program is starting to reach out beyond that narrow base. The Senate Armed Services Committee, which Nunn chairs, has urged SERDP administrators to set up "guidelines that will clarify how universities and the private sector" can participate, and Congress is preparing to increase the civilian component of the program by adding the administrator of the National Oceanic and Atmospheric Administration (NOAA) to the interagency council that oversees it. And with Gore in the White House, SERDP now has an influential patron.

Such heady prospects are a marked change for a program that got off to a very slow start. In addition to the usual competition among the military services for control of any new program, Pentagon officials resented being told by Congress to spend a part of their multibillion-dollar research budget on environmental projects. "It was only about a year ago that DOD finally decided to stop fighting it and began to embrace the idea," says one congressional aide that follows the program. This year's request for funding by the Clinton Administration was the first time that the executive branch had asked for money for SERDP. Reflecting early uncertainties, the first round of awards was limited to projects that could be completed within a year.

Support from SERDP can be a big help in carrying out an agency's research agenda. Ari Patrinos, director of environmental sciences for DOE, for example, has supplemented the agency's global change budget with a $4 million SERDP grant to design and build instrumentation for unmanned vehicles to explore the troposphere. Although DOE's global change program has grown to $100 million in recent years, the rate of increase "is not what we had expected," Patrinos says, and SERDP funds fill in some of the gaps.

To Munk, his project seemed tailor-made for SERDP. He was hoping to use Navy bases in the Pacific to follow up the 1991 Heard Island Feasibility Test (*Science*, 6 April 1990, p. 33) "It was a perfect match," recalls Munk. "We were proposing to use defense assets for civilian purposes, and also we knew that this next step would be expensive." Munk met with Victor Reis, then director of the Defense Advanced Research Projects Agency (DARPA) and head of the interagency council that oversees SERDP, who agreed that the project seemed appropriate for the new program. In June 1992, Munk and his colleagues submitted a proposal as part of an open competition conducted by DARPA, and last February Munk's project, now called Acoustic Thermometry of Ocean Climate (ATOC) and expanded into a 13-nation effort led by Munk and oceanographer Robert Spindell of the University of Washington, was awarded $31 million.

Munk is not the only oceanographer to dip into this pool of defense funds. In May a proposal from a consortium headed by John

A Different Kind of Grants Program

If you have an idea for an environmental research project that could use military technology or facilities, the Strategic Environmental Research Defense Program (SERDP) would like to hear from you. But this little-known program (see main story) operates a bit differently from most competitive grants programs.

Projects must attract the interest of at least one of the three agencies involved—the Department of Defense (DOD), the Department of Energy (DOE), and the Environmental Protection Agency—and in some way advance their mission. Although there's no requirement for university scientists to collaborate with a government laboratory, such ties can reduce the administrative problems of working with the Defense Department.

The selection process itself is shaped by DOD's reliance on strong program managers. Individual programs within each agency receive an informal allocation of funds, and the proposals that they select are screened by teams of government scientists working in one of six technical areas. The most promising are passed along first to the SERDP executive director, Robert Oswald, and then to an interagency executive panel.

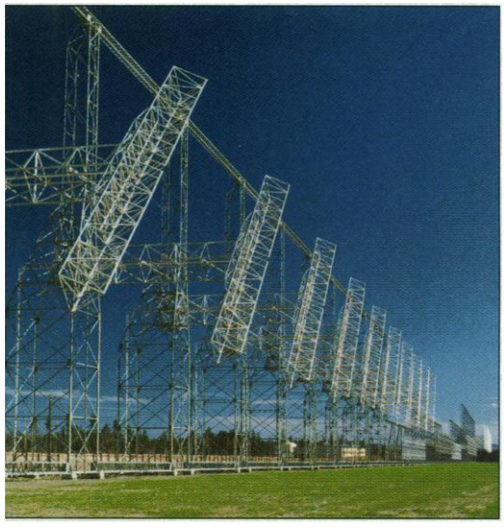
Requests for more than $1 million must be reviewed by an 11-member Scientific Advisory Board (SAB), composed mostly of outside scientists from relevant fields. The board, chaired by ecologist Lawrence Jahn, a private consultant in Arlington, Virginia, is supposed to make sure that the proposals meet rigorous scientific standards. "It does a pretty good job of making sure that no log-rolling occurs," says Princeton physicist and former DOE research chief Will Happer, referring to the tendency of Congress to earmark money for projects that have not undergone peer review.

Even so, members say that a significant fraction of the proposals they see fail to meet their expectations. "It's not what we in the academic world would expect," says Frank Parker, an environmental engineer at Vanderbilt University and former chairman of the National Academy of Engineering's Board of Radioactive Waste Management, about many of the submissions. Ned Ostenso, assistant administrator for oceanic and atmospheric research at the National Oceanic and Atmospheric Administration and one of two board members from the federal government, explains why. "By and large," he says, "the proposals come from a pool that's not accustomed to writing proposals." That pool includes scientists at in-house defense labs, some of whom are not used to the type of full-fledged descriptions demanded by agencies with extensive outside peer-review systems. Ostenso says that oceanographer Walter Munk's proposal to use sound waves to measure variations in ocean temperatures "stood out from the pack" not just because of its intrinsic value but also because of its intellectual rigor and attention to detail.

Every proposal is reviewed by each member before the board meets, and then discussed jointly following a short oral presentation by the relevant scientist or administrator. Members can vote in one of three ways—yes, no, or needs work—and their recommendations are passed along to the SERDP Council, which forwards its decision to Congress for final approval. The process keeps program managers on their toes. "We submitted a proposal to study subsurface heterogeneity at contaminated sites," says Ari Patrinos, director of DOE's environmental sciences division, "but the SAB felt that it didn't link up well enough with existing work in the area. It was a helpful tip, and we'll be back with a better plan."

–J.M.

Spiesberger of Pennsylvania State University and Dan Frye of Woods Hole Oceanographic Institution was given $11.4 million for a related project on mapping ocean temperatures that uses a different technology. Munk's project uses fixed sound sources and receivers, while Spiesberger's deploys loosely moored sources and free-floating receivers. Together, the two projects expect to receive $55 million by June 1995 for work that ARPA (the 'D' was dropped recently as part of the government's emphasis on civilian technology) has clumped under the rubric Acoustic Monitoring of Global Ocean Climate.



GENERAL ELECTRIC

Peering over the horizon. One of three transmitting antennas in Maine.

Scoping out storm patterns. Other branches of the Armed Forces have similar unique assets that scientists are eager to tap into. Tom Georges, a physicist at NOAA's Wave Propagation Laboratory in Boulder, Colorado, wants to convert the $1.5 billion over-the-horizon (OTH) radar system that the Air Force built during the 1980s to protect against invading Soviet bombers into an international research laboratory devoted to environmental monitoring of areas ranging from the oceans to the upper atmosphere. The radars consist of three sets of transmitters and receivers in Maine and a similar array along the Oregon-California border that together are capable of scanning 40 million square kilometers of ocean surface. Brought on line just as the cold war was ending, the West Coast facility has been mothballed and the East Coast operation has been put on a 40-hour-a-week schedule.

Last summer, Georges used the Maine facility to measure the surface wind direction of Hurricane Andrew, 1500 miles away, shortly before it smashed into south Florida. He has also showed that the radar can track storms and collect real-time data on weather patterns without being diverted from its military surveillance duties. Georges would now like to deploy a small team of scientists and technicians to demonstrate the Maine facility's capacity to provide expanded meteorological services and to revive the West Coast facility, which can be controlled from Maine via satellite. He plans to join with the Air Force lab in Rome, New York, to submit the proposal as soon as SERDP holds its next competition, probably in the fall.

As welcome as SERDP funding has been, Munk and Spiesberger say they would prefer to get funding from NOAA for subsequent work—a more extensive and longer-lasting network of receivers and transmitters that could collect the data oceanographers need for a real understanding of global ocean temperatures. They believe the agency's mission is more in keeping with their research aims, and that NOAA is a better home for a continuing program on the ocean's role in regulating global climate. But SERDP has given them a chance to stay in the game. "Good results have a way of making people interested in important problems," says Spiesberger. "But you always have to push for what you want. Hunting for funds is a way of life for most academics."

–Jeffrey Mervis