

Germany's Bleak Future in Space

This year, Germany found it could not support a separate space agency and folded it into its aerospace research center. If budget trends continue, some of its basic space science may not survive, either

COLOGNE, GERMANY—In the prosperous days of 1989, just a few months before the fall of the Berlin Wall, West Germany launched its own high-flying space agency to manage and boost the nation's space effort. Like a rocket with a flawed final stage, the new agency soared for a while, but ultimately ran low on fuel as the high costs of reunifying East and West Germany deflated the space budget and shifted national priorities. Last month, the short-lived agency—the Deutsche Agentur für Raumfahrtangelegenheiten (DARA)—was quietly merged with the German Aerospace Center (DLR), a national research center which will now also take over the job of managing Germany's space program.

The newly expanded DLR—which has annexed most of DARA's former staff—wants to preserve the quality of German space research while cutting back on duplicative management costs. "If we cannot get more money for space, then we must find ways to get more space research for our money," says physicist Walter Kröll, chair of DLR. "The new DLR can more efficiently deliver a high-quality German space program that will contribute to European and other international space projects."

But German space science is hardly headed toward new heights. With government funding for the space program still shrinking, and a bigger slice of that pie going to the European Space Agency (ESA) and the international space station, domestic projects are getting squeezed. Researchers are also worried that the government is trying to promote applied space research at the expense of basic science. While Germany has pledged to continue its role in the international space sta-

tion project, Kröll recently told NASA officials that Germany will be unable to pay for any cost overruns, and definitely will not contribute to a proposed international crewed space mission to Mars over the next 15 years.

National vs. international

Ever since Wernher von Braun and other top German rocket scientists surrendered to U.S. troops at the end of World War II and joined the U.S. missile development program, Germany has been trying to find its proper position in the constellation of international space efforts. After a slow rebuilding in the late 1950s, German space research began to blossom in the 1960s when its first cooperative efforts with NASA and other European nations took place. With the establishment of ESA in the 1970s, the ties between German and European space science have become increasingly close. "Major space projects are too expensive for a single European country. That's why ESA is crucial," says Dietrich Lemke, a researcher at the Max Planck Institute for Astronomy in Heidelberg. "ESA has been a great success, both in terms of science and in terms of applications," agrees German physicist Reimar Lüst, a former ESA director-general and a seminal figure in postwar German space science.

Playing a major role in ESA does have drawbacks, however: It locks countries into fixed funding commitments for many years. Because of its tightening finances, Germany, along with other ESA members, such as the United Kingdom, has been pressuring ESA to cut management costs and work harder at making projects stick to their budgets. "It is a difficult exercise, but I am convinced that ESA can become more efficient," says Kröll.

However, the inflexible level of funding for European cooperation and the expensive space station project are already cutting into domestic space science projects. "If the current budget trends continue, it could lead to a situation where Germany won't be able to do much other than ESA projects—and even that poorly," warns Reinhard Genzel, director of the Max Planck Institute for Extraterrestrial Physics in Garching. Genzel's institute, for ex-



Expanded role. DLR chief Walter Kröll.

ample—which in the past has built entire research satellites on its own—might find such projects impossible if outside funding dries up.

While Germany's annual space budget amounts to about \$837 million, some 70% of that total (\$577 million) is channeled straight to ESA for European space projects. As part of that commitment, Germany will spend nearly \$1.5 billion on the international space station project—41% of Europe's total contribution—between

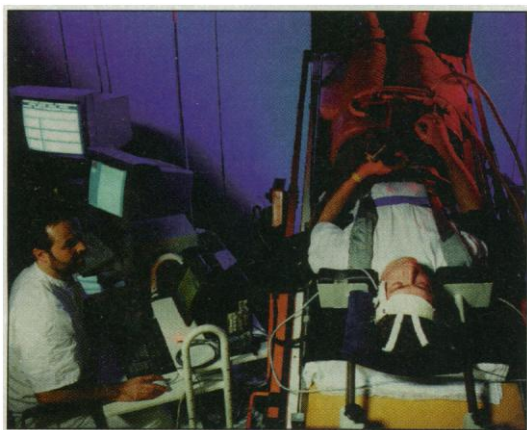
now and the year 2004. That leaves about \$250 million a year for Germany's national space budget, which pays for DLR's space activities and other programs formerly managed by DARA. But space scientists complain that only about a third of the national budget goes to basic research in fields such as astronomy, space plasma physics, and planetary exploration.

According to German government statistics, Germany—which spends about 0.05% of its gross domestic product on space—trails far behind the United States (0.53%) and France (0.18%), and also ranks behind Britain and Italy (both 0.06%). Moreover, Germany spends a higher percentage of its budget on international space projects—and correspondingly less on purely national space research. "The total budget has been shrinking, and the sum available for space science has declined even more," says Lüst.

Basic vs. applied

Another development that has disturbed basic researchers is the research ministry's initiative to increase the focus on applied space research and closer ties to German industry. That shift was outlined in a white paper, approved by Germany's Cabinet in July, that recommitted Germany to full participation in the international space station—a commitment that some German scientists question.

"We are very concerned" by the ministry's increased emphasis on applied space science, says Genzel. "Basic research now accounts for only one-fifth of Germany's space budget, and real funding for that basic research has declined by more than 40% over the past 4 years. Any further shift of resources away from basic research could have serious consequences." Genzel says a group of prominent German



Station preparation. Scientists at DLR ready a circulation experiment for Russia's Mir space station.

France Brings Space Goals Down to Earth

France has long been at the vanguard of Europe's space effort: It was the driving force behind the Ariane launcher program and the now-abandoned plans for a space plane to ferry European astronauts to and from the international space station and its European lab module Columbus. In the late 1980s and early 1990s, the French space agency (CNES) would see annual budget increases of 20%. But those heady days are now nothing but a memory. The French space program, like its German counterpart (see main text), has slid down the list of national priorities, and CNES is lucky to get a static budget from one year to the next. And it could get worse: Claude Allègre, the pragmatic new minister for research and education, whose remit includes space, has made it clear that, while his vision of France's role in space is substantial, it is much less grandiose than before.

The political message from the new Socialist government is that space policy must fit with its broader objectives, such as reducing unemployment, monitoring and understanding environmental changes, and improving industrial competitiveness. Allègre appointed a new CNES director-general, Gérard Brachet, last June and, says André Balogh, a professor at London's Imperial College, French scientists generally believe he was brought in to temper the traditional French enthusiasm for space. Indeed, Brachet has some tough marching orders. These include less emphasis on crewed space flight, better management at CNES and the European Space Agency (ESA), continued commitment to Europe's new heavy launcher (Ariane 5), high-quality science, a strong Earth-observation program, and possible collaboration with NASA on a sample-return mission to Mars in 2005.

Allègre has said France will honor commitments to the space station it made at a meeting of ESA's ministerial council in Toulouse in 1995 (*Science*, 13 October 1995, p. 224). France is due to contribute 27% of the \$2.3 billion ESA is spending on the space station. But in an interview with *Science*, Brachet said there will be no extra money for the station in the future, and negotiations on the amount Europe pays toward the station's operations are likely to be tough. "We have no agreement yet on operation costs, and we are watching with care," says Brachet. Already, France has signaled its retreat from crewed space flight by pulling out of a

European project to develop a crew-transfer vehicle for the station. Says one seasoned observer who does not wish to be named: "Allègre would be very happy if the space station would just go quietly away. They've bought an expensive mortgage, and now they can't afford to go out for dinner. It's frustrating for them."

While the station is a frustration, Ariane 5 is still France's jewel. France has funded more than 46% of the \$7.5 billion development costs of Ariane 5, and CNES manages the project on behalf of ESA. Allègre sees the launcher as a cornerstone of an autonomous space policy that would free France from dependence on the United States. The loss of Ariane 5's first flight last year (*Science*, 14 June 1996, p. 1579) shook the French establishment. "It really was their Challenger," says one observer. Following the first successful launch last month, one more is needed for flight qualification, then Ariane 5 can be transferred from CNES to Arianespace for commercial operation.

However, CNES is now roughly half a million dollars in debt to ESA because it borrowed from the agency to keep Ariane 5 on schedule when other countries, principally Germany, did not fulfill their commitments to the project in the early 1990s. Allègre has been outspoken about his annoyance over this debt, which, says Brachet, CNES is now beginning to pay off. Allègre has also criticized ESA for poor management and inefficiency. He has plenty of incentive to tighten its operations: France provides nearly one-third of the agency's budget. The feeling among ESA's two big funders—France and Germany—is that ESA is not operating to their best advantage, so CNES is now working with its newly enlarged German counterpart, DLR, to develop a European space strategy and to suggest ways in which ESA could evolve.

The initiative comes at a time when Antonio Rodotà, ESA's new director-general, is carrying out his own agencywide strategy review in preparation for a ministerial council meeting next June (*Science*, 5 September, p. 1426). "Mr. Rodotà has his own approach," Brachet told *Science*, "but the member states will decide." By this Brachet undoubtedly means France and Germany.

—Helen Gavaghan

Helen Gavaghan is a writer in Hebden Bridge, U.K.

space scientists wrote to the research ministry last summer to express concerns about the shift of emphasis toward applied space research.

In July, Research Minister Jürgen Rüttgers declared that "Germany will continue as a driving force in European space efforts," but also will draw in industrial partners to help strengthen Germany's "technological and commercial competitiveness." Kröll says he generally agrees with the need to focus on space projects with potential commercial value. But he does not believe that the new emphasis will hurt basic research. "In all three main areas of basic space-science research—extraterrestrial, microgravity, and Earth observation and the environment—Ger-

man researchers play a prominent role, and will continue to do so," Kröll says.

However, because DLR is known mainly for its applied research efforts, some space scientists are concerned that DLR may have too

research. While Lüst credits DLR for its "high-class aeronautical research," he maintains that Germany's best space research projects—such as the ROSAT X-ray astronomy satellite and its contributions to ESA's Infrared Space

Observatory (ISO)—have emerged from Max Planck institutes or universities, with funding from national and ESA budgets. Lemke, who helped develop ISO, also told *Science* that his main concern with the direction of German space policy is "whether DLR will shift the emphasis

too much toward applied science."

While DLR's scientists have done excellent work in such fields as Earth observation and microgravity research, much of its reputa-

Nation	Space Budget as Percentage of Gross Domestic Product	Percentage of Budget for National Space Program	Percentage Increase or Decrease in Space Budget, '95 to '96
Germany	0.05%	25%	-11%
France	0.18%	62%	+21%
United Kingdom	0.06%	33%	+14%
Italy	0.06%	29%	-13%

much control of setting the direction of space research. Before last month's merger, DARA took the lead role in prioritizing space research projects, while DLR mainly conducted

tion is based on its applied research in areas such as communications, navigation, and robotics. Even so, Kröll and other scientists at DLR's sprawling research complex near Cologne emphasize that basic research plays a crucial role. According to Rupert Gerzer, a molecular medicine researcher who directs DLR's Institute of Aerospace Medicine, "we balance our activities in basic research and applied research." While the institute focuses on medical research involving microgravity conditions, his scientists have also used lessons learned from monitoring astronauts in space to develop "telemedicine" techniques to connect remote patients with physicians.

Station stasis

To many German space scientists, the solution to the budget squeeze seems clear: Delay or scale back Germany's substantial commitment to the space station and divert that money to the national space effort. If it were still possible, "I would try to delay the space station in order to free more money for basic space science," says Lüst, who had supported the space station as ESA's director-general from 1984 to 1990, at a time when Germany's space budget was growing.

But the research ministry and Kröll say Germany will not delay or back away from its commitment to the space station. In fact, the federal Cabinet approved the decision in July to make the space station the central focus of Germany's space activities over the next few years. Even so, Kröll has made it clear to NASA that Germany "will not be able to increase our budget for the space station, under any circumstances. This project must stay on budget: A 20% overrun on our part might endanger the German space program."

Many German space scientists question the space station's value for scientific research, and Lüst also asserts that—despite the research ministry's desire for commercial applications—the station offers little commercial potential. But Kröll—while he cautions against overestimating the space station's direct commercial potential—believes the station "will offer tremendous opportunities for research" and that such research eventually will have commercial applications. Herwig Öttl, DLR's associate director for space programs, agrees: "The space station is a technological challenge as well as an investment in the future."

Meanwhile, for Germany's space scientists, more investment in the present would be appreciated. While Lüst says he worries about the budget trends, he is hopeful that "this difficult financial period will be overcome without great losses in talented young people. Germany has built a good research program over the last 30 years, and I hope we will be able to keep it."

—Robert Koenig

Robert Koenig is a writer in Bern, Switzerland.

ANTHROPOLOGY

Native Claims Muddy Waters In Fight Over Australian Lake

MELBOURNE—In April 1994, engineers drained the waters of Lake Victoria in New South Wales (NSW) to carry out repairs to a sliding gate that regulates its path to the Murray River. They hoped to refill the lake quickly, but the receding water exposed what appeared to be an ancient burial site extending through a line of sandy islands. A team of archaeologists and Aborigines went to examine the site and rebury the skeletons in accordance with Aboriginal beliefs, but nobody was prepared for the magnitude of the job.

Colin Pardoe, curator of physical anthropology for the South Australian Museum in Adelaide and the man who assembled the assessment team, estimates that the site contains 10,000 burials, some going back 10,000 years. That makes it "the largest hunter-gatherer cemetery in the world," says Pardoe. "People freaked out, even archaeologists," recalls Jeannette Hope, an archaeolo-

native title claim to the site, are split on what its fate should be. And researchers such as Pardoe (see sidebar) have all but given up hope of studying its rich archaeological record. "Lake Victoria is a can of worms," says Peter Clark of the Department of Land and Water Conservation.

Next month, *Science* has learned, the commission's environmental impact statement will recommend that the lake be refilled. The report will argue that it is possible to retain the lake as a water storage and still protect the sites. The recommendation will go to NSW authorities, who will make the final decision.

Shaping their deliberations is the rich history of the land occupied by the lake, which sits near the border with South Australia and is part of the floodplain of the Murray River. For the past few thousand years, it has been a seasonal wetland, rising and dropping with each flood cycle. Long a sacred site in Aboriginal mythology, it was also the setting for the Rufus River massacre, a 1841 clash between white cattlemen and the native population. In the 1920s, the flow of the river was altered to provide "drought insurance" for the region.

Traditional mythology, according to independent anthropologist Sarah Martin, views the lake as the ascension to Nurelli, a Dreamtime creator of the Murray River and Lake Victoria. Burial there was said to assure passageway

to the spirits in the sky. That belief, says Martin, who was called in to review the lake's anthropological significance, accounts for the cemetery's great size and its use over thousands of years.

Pardoe also believes Aboriginal cemeteries in this region served as symbols of "corporate" land use and suggest a settled lifestyle over many generations. According to Aboriginal lore and linguistic and archaeological evidence, the Murray and Darling region encompassing Lake Victoria was occupied by the Maraura-Barkindji (also spelled Paakantji) tribes. In ancient times, says Pardoe, the cemetery would have been "like a neon sign proclaiming [tribal] territory."



JEANNETTE HOPE

A history revealed. Researchers examine signs of ancient civilization exposed after Lake Victoria was drained.

gist later hired by the Murray Darling Basin Commission to coordinate an environmental impact assessment of the site.

The discovery delayed plans for refilling the lake until local authorities could figure out what to do. Under the state's National Parks and Wildlife Act of 1974, the existence of Aboriginal relics at the site means that the lake can't be restored unless a "consent to destroy" is obtained from the NSW government. As the austral summer approaches—the second with the lake unfilled—local graziers and irrigation farmers are getting anxious about their vulnerability to a drought. They want the lake refilled. Local Aboriginal groups, one of which has filed a