High Noon for Europe's Space Plans

National rivalries return as Europe learns the cost of joining the big league in space; scientists complain that big projects are squeezing research

Berlin and Paris—ON 20 NOVEMBER, representatives of the 13 countries that bankroll the European Space Agency (ESA) will assemble in Munich to decide the future of Europe's ambitious space program. They will be grappling with a problem that their counterparts across the Atlantic would find painfully familiar: Grandiose plans hatched just a few years ago are turning out to be unaffordable, as the estimated cost of big-ticket projects threatens to balloon out of control. And, like their U.S. colleagues, European scientists are watching the coming battle over the space budget with a mixture of anger and alarm, concerned that the manned space program will soak up funds that might otherwise have gone to more fruitful areas of research (see box p. 367).

Next month's meeting was originally scheduled to take place in June, but it was put off when an outright confrontation seemed inevitable between individual nations, each battling for its own favorite projects to be funded in a tightly constrained ESA budget. Many researchers would like to see some of ESA's big projects canceled, but that's not going to happen. Instead, Europe is likely to keep the major elements of its space program largely intact, trimming budgets where possible and stretching out construction timetables. The parallels with NASA's efforts to keep its Space Station Freedom program going are striking.

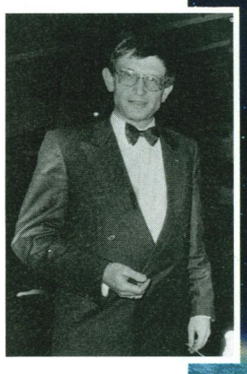
Over the past week, one possible compromise has begun to take shape. Prolonged behind-the-scenes negotiations have marked Hermes, Europe's planned version of the space shuttle, to bear the brunt of the cuts. The French, the major backers of Hermes, are not happy. But neither are the Germans, whose own favorite project—a module and associated platforms, collectively known as Columbus, that will form part of the U.S.-led space station project—would also be trimmed and stretched out. Many details of the compromise remain to be worked out, however, and it is still possible that national rivalries will prove too strong for the deal to stick.

The proximate cause of ESA's predicament is German reunification. Germany is a key partner in all three of ESA's big development projects. It is putting up the biggest share of funds for Columbus, while France holds the largest stake in the other two—Hermes and the launcher Ariane (see charts). The massive expense of reunification last year forced the German research ministry to slash $2.8 billion from its $17.7-billion budget for space—which includes space research and its contributions to ESA—over the remainder of this decade. And it is now considering a further 20% reduction. While Germany is cutting back, the cost of Hermes, in particular, has been climbing rapidly. The latest estimates have indicated that Hermes and Columbus each will be more than 20% over budget—the critical threshold at which any of ESA's members has a right to drop out.

Only Ariane 5—a big, new rocket designed to carry heavy payloads, including Hermes—seems secure. With the success of Arianespace, Europe's commercial satellite launch consortium, behind it, Ariane 5's $5.3-billion development program is sure to win continuing support. Arianespace still holds around 50% of world commercial satellite launch contracts and has an order book of 34 commissioned satellites, worth $2.6 billion.

For German Research Minister Heinz Riesenhuber the turmoil in European space policy has a bitter irony. Riesenhuber chaired the historic ESA meeting at The Hague in 1987, where much of Europe decided to opt for self reliance with a space program that guaranteed manned access to low-earth orbit. Ariane would provide independent launch capability; Columbus would give Europe a share in the Freedom project as well as a polar platform that would orbit separately; and Hermes—which would be launched by Ariane—would ferry European astronauts twice a year to service European components of the space station. Only Britain concluded that the world didn't need another space shuttle and opted out of the program, boycotting all but the polar platform of the Columbus package. Now Riesenhuber—who remains an enthusiastic supporter of the manned space program—has to tell his partners that the German cupboard is bare and that the time has come for "cutting and stretching the big programs." "ESA has not yet exhausted every opportunity for cuts," he told *Science* in an interview. "So far, efforts in that direction have not been very dramatic and not very successful either."

Under the compromise now being worked out, the basic elements of Columbus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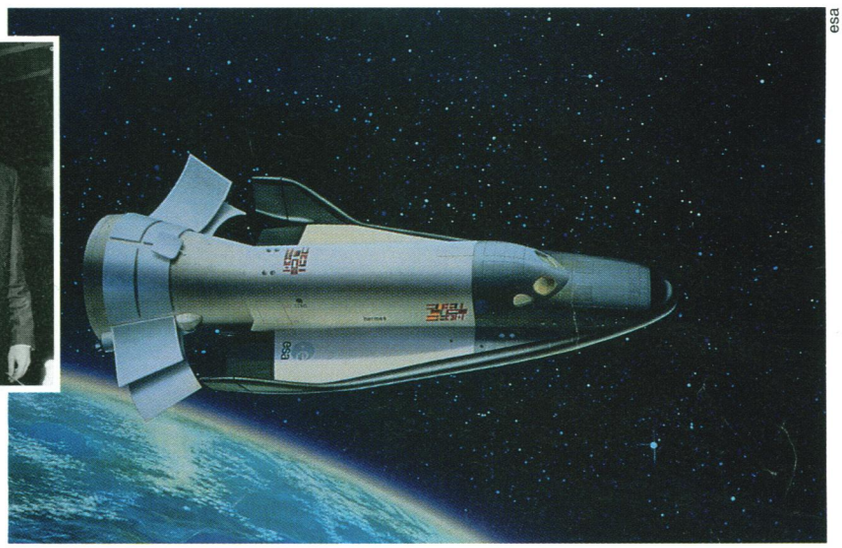
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Clipped wings. *Europe's space shuttle, Hermes, may have to be delayed. Heinz Riesenhuber, an architect of Europe's ambitious space program, is forced to reduce Germany's financial commitment to the effort.*

would remain intact. The project consists of a pressurized laboratory to be attached to the Freedom international space station, an unmanned Polar Platform Satellite carrying remote sensing instruments, and the Columbus Man-Tended Free Flyer—a small orbiting laboratory for microgravity experiments. Germany is due to provide 38% of the estimated $5.6-billion total cost.

The free flyer would be most affected, according to Romano Barbera, head of the Columbus program at ESA; indeed, it is already being thoroughly picked over for savings. Originally, the free flyer was designed to last for 30 years; every 5 years it would dock with Freedom so that astronauts could change critical power supplies. The latest design aims for a shorter, 10-year lifespan with longer-lasting solar arrays. Under the new plan, it would no longer be required to dock with Freedom. This would avoid the development of specialized communications equipment, radar, and propulsion systems and save about $100 million, he says. The launch date would also slip—from 2001 to 2003.

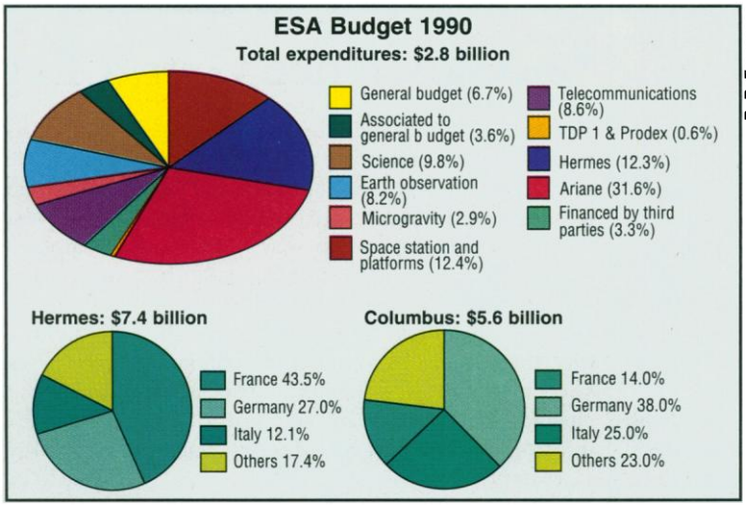
As for Hermes, the first launch would be delayed from 1998 until March 2002, and manned flights wouldn't begin until 2003 or even later. Conceived along the lines of the trouble-plagued U.S. space shuttle, Hermes has undergone drastic design changes in recent years. After the 1986 Challenger accident, ESA reduced the number of astronauts Hermes could carry from 6 to 3 and demanded that it have an ejectable cockpit. The modifications vastly increased its weight—from 12 to 22 tons—and placed it at the outer limit of the Ariane 5 launcher's planned payload capacity. Says Riesenhuber: "Hermes has not met the technical goals and has exceeded costs substantially."

The plan to stretch development until 2002 would bump up the total costs even more—a hefty $300 million—but they would be spread out over a long enough time that Europe would be able to afford the yearly installments. The 1987 version of Hermes was going to cost $5.3 billion, but by early this year it was already running 20% over budget. Then, in July, the launch date was put back from 1998 to 2001, bringing the Hermes budget to $7.1 billion. Now, with a 2002 launch on the table, the cost has rocketed to $7.4 billion but it would be spread more evenly over the timetable.

All of this is still under discussion, however, and there is intense disagreement over some elements of the plan. For example, Riesenhuber told *Science* that he plans to propose another "technology phase"—essentially another design review—before starting to bend metal for Hermes. This will enable engineers to "check carefully whether, for each single problem, the best technical and most cost-effective solution has been found," he says.

The idea is totally unacceptable to the French, however, who view it as a ploy to kill off the program.

In sharp contrast with Germany, space projects remained a top priority in the 1992 French research budget, announced in mid-



D. DeFrancesco

Money matters. *How ESA divided the pie last year; latest total cost estimates and national sponsors for Hermes and Columbus.*

European Researchers Take Pot Shots at ESA's Budget

On the eve of a crucial vote this summer in the U.S. Congress on the budget for NASA's Space Station Freedom, some 14 scientific societies issued a statement highly critical of the project. Their counterparts in Europe are no more enamored of the European Space Agency's (ESA) grandiose plans.

The French Academy of Science's committee on space research published a memorandum last November casting doubt on the value of a free-flying laboratory for microgravity research that is part of the Columbus project, ESA's proposed contribution to the Freedom project. "Microgravity research, as envisaged by ESA for the orbiting Columbus infrastructure, is not a scientific activity," it said. The academy called upon the government to "re-examine the scientific and technical use of [the orbiting lab]." Shortly before next month's ESA meeting (see accompanying story), the academy committee will hold two meetings to discuss Hermes, and it is expected to release an equally critical assessment. The German Physics Society has gone even further. Earlier this year, it came out with a strongly worded memorandum arguing that "neither science nor business has demanded manned space flight," and recommended that Germany leave the Hermes and Columbus projects if costs continue to rise.

In Germany, leading scientists have been vociferous in their criticisms of the space program, fearing that its glamorous projects are being developed at their expense. "It is obvious to anybody that this is a catastrophe, so much money going into space flight," says Benno Müller-Hill, one of Germany's best-known molecular biologists and head of the Cologne University Institute for Genetics. Müller-Hill is particularly bitter that the future of funding for his own institute is in doubt because of uncertain federal support: "We may have to reduce our activities, while space flight can go on happily. To me this is absolutely incomprehensible," he says. Dieter Bimberg, executive director of the Institute of Solid State Physics at the Technical University of Berlin, feels the same way. "Integrated optoelectronics suffers from the drawback that its projects do not provide as good public relations as a space-glider," he says.

But European researchers are likely to be no more effective than their U.S. colleagues were in opposing NASA's plans. Moreover, Germany's research minister, Heinz Riesenhuber, argues that scientists are too naive about how money is won from the government. Scientists act as if the research budget "were a cake one has to fight over for a slice, as if the sums could simply be shifted from A to B," he says. "But if I had renounced the increase I got for space next year [from the cabinet], I would not have obtained one single mark more for any other area." ■ R.S. and P.C.

September by research and technology minister Hubert Curien. According to Curien, the long-term program still has President François Mitterrand's support and France will go into the Munich meeting determined to save Hermes. "There is no reason why France should stop its commitment," he says. Daniel Sacotte, deputy director for international and industrial affairs, told *Science* that "We cannot just decide today to have another supplementary [technology] phase. This effectively means a moratorium and there is the word 'mort' (death) in 'moratorium.' "

The French are not the only ones who may feel bitter about any delay in Hermes' schedule. Guy Valentini, Hermes program officer at ESA's headquarters in Paris, says, "We are at the limit of stretching. Further stretching leads to cracks in the industrial layer which might not be easily reversible." German industry would be affected as well as other countries, he says, "but the real strain will fall on the small countries—Spain, Belgium, Switzerland, and the Netherlands—that are involved at subsystem and equipment level."

In the short term, the delays to Columbus will also cause German space industry some hardship. But for Riesenhuber, the big space projects remain insurance that European industry will stay in the high-technology race. His logic is "the principle of least regret," he says: To be on the ESA team is expensive, but to see others commercialize space while Europe sits on the sidelines would be much more costly. "Once we get out it will be extremely difficult to get in again later on. For Europeans it makes perfect sense to build on their own competence in space transport techniques. To quit is out of the question."

Riesenhuber even singles out Germany's earlier penny-pinching in space research to emphasize his point. In the early 1970s, the German government refused full involvement in plans to develop European rocket technology. "France decided differently," recalls Riesenhuber. "Had France not stuck to it despite setbacks, we would not have Ariane now. For years Ariane was the only payload carrier of the free world, since the shuttle did not fly and the other unmanned rockets no longer existed in the United States."

European researchers may argue instead that the real lesson to be drawn from that example is that Europe should not now repeat U.S. errors by going ahead with a shuttle development program.

■ RICHARD SIETMANN and PETER COLES

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Social Science Gets a Leg Up at NSF

Just last year, the suggestion that the National Science Foundation (NSF) needed a separate bureaucracy to fund social and behavioral sciences was greeted with disinterest—if not outright hostility—by NSF's top brass, including then director Erich Bloch. But last week the agency made an about face, announcing that it would, after all, give the social, behavioral, and economic sciences their own directorate. So what changed in the last year? "We got a new director," says current NSF director Walter E. Massey.

Until now, social science has been nestled in a mega-directorate with the unwieldy title of Biological, Behavioral, and Social Sciences, an entity that has been traditionally headed by a biologist. The new directorate will have a budget of about $70 million: $40 million from the old biology directorate's $200-million budget, and $30 million from other foundation programs. It will also pick up the international program and the science resource studies program from the directorate for Scientific, Technological and International Affairs, which is being abolished.

Social scientists—who have lobbied long and hard for their own directorate—are ecstatic about the moves. Alan Kraut, director of the Washington office of the American Psychological Society, points out that the move will put the social sciences on a par with other disciplines in NSF's hierarchy. "[A]n historic day for social and behavioral science research," proclaimed Howard J. Silver, executive director of the Consortium of Social Science Associations.

If NSF was unenthusiastic about reorganizing its biological directorate, Congress has been warmer to the idea and pressured NSF to look into it. When Representative Rick Boucher (D–VA), who chairs the subcommittee that oversees NSF's activities in Congress, was persuaded a few months ago that the time was right for a social sciences directorate, the plan gained added momentum. The White House Office of Management and Budget also gave its tacit approval.

There will be a nationwide search for a new associate director to lead the new directorate. In the meantime, W. Franklin Harris, second in command of the old mega-directorate, will be acting director. ■ JOSEPH PALCA

Court Leaves Patent Issue Unclear

Many biotech companies were on edge this fall, fearing that they might become entangled in costly legal challenges to their patents if the Supreme Court ruled on a case filed by the Cambridge, Massachusetts, firm Genetics Institute (GI). But now the gene-splicers can breathe easier: On 7 October, the Court declined to hear GI's petition.

The trouble began when GI lost a battle in the lower courts with Amgen, Inc. over priority for a genetically engineered product called erythropoietin, a promoter of red blood cell growth. Although Amgen won on appeal, GI wanted the Supreme Court to invalidate Amgen's patent because Amgen had failed to make available to the public a sample of the "best mode" of manufacturing erythropoietin under its patent. That is, Amgen did not submit to a public depository a batch of chinese hamster ovary cells of the type it used to manufacture erythropoietin. The Patent Office requires such deposits when a biological invention cannot be adequately disclosed in words. In this case, Amgen argued, the technology was readily available to researchers, and all the law required was a full verbal description of it.

The appeals court agreed. The judges wrote that biological deposits are mandatory only for patents on a new organism isolated from nature—such as a bacterium used in antibiotic manufacturing. As for genetically engineered organisms, the court decided that many gene-splicing techniques are now so well known that they can be used by anyone skilled in the art, so cell deposits are not always needed to make an invention publicly accessible. Says Joe Onek, an attorney for GI at the firm of Crowell and Moring, "The decision seems to leave much more leeway" for those who wish to avoid making a deposit.

Genetic engineering companies were relieved. According to Lisa Raines of the Industrial Biotechnology Association: "We were preparing to file an amicus brief supporting Amgen," because GI's argument threatened to open a Pandora's box of challenges to other patents for which no public deposit has been made. "Most companies are pleased" that the court is keeping the box shut, Raines says. She added, however, that the Amgen case leaves some uncertainty about when a public deposit is required. The Supreme Court, which reputedly hates patent cases, seems content to leave the issue fuzzy. ■ ELIOT MARSHALL