PAGE 1246

Heat source for early solar system

1247

EPA urged to broaden focus

SPACE

European Ministers Back Commerce Over Space Science

BRUSSELS—The European Space Agency (ESA) veered sharply toward support for the commercial exploitation of space at a meeting of ministers from its 14 member states here last week. The abrupt shift left space science programs in the lurch. During the frequently tense meeting, ministers negotiated which elements to back from a $6.4 billion menu of programs proposed by the agency. They enthusiastically pledged funding for programs in satellite navigation, Earth observation, and communications. But, to the frustration of space scientists, the politicians voted to maintain a cap on science spending, which has already been in place for 4 years, and only reluctantly backed spending plans for the utilization of the space station.

David Sainsbury, Britain's science minister, who chaired the meeting, declared it a success because of its strong support for commercial and environmental programs. Germany's research minister, Edelgard Bulmahn, told *Science* she was "very satisfied" with the outcome. ESA officials were not so buoyant. Commenting on a 10% downgrading of the Earth-observation budget, David Southwood, who headed the agency's efforts to develop the program, says the decision was "challenging" and "would concentrate the mind." Others were less circumspect. "Hardly a day goes by when we are not asked for cost cuts," says Jean-Jacques Dordain, head of group strategy and space development for the agency, "so this is business as usual."

The member states' changing priorities became obvious in the debate over the agency's science budget. Science is a "mandatory" program, which means that once a level of funding is agreed by unanimous vote, each country's contribution is determined by the relative size of its gross domestic product. Germany is the largest single contributor, paying 25%, then France at 17%. ESA's science directorate has often been praised for its coordinated approach to funding a steady stream of large and medium-sized missions put forward by the scientific community. But at the last ESA ministerial meeting, in Toulouse in 1995, ministers capped the science budget. "Because the program is mandatory," says Hans Balsiger, head of ESA's advisory Science Policy Committee, "and there must be a unanimous vote, we are an easy target [for cuts]." The science directorate's difficulties were made more acute in 1996 when the inaugural launch of the agency's Ariane 5 rocket exploded, destroying Cluster, a mission to explore the Earth's magnetosphere with four spacecraft.

ESA'S BRUSSELS BUDGET BATTLE

	Year	ESA proposal	Contributions offered
		Million Euros	Million Euros
Optional programs:			
GalileoSat			
definition	1999–2000	40	60
development	2000–2005	460	178
Telecommunications	1999–2005	359	290
Earth Observation	1999–2002	759 (690*)	593
Space station exploitation	2000–2001	344	343
Ariane 5 Plus	1999–2001	462 (416*)	416
Future Launcher Technology	1999–2001	70	54
Mandatory programs:			**Approved**
Science	1999–2003	1850	1460†
General budget	1999–2003	850	649†

* Ministers reduced the request. † 1999–2002 (1 Euro = $1.09)

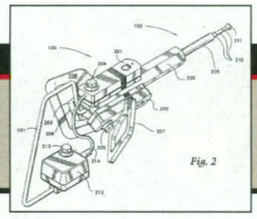
At the Brussels meeting, the science directorate requested just over $2 billion for 1999–2003, which would bring the science budget's purchasing power back to 1998 levels by 2002. However, Karl Reuter, head of the ESA director-general's cabinet, told reporters that this turned out to be "one of the most difficult areas of discussion." Germany, supported by France, wanted the budget freeze to continue. According to observers in the closed meeting, Bulmahn argued that the science directorate was amply funded and should have realized long ago that it could not do all that it wanted.

ESA had already warned the ministers that without any increase for inflation, the science directorate would not be able to maintain its lineup of currently approved missions, including the infrared and submillimeter telescope FIRST/Planck, due for launch in 2007, and the newly approved Mars Express, Europe's contribution to the highly coordinated stream of U.S. and Japanese missions heading for the Red Planet. In a compromise brokered by Sainsbury, ministers maintained the freeze on space science spending but approved a one-time payment of $44 million to safeguard Mars Express. "We should be grateful," says Balsiger, "for the [$44 million], but I resent some of the statements made, because we had worked very hard [to cut costs]."

Asked what impact the compromise would have on Europe's space science policy, ESA Director-General Antonio Rodotà said immediately after the meeting: "There is no real answer that the agency can give today. The agency will have to turn to the Science Policy Committee. It is their problem to decide what is the best way forward." The committee was due to meet this week, after *Science* went to press. "The questions we have to answer are, how many of the small missions do we have to cancel and how long can we defer FIRST/Planck without affecting the science or pushing up the cost," Balsiger says. Some particularly vulnerable missions include Europe's part of the Next Generation Space Telescope and MiniStep, a fundamental physics mission to test whether inertial and gravitational mass are identical.

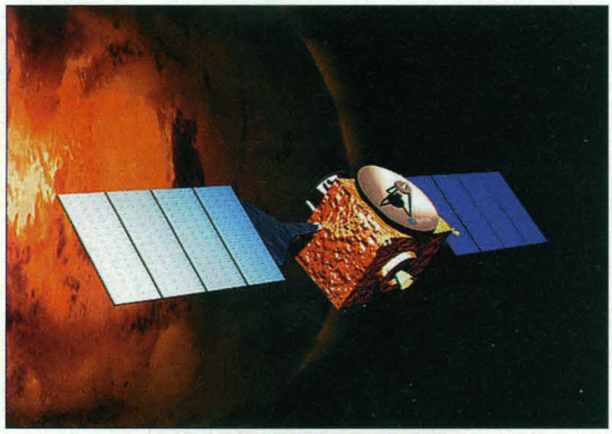
Although space science had to fight hard just to stand still, ESA's input to the deeply unpopular space station took an even more severe battering. The ministers could not reach agreement on funding for the crew return vehicle (CRV), a joint NASA/ESA craft that would ferry station crew to Earth, and so put off a decision on whether to join NASA in developing the vehicle. ESA had also proposed to spend about $107 million on micro-

SOURCE: ESA



gravity research between 2000 and 2003 as a precursor to science aboard the station, but ministers slashed this program by half.

Even ESA's basic program for space station exploitation only barely won full commitment of funds from member states. Germany, which has accounted for 41% of Europe's contribution, had long been the station's champion, but the new Social Democrat administration elected last year is no friend of the project (*Science*, 5 February, p. 784). Bulmahn says it is time to find ways to interest industry in exploiting the facility. "Industrial involvement on [the station] will be an important task for ESA," she says. Speaking after the meeting, Rodotà told *Science*, "We will stick with the commitments we have made. That is the right decision, but we do not like this station. It is hard to say what the value of such a project is."



Staying in the race. Ministers agreed to a special payment of $44 million to keep Mars Express on track.

When the discussion turned from science to application programs, however, the ministers got out their checkbooks with relish. ESA put forward a new plan for a constellation of navigation satellites called GalileoSat that would allow receivers on the ground to fix their position with millimeter accuracy—a European competitor to the U.S. military's Global Positioning System. As an optional mission, each government can pledge however much it wants to spend, but even the 1-year definition phase of GalileoSat was 50% oversubscribed at the Brussels meeting, and without even being asked some member states, including the usually tightfisted United Kingdom, indicated their willingness to fund the development stage.

The agency's overhaul of its Earth-observation strategy in the 2 years since Rodotà's appointment also won support. Previously, ESA's remote-sensing satellites had been huge technology demonstrators, such as ERS-1 and ERS-2, which did a lot to open up the field of radar remote sensing for civilian users. "These were magnificent beasts," says Southwood, but the launch of ESA's Envisat this year "will mark the end of the great technology demonstrators for Earth observation." Southwood and Roger Bonnet, the agency's science chief, have now drawn up a 5-year program of small application and research missions designed to provide data to a wide cross section of Earth-observation users. The plan won plaudits at the meeting, yet ministers cut ESA's request by 10%. As one U.K. official said at the meeting, "the days of the big prestige projects are over."

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ARCHAEOLOGY

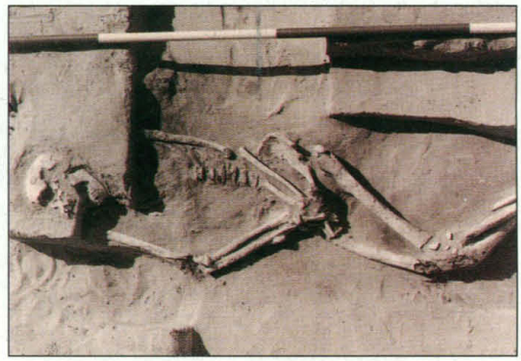
New Date for the Dawn of Dream Time

LAKE MUNGO, AUSTRALIA—Looming over this dry lake bed is a crescent of ancient sand dunes, carved by the wind into miniature canyons and mesas. Built up over tens of thousands of years, the dunes preserve traces of fires made by Aborigines to cook golden perch they once caught in the lake, spear points they used to hunt the kangaroos and other game that crowded Mungo's shores—and now, a team of researchers claims, the oldest human remains ever found in Australia.

In the June issue of the *Journal of Human Evolution*, Alan Thorne of Australian National University (ANU) in Canberra and his colleagues put the age of a skeleton from Lake Mungo at 62,000 years. If correct—and some experts are withholding judgment until they see the paper—the date would mean that human beings had reached Australia tens of thousands of years earlier than some archaeologists thought. It also has implications for the history of modern humans. Many researchers maintain that all modern humans descend from a single population of Africans dating back perhaps 100,000 years; these founders later spread out across the Old World, replacing any humans or hominids they encountered. One of the last places they would have reached would be Australia, so an early date for their arrival would mean an earlier migration than some researchers had pictured—or perhaps an alternative scenario of modern human origins. "If the dates are reliable, the implications are very substantial," says Stanford University's Richard Klein.

The skeleton itself, called Mungo 3, is not a new discovery. In 1974 geomorphologist James Bowler of ANU uncovered the remains of a lightly built man in one of the dunes. Thorne completed the excavation and determined that the body had been ceremonially buried in a grave, with red ocher scattered over it and its fingers intertwined around its penis. Carbon-14 dating initially put its age at 28,000 to 32,000 years old. But in the mid-1980s, as researchers further refined ^{14}C dating techniques, they were able to remove younger organic contamination and push the date back to at least 38,000 years ago.

Some researchers wondered if Mungo 3 might be still older. When organic material gets to about 40,000 years old, so much of its ^{14}C has decayed that it's often difficult to get a precise age. And new dating techniques that can reach beyond ^{14}C had already hinted that human beings were on the continent well before 40,000 years ago. These methods rely on counting the elec-



Man from Mungo. This ancient Australian was sprinkled with red ocher and carefully arranged in his grave.

CREDITS: (TOP) ESA; (BOTTOM) ALAN THORNE