those pushing for the rapid development of the new, heavy-lift version of Ariane, Ariane V, currently scheduled to be ready in 1995. This launcher's potential role in the construction and servicing of the space station is already being discussed as one way that Europe might contribute to its operating costs.

Furthermore, French officials are already describing Hermès, which they hope to have adopted by ESA next year, as a possible backup to the shuttle. "Access to the space station by two different launch systems is necessary to bring safety to an acceptable level, in case problems are encountered with one and it is necessary to use the other," says one top French space official.

Then there is the question of budget. Many European officials feel that NASA is being excessively optimistic in claiming that, under current financial pressures, it can still meet the first launch deadline of 1994 which was set by President Reagan 2 years ago.

Europe, however, also has its budgetary problems. The five-element Columbus package is already expected to cost 10% more than the budget agreed to in principle by the European ministers last year. And the acceptance of Hermès (and possibly the British project HOTOL) as additional projects will increase financial pressures still further (*Science*, 17 January, p. 209).

On the legal side, detailed consideration is currently being given to the conditions that would allow Europe the full use of any technology it contributes to the space station. There are still bitter memories of Spacelab, which European countries built but now must hire from NASA at commercial rates whenever they want to use it.

For the moment, however, the key question is whether NASA will accept the Columbus package in its revised form. The U.S. agency is currently reluctant to make any commitment to provide support services for the free-flier, which a recent NASA task force described as being "of little value."

European officials hope that their determination to proceed with the free-flier regardless of NASA's decision will convince NASA to support it, just as—in reverse—the United States' unilateral commitment to the space station was a major factor in convincing the European space community to sign up for it.

Whether the two space agencies can reach agreement that will allow Europe to participate as a full partner in the next stage of the space station design will depend on the outcome of a round of negotiations that are just getting started. But, as one Italian delegate to the EUROSPACE conference said, "at least we have all now agreed on what we are discussing." ■ DAVID DICKSON

Microgravity Seeks Lift-Off

Venice

"Microgravity is a virgin field," says Frederick Engström, director of space station and platforms for the European Space Agency in Paris. "It may turn out to be the promised land; at least you can sell it as the promised land." That statement, delivered to a meeting of space officials and industrialists from both sides of the Atlantic, suggests the dilemma currently faced in Europe by those eager for more space-based facilities aimed at exploiting the behavior of physical processes in low gravitational fields.

On the one hand, European industry so far has shown relatively little interest in the potential use of space for producing materials ranging from superconductors to protein crystals. Indeed, space production was hardly mentioned in a recent report on "The Space Industry" produced by the Paris-based Organisation for Economic Cooperation and Development. However, enthusiasm for the potential rewards of microgravity research plays a significant role in the case that European space agencies must put to their respective governments to justify increased expenditure on future space projects. These range from further flights of the German/Italian-built Spacelab through participation in the U.S. space station to plans for a totally European, man-tended free-flying laboratory (see accompanying story).

The main push for microgravity research is coming from the aerospace companies that have a direct interest in producing the space-based laboratory systems with which the research would be carried out. These include MBB/Erno and Dornier in West Germany, Aeritalia in Italy, and Matra and Aerospatiale in France, each of which is scheduled to receive major contracts for Columbus, Europe's proposed contribution to the U.S. space station.

Later this month the first general meeting of a new organization called INTOSPACE will be held. With some 60 members, the group hopes to coordinate and stimulate interest in microgravity research among Europe's industrial and commercial communities, and lobby for it in political circles.

"We want to provide concrete inputs into future programs from the users' side, for example, by finding out from different disciplines their particular research requirements," says INTOSPACE general manager Hans Hoffman, previously with the German aerospace company MBB/Erno.

Hoffman argues that the major problem facing microgravity research is the lack of facilities, and suggests that industrial enthusiasm will only grow once a substantial number of experiments have been carried out and the costs of research have been brought down. "Launch costs are still too high, and flight opportunities are still too few."

At least two-thirds of INTOSPACE's members are potential users of microgravity research facilities. These range from the French pharmaceutical company Roussel-Uclaf—which has expressed particular interest in the potential applications to biotechnology—to Italy's Olivetti, keen to study the possibilities for semiconductor production.

The advantages of microgravity research are one of the main technical claims being made for a free-flying laboratory that would operate in conjunction with—but physically independent from—the main U.S. space station. "In the space station, you have man walking around all the time; with a free-flier you have a quiet laboratory without such disturbances, but with experiments better shielded than they would be on an open platform," says one German space official.

There are a growing number of enthusiasts within Europe's scientific community. "We are creating a new science which no one even spoke about 5 years ago," says Italian physicist Luigi Napolitano, chairman of the European Low Gravity Research Association. "We need both scientific and engineering data, as well as the facilities that will enable us to make measurements at a number of different levels of gravity."

However, British Aerospace, which expects to be given the contract under Columbus for Europe's polar platform, shares the skepticism of the British government. "We have been interested in the platform because it seems to be one of the routes to early commercialization," BA executive John Holt told the Eurospace meeting. "We have not yet had the same insights into microgravity." ■

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