

Europe draws up plans for a major programme of Moon exploration

Paris and Washington. Twenty-five years after the United States captured the imagination of the world with the Apollo Moon landings, the European Space Agency (ESA) is preparing to ask its space ministers to approve a long-term programme of expeditions designed to explore, exploit and colonize the Moon.

The agency hopes that such a 'return to the Moon' programme, which ministers will be asked to consider for funding next year, will rekindle international support for space exploration. The final phase could, as now planned, include an artificial ecosystem and a permanent manned presence.

ESA is presenting its proposal as a long-term, open-ended venture. To make the programme appear less daunting and allow greater budgetary flexibility, the agency, based in Paris, has also designed it in four overlapping phases.

If funding is approved, the first 'exploratory' phase could begin within a decade. This would involve sending orbiting lunar observatories, such as the proposed MORO

mission (see *Nature* 369, 90; 1994), to survey the surface and interior of the Moon over several years, using a wide range of remote sensing technology.

According to Julie Cave, an astronomer



Heading back? NASA's micro-rover in New Mexico — (see below).

at University College London and a member of the MORO science team, this would be much more comprehensive than any previous survey, including that carried out recently by the US Clementine observer (see below). Planetary scientists, she adds, have become "immensely interested" in a new Moon mission following the preliminary data obtained from Clementine.

The observatories would also survey lu-

nar resources and identify suitable sites for landing craft, as well as building a manned outpost on the far side of the Moon. New technology such as rovers would also be tested during this phase.

The second phase — a 'permanent robotic presence' — would establish the Moon as a platform for automatic large scientific instruments and telescopes. Such instruments would take advantage of the Moon's stable surface, its lack of an atmosphere and the absence of electromagnetic interference emitted from Earth on the 'radio-quiet' far-side.

Astronomers say the Moon offers unique opportunities for ultraviolet and submillimetre imaging, and for very-low-frequency astronomy. It would also provide improvements measured in orders of magnitude in angular resolution and sensitivity at all wavelengths, they say.

In the third phase, the 'utilization of lunar resources', robots would search for geological resources and seek ways to exploit them for use in establishing a manned outpost in the fourth phase.

ESA also says it should be feasible to manufacture propellants *in situ* for refueling craft returning to Earth. This phase would also study the possibility of excavating an underground lunar base. Astronauts would be required to visit occasionally during this phase.

The final phase would involve establishing the first artificial ecosystem and permanent manned presence on another celestial body. This would provide the groundwork for exploration to Mars and beyond.

At a time when Europe is repeatedly scaling down its space plans because of its budgetary difficulties much of this may sound like science fiction. But officials in both Germany and France, for example, say that the proposals could provide a much-needed opportunity to look beyond immediate pre-occupations and define a long-term space strategy.

At the same time, however, German officials add that the proposal is unlikely to receive support until Europe resolves outstanding budgetary problems, in particular the terms of its participation in the National Aeronautics and Space Administration (NASA)'s international space station.

The United Kingdom is less enthusiastic. British space officials point out that they are mainly interested in short-term commercial space applications and 'cost-effective' science missions, and that ESA's budget ►

US military backs new lunar mission

Washington. Draft proposals from the European Space Agency for a long-term Moon programme (see above), combined with growing enthusiasm among the American military for a follow-up to the recent Clementine lunar mapping mission, may revive interest in lunar exploration at NASA.

NASA has abandoned its own lunar ambitions. Two-years ago the US Congress killed the agency's plans for a pair of US\$ 100 million lunar orbiters, and forced it to close the exploration office that was studying a return of man to the Moon.

The little momentum which exists for a US return to the Moon is coming from the Department of Defense (DoD). Although Clementine was designed to test hardware, and not as a science mission, it has filled the void in lunar exploration left by NASA.

Members of the military team which organized the Clementine mission are now lobbying for a Clementine 2 to test advanced propulsion and communications technologies not flown on the first mission.

They also argue that Clementine 2 could carry a rocket-propelled lander, based on hardware developed in the Pentagon's Strategic Defense Initiative (SDI). The lander, which has been built by the Air Force's

Phillips laboratory in New Mexico, recently deployed a two-pound micro-rover on a simulated lunar landscape.

The US\$100 million Clementine project is considered to have been a success, despite the software failure that has made it unlikely that the craft will rendezvous with an asteroid this summer as was planned.

The project has shown that deep space missions can be put together quickly and cheaply. Advocates argue that demonstration projects such as Clementine 2 are needed to recover some of the massive investment in advanced spacecraft technology made during the SDI programme.

Such advocates, who hope to obtain funding for a new mission from the Air Force or other armed forces, believe its approval will depend on persuading NASA to share the costs of the project and to provide the reasons for landing on the Moon. They hope, for example, that NASA will agree to use the craft to test advanced lightweight scientific instruments for planetary exploration.

But NASA has had to watch from the sidelines as the DoD earned the accolades for Clementine, and it is now eager to prove that it too can mount cheap and clever missions.

Tony Reichhardt

is already stretched.

But the officials agree that they might become interested if the costs of the programme were shared with international partners. "We are certainly not dismissing it [the proposal]," says one official in London.

Indeed, ESA agrees that its plans are only to be achieved by a global programme. Next week, the agency will host a workshop in Switzerland on plans to study and explore the Moon. The meeting will also be attended by representatives of NASA, as well as of the Russian, Japanese and European space agencies.

Some NASA scientists, conscious that Congress would reject any plan for a NASA Moon mission, are beginning to talk of the ESA proposal as a way back into action. They believe it could revive flagging US interest in the Moon.

Wendell Mendell of NASA's Johnson Space Center says that the ESA proposal is "totally independent of NASA, which to me is good news". He adds that the US Congress is likely to accept a lunar exploration plan only "if it is brought to the table by an external party".

Jean-Jacques Dourdain, associate director for strategy, planning and international policy at ESA, describes the Moon as a "suburb" of Earth, and says that a lunar mission is inevitable at some point. He argues that the time is now right for space agencies to recapture the momentum that has been lost in space exploration.

Dourdain adds that ESA will not oversell the potential industrial spin-offs of a Moon mission — a mistake he says was made with attempts to use microgravity research, which has been used to "sell" the space station. He says that ESA is keen to assemble a "credible" plan that it can present to its member states and potential foreign partners.

Declan Butler & Tony Reichhardt

Switzerland eyes the costs of joining Framework

Basel. Swiss scientists are growing increasingly nervous that their government's enthusiasm for participating in the European Union (EU)'s fourth five-year Framework programme may take money away from basic research in order to cover the higher-than-anticipated costs that its participation would involve.

Last week, the foreign ministers of the EU announced in Brussels that bilateral negotiations with Switzerland will start "as soon as possible". Officials in Berne expect that the next research ministers' meeting at the end of June will open the way for bilateral talks about Framework.

Initial discussions took place two years ago, in the context of Switzerland possibly becoming a member of the European Economic Area (EEA). Since the beginning of this year, countries in the EEA — such as Sweden, Austria and Finland — have automatically participated in Framework.

Although Swiss voters rejected the EEA proposal at the time in a referendum, they approved the idea of participating in Framework. If parliament agrees, delegations from Berne and Brussels will meet later this year to start talks on a bilateral agreement for Swiss participation in European research programmes.

But calculations of its potential financial commitment were based on the ECU6.6 billion costs of the third five-year Framework programme (1989–93). In December 1992 the Swiss parliament approved SF477 million for participation in European research programmes for a four-year period.

In contrast, the budget for the fourth Framework will be ECU12 billion (the increases result primarily from additional European Commission projects). This will mean an expected cost to Switzerland of SFr800 million. And the need to find an additional annual SFr60–70 million on top of funds already approved by the parliament comes at a time when the federal government's finances are already tight.

Jean-Pascal Delamuraz, the Swiss Economic Minister, says that a definite solution has not yet been reached. "We will see whether it is really necessary to pay so much to take part in EU programmes and whether we will have to sacrifice something."

Rather than reduce its level of participation — which would need negotiating with Brussels — the government would prefer to find the extra money from research funds that would otherwise have been spent inside Switzerland.

Tim Guldemann, of the Gruppe für Wissenschaft und Forschung, which advises the Swiss government on research and science policy, says that about half the outstanding amount would have to be found from other budgets. But he points out that, providing Swiss researchers are successful in applying for grants from Brussels, more than SFr200 million will be returned to the country each year.

Nevertheless, many Swiss researchers fear that participation in European programmes could lead to reduced funding for basic research in Switzerland itself. Most research administrators agree in principle that the 'compensation' solution is appropriate, but no-one is eager to see his or her budget cut.

Hans Peter Hertig, general secretary of the Swiss National Science Foundation, the state agency that funds basic research, says he supports Swiss participation in European-level programmes funded through Brussels, but not at the price of a reduction in basic research at home.

"The fourth framework is mainly about applied research carried out in collaboration with industry", says Hertig. He argues that money earmarked for applied research in Switzerland might more suitably be transferred to finance the European participation, and that funding for basic research should be protected.

Paul-Erich Zinsli, vice-director of the Ministry of Interior's department for research, also feels that compensation should be restricted to applied research, and that steps should be taken to preserve the country's fundamental research base. "Otherwise we could not contribute to European science in the long run," he says. **Oliver Klaffke**

Election costs hit Pretoria science budget

Cape Town. South Africa is not spending enough on research and development, according to the country's new Minister for Arts, Culture, Science and Technology, Ben Ngubane, speaking in his first public address at the Human Sciences Research Council in Pretoria last week.

Ironically, however, Ngubane's speech, in which he committed himself to working towards "more focused and effective science and technology", came only days after the country's three largest science councils had been informed of cuts in their parliamentary grants for the current financial year.

These cuts are part of an across-the-board reduction of 5 per cent of this year's budget for all government departments, rather than a reflection of any deliberate effort to reduce the science budget. Furthermore the overall cut was imposed not by the new cabinet, but by its predecessor,

in order to finance a R1-billion (\$272 million) bill for the recent election.

The reduction has had different consequences for the various research councils because the science vote, despite being voted on as a single budget item, is allocated to five 'mother' departments as funds earmarked for the councils. Departments have been allowed to exercise discretion on where the cuts are applied.

The Foundation for Research Development's R16 million allocation for new equipment in the universities has been cut to R6 million. The largest council, the Council for Scientific and Industrial Research, has been notified of a 5.5 per cent cut to its budget, and the Agricultural Research Council will have its budget reduced by slightly less than this. The three smaller councils — including the Medical Research Council — appear to have escaped the knife. Michael Cherry