SPACE SCIENCE

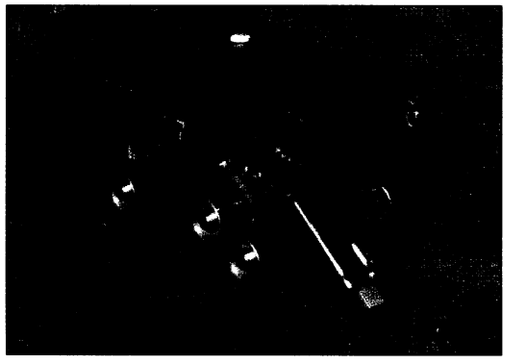
Mars 2001 Mission Hits the Wall

PASADENA, CALIFORNIA—NASA's exhortation to design and build "faster, cheaper, better" space missions may be losing its incantatory power. There are signs that the phrase might turn out to be a recipe for a one-time-only step change in the cost of single missions rather than a way of continually improving whole programs, especially those that need new technologies. Last month researchers gathered here* learned that NASA's Mars program is starting to have real difficulties with the mantra and that the Mars mission for 2001 is in serious trouble.

The idea of faster, cheaper, better was a reaction to multibillion-dollar planetary missions that took decades from conception to data analysis. The early results looked good. In the past few years, NASA Administrator Dan Goldin has touted the accomplishments of the first three launches in NASA's Discovery program of small planetary missions: Mars Pathfinder, Lunar Prospector, and the Near Earth Asteroid Rendezvous mission. Last month's meeting showcased some of the results, along with information on a dozen upcoming missions of similar scale. "It's great to see graduate students working with data that's 12 weeks old, not 12 years," said Wes Huntress, NASA's outgoing associate administrator for space science.

Yet recent problems have focused attention on the limits of Goldin's philosophy. The Earth-observing Lewis spacecraft failed in orbit last year, while its sister satellite Clark was canceled this winter because of cost overruns and schedule delays (*Science*, 6 March, p. 1443). And 3 weeks ago, technical problems forced NASA to delay by 3 months the scheduled July launch of Deep Space One, the first of the New Millennium program missions intended to try out groundbreaking technologies in the course of flying past an asteroid, a comet, and Mars.

Now problems have struck the Mars program, still basking in last year's spectacular performance by Mars Pathfinder. The proposed 2001 mission, budgeted at $400 million for 15 instruments on three vehicles—orbiter, lander, and rover—is in trouble. One major snag is delays in completing the rover on time and within budget: It's bigger and needs a more robust power source than Sojourner, Pathfinder's rover, as well as a drilling arm to collect samples. As a result, there is talk of dropping it from the mission altogether. "Our commitments on the 2001 mission have got out of line with the resources available for it," says Carl Pilcher, NASA's head of solar system exploration.



NASA/JPL

Bumpy path. Fiscal and technical problems could ground rover planned for Mars 2001 mission.

Earlier parts of the program met their cost goals by using existing technology, says Donna Shirley, who ran the Pathfinder rover program and now manages the team implementing NASA's Mars strategy at the Jet Propulsion Laboratory in Pasadena. She notes that Mars Global Surveyor, launched in 1996 at a cost of $260 million, was able to take advantage of its inheritance from the last of the old-style missions, the $980 million Mars Observer, which was carrying seven instruments when it apparently exploded during its approach to Mars in 1993. And this year's two Mars missions, delivering 10 instruments including a pair of nifty little 4-kilogram penetrators produced by the New Millennium program for less than $300 million, are using commercial technology, as well as taking advantage of spares from the recently launched Cassini mission to Saturn. At the same time, says Shirley, the 2001 mission is as technically demanding as the much higher priced Cassini or the Galileo mission to Jupiter.

There are various initiatives under way at NASA to develop new technologies, but none will be ready by 2001. In any case, says Shirley, unmet technology needs are a symptom, not a cause, of the problems with the Mars program. The Mars program was conceived as a set of missions meant to culminate in a sample-return mission in 2005, she notes, not as a way to deliver as much science as possible at every opportunity. "Yet each mission is [viewed as] the last ship out of port, and everybody wants to jump on it," she says. "You end up having to redesign your spacecraft after you get your instrument payload." The way out of the problem, say Shirley and Pilcher, is to sacrifice individual gratification for the common good.

A faster, cheaper, better program cannot be all things to all people, any more than a single Discovery mission can. But it may be that the right management can apply the lessons of the Discovery missions—define your ambitions clearly and create a tight-knit team with the authority to make trade-offs in its pursuit—to whole programs. If so, then there should be life in faster, cheaper, better yet.

–Oliver Morton

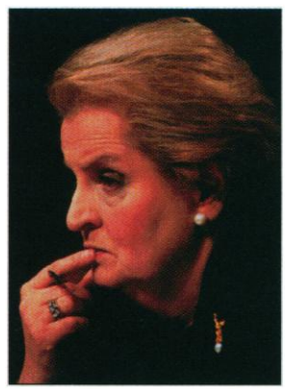
Oliver Morton is a writer in Greenwich, U.K.

* The third International Academy of Astronautics' meeting on low-cost planetary missions, 27 April–May 1, California Institute of Technology.

U.S. FOREIGN POLICY

State Department Sees S&T Weaknesses

India has more scientists and engineers than any other country in the world, and its decision this week to test three nuclear weapons (see p. 993) underscores its importance in global affairs. Yet last year, as part of a cost-cutting move, the U.S. State Department eliminated the position of science and technology counselor at its embassy in New Delhi. That action, combined with a major reorganization last year seen by some as downgrading the status of science in the department's bureaucracy, epitomizes what many scientists say is a chronic lack of concern for the role of science and technology (S&T) in shaping the country's foreign policy.



ROBERT TRIPPETT / SIPA PRESS

Sorry state. Albright is trying to remedy past neglect of science by the State Department.

After years of rebuffing such complaints, State Department officials now acknowledge there are shortcomings. They have asked the National Academy of Sciences (NAS) for suggestions on how to raise science's visibility, a step that veteran science hand William Golden calls a "breakthrough." But department officials warn that a continuing budget crisis may limit their ability to put more emphasis on science.

U.S. researchers have long complained that State fails to support international R&D efforts adequately. A 1992 report by the Carnegie Commission on Science, Technology, and Government concluded that science too often is used as "a bargaining chip

to achieve an underfunded, cobbled together, disappointing technical exchange." This spring, former Energy Secretary James Watkins told the House Science Committee that "if anything, the situation has worsened" since then. In particular, Watkins says State's lack of interest was a factor in the country's failure to obtain more international support for the canceled Superconducting Super Collider and the precarious status of the current International Thermonuclear Experimental Reactor.

But department officials say a lack of congressional support for its activities has been a more significant factor. Its Bureau of Oceans and International Environmental and Scientific Affairs (OES)—which oversees international S&T agreements and works on multilateral negotiations in areas like climate change, toxic waste disposal, and biodiversity—has been asked to do more in recent years with a slightly declining budget. OES officials say their workload has increased 84% since 1992, while special program funds—for efforts like an initiative to protect the world's coral reefs—have dried up. Moreover, in a scramble to lower costs, many embassies have eliminated some S&T positions like the one in India. "These positions are like cultural attachés—they are always the weak members, always vulnerable," says one State official.

A year ago, former OES chief Eileen Claussen caused an uproar when she eliminated the position of deputy director for science, technology, and health and shifted the bureau's focus to environmental matters. Watkins called the move a clear sign that international science was receiving too little attention (*Science*, 1 August 1997, p. 650). That criticism led Timothy Wirth, then under secretary of state for global affairs, to defend the move as "shift[ing] the responsibility for science to a higher level" through creation of a new principal deputy position (*Science*, 29 August, p. 1185). But critics say that deputy is responsible for far more than just science and technology.

Despite State's assurances of science and technology's worth, advocates like Watkins and Golden [who serves on the board of the American Association for the Advancement of Science (AAAS), which publishes *Science*] have continued to lobby for change. Last month their efforts began to bear fruit. First, State Department Counselor Wendy Sherman wrote to NAS President Bruce Alberts asking for a study of the contributions science can make to foreign policy and "how the department might better carry out its responsibilities to that end, within its resource constraints." She noted that "we may not be doing as much in the science, technology, and health areas as we can." Then Thomas Pickering, under secretary for political affairs, told an audience at the annual AAAS R&D colloquium that he "shared their concern." He acknowledged that "science has taken a heavy hit" as a result of budget cuts.

The NAS study is being coordinated by John Boright, a former OES science deputy and now chief of the NAS's international office. A first meeting is tentatively slated for late June, with a report by the end of the year. Panel members also will meet this summer with senior State officials. Pickering said the NAS review "will help us make decisions and evaluate options," including organizational changes to strengthen science and technology.

Science and technology advocates say they hope the panel will recommend the appointment of a science counselor and a science advisory board reporting directly to the secretary. In a gesture to the S&T community, Secretary of State Madeleine Albright announced last month that she would appoint a special coordinator for global climate change. Pickering, meanwhile, says he's hopeful that State can increase the number of S&T counselors abroad and make State more science literate. But he warned that fiscal problems are "very, very serious."

By soliciting the views of senior State officials like Pickering, researchers and NAS and State officials hope to raise the visibility of the academy's report. Still, they expect an uphill battle to give science a higher profile in a diplomatic culture notably lacking in scientific expertise.

–Andrew Lawler

GENOME SEQUENCING

German Biotechs Form Gene Venture

Bold new genome sequencing ventures seem to be all the rage these days. Shortly before Perkin-Elmer shook up the U.S. genome community last week by unveiling plans to sequence the entire human genome (see p. 994), five German biotechnology companies announced that they have agreed to band together with the aim of becoming "one of the three leading European [commercial] players" in genome sequencing and bioinformatics. The collaboration, dubbed the "Gene Alliance," is offering the companies' combined services on "large-scale genome analysis projects" to customers in the pharmaceutical, agricultural, and food industries.

QIAGEN	Düsseldorf
AGOWA	Berlin
Biomax Informatics	Munich
GATC	Konstanz
MediGenomix	Munich

SOURCE: GENE ALLIANCE

Andreas Düsterhöft, a molecular biologist and business unit manager with the largest of the five partner companies, QIAGEN, who helped put together the Gene Alliance, claims that the Alliance firms have a total sequencing capacity of 160 million bases per year of raw data. That is about half the projected capacity of France's new Genoscope sequencing center near Paris (*Science*, 3 April, p. 30). Aside from large-scale sequencing, the Gene Alliance's projects are expected to focus on genome mapping and library construction, as well as detailed sequence annotation. In terms of its collaborative structure, "there is nothing quite comparable to the Gene Alliance anywhere else," says Düsterhöft.

Researchers involved with the five companies note that most of them have already worked together on several European Union–funded sequencing projects, an experience that was crucial in the formation of the Gene Alliance. These projects included the first sequence of a gram-positive bacterium, *Bacillus subtilis* (*Science*, 25 July 1997, p. 478), and the first complete sequence of a member of the eukaryote family of organisms, *Saccharomyces cerevisiae*, or brewer's yeast (*Science*, 26 April 1996, p. 481).

"These firms knew they could work together because they were all involved in the academic part of the yeast sequencing project," says H. Werner Mewes, a biochemist and bioinformatics expert who directs the Munich Information Center for Protein Sequences. Along with two other Max Planck Society scientists, he co-founded Alliance partner Biomax Informatics. Says Düsterhöft: "The public funding we have received for genome projects over the last few years has helped all of

Saccharomyces cerevisiae	Brewer's yeast, first complete sequence of a eukaryote.
Schizosaccharomyces pombe	Yeast, ongoing
Arabidopsis thaliana	A small, flowering weed of the mustard family and model plant organism, ongoing
Bacillus subtilis	First sequence of a gram-positive bacterium
German Human Genome Project	Full-length complementary DNA sequencing

SOURCE: GENE ALLIANCE