

still isn't operating at anywhere near full capacity.

Most board members prefer to talk about the accomplishments of the past year rather than the turmoil of the year before. Credit for much of the progress, say board members, goes to Joseph F. Traub, who took over the presidency last November. A canny negotiator, Traub worked out a deal with Control Data under which the second Cyber 205 is essentially free—the center is responsible only for site preparation and electric power. He also wangled new financial arrangements for the ETA-10 that take into account the slow progress in developing software for the machine.

But Traub never got to do the job for which he was hired. Instead of making von Neumann a top supercomputing center, he quit unexpectedly, for personal reasons, he declares, to return to his post as chairman of the computer science department at Columbia University. He prefers life on a vibrant university campus, he says. Although only a few miles from the main campus of Princeton University, one of the consortium members, the von Neumann center lacks the continuous stimulation of scientific and cultural activities. The other four NSF centers are on bustling college campuses. To make up for this lack, Traub says, the consortium must create an "invisible college" that will provide the infrastructure to attract and retain top scientific and computer experts. One way to do that, he suggests, would be to offer programs in such fields as molecular modeling to attract leading people. Some board members disagree with Traub's ideas and approach.

When the Science Board met on 20 August, members were told that Doyle D. Knight, a von Neumann trustee and professor of mechanical and aerospace engineering at Rutgers, had agreed to become president of the center.

Research changes. The computeriza-

tion of scientific research is one of the most dominant changes in university research work. Erich Bloch, NSF's current director and himself a former computer engineer who managed IBM's 360 program, is convinced that supercomputers will change the course of some research forever. "Predicting the future is always risky," he asserts, "but I already see that computational research is practical and productive in such fields as physics, biochemistry, aeronautical engineering and atmospheric science."

For example, Michael G. Rossmann, a Purdue biologist, has used NSF supercomputer time on Purdue's machine to simulate the structure and behavior of human rhinovirus 14 in his study of common cold viruses. Rossmann claims he was able to do in one month on a Cyber 205 what might have taken ten years of laboratory work. Another example involves computational simulation of interactions among vehicle emissions, meteorology and chemistry in the Los Angeles basin. Gregory J. McRae and his colleagues at Carnegie Mellon solved more than a half-million coupled, nonlinear partial differential equations on the Pittsburgh center's X-MP/48 to determine that conventional emission control technologies are likely to be extremely expensive and not particularly effective in altering ozone and NO_x concentrations in such cities as Los Angeles, Houston and New York. McRae's group suggested using methanol in cars and trucks instead. Various agencies in California and the US Environmental Protection Agency are working together to advance the introduction of vehicles that would use methanol as well as gasoline to reduce air pollution in the Los Angeles area.

Electronic networks. NSF funding of investigators using supercomputers has increased with the expansion of electronic networks to greater numbers of universities and private companies. For instance, CSNET, which is run by

Bolt, Beranek & Newman in Cambridge, Massachusetts, connects Apple Computer Corp, Bell Communications Research, Emory University, Hewlett-Packard Labs, IBM Research and Rice University, among others, with more than a dozen additional networks. The networks are linked to the NSF centers and the National Center for Atmospheric Research (see map, page 61).

The foundation is taking steps with additional research implications. One innovation involves a system called EXPRES (Experimental Program of Remote Submission), which will enable researchers to transmit grant proposals to the agency by electronic mail. Another relates more directly to computer research. On 27 August NSF announced five-year projects at five universities to establish and enhance various experiments in computer or information science and engineering research. In this program the University of Washington will get \$827 000 to advance understanding of memory multiprocessors and to design a networked multiprocessor with workstations. Princeton University will use its initial NSF grant of \$549 000 plus university funds to set up an experimental computer science program in programming languages, graphics, very large-scale integration algorithms and algorithm animations. Purdue University will get \$867 000 the first year to devise mathematical software and tools to stimulate geometric modeling. Georgia Institute of Technology will receive \$708 000 for its Clouds Project, which is designed to develop a distributed object-based computer system. Rice University is to get \$844 000 to create a parallel software laboratory called PARASOL, which is intended to support studies of the fundamental nature of parallel computing and applications to problems of importance in software engineering and scientific computing.

—IRWIN GOODWIN

Ride report: Charting the nation's future course in space

What happened to the nation that went first to the Moon and clearly dominated the exploration of the Solar System for more than two decades? A thoughtful answer to that question came on 12 August in a 63-page report by Sally K. Ride, the first US woman in space, who holds a PhD in astrophysics. Her report, based on a study conducted over 11 months with the help of a half-dozen unnamed members of NASA's new Office of Exploration, was commissioned by the agency's administrator, James C. Fletcher. Bearing the

straightforward title *Leadership and America's Future in Space*, it is the most comprehensive recent effort within NASA to chart long-range directions for the nation's space program. Along with setting the course, the Ride report, as it is referred to at NASA, carries a disquieting message: The US space program lacks leadership, direction and, possibly most troubling, capability.

The report is certain to stoke the fires already burning in Congress on the space program. While it is ad-

dressed to NASA's management, the report serves notice that revitalizing America's space enterprise will require the commitment and support of the White House and Congress. Neither, says the report, has provided any coherent policy for a sensible and systematic program to explore space since the Apollo project began more than a quarter of a century ago. Worse still, NASA's program has been drifting aimlessly while the Administration and Congress debated whether to build a fourth orbiter to replace Challenger,

how to pay for a space station whose cost estimates go up every time the project is examined and what type of launch capability is needed to loft the scores of military and civilian satellites that are now grounded. Amid such furor, there is little national agreement about where the space program ought to be by the year 2000 or what NASA should do now to get there. "Without an eye toward the future," says the report, "we flounder in the present."

Serious losses. Indeed, what distinguishes the new report from the plethora of academic reviews, Congressional hearings and other examinations, such as the National Commission on Space and the Presidential Commission on the Space Shuttle Challenger Accident, is that it comes to grips at last with both the symbols and realities that disintegrated when the Challenger blew up on 28 January 1986—the loss of national pride, technological prestige and scientific leadership in space.

"The US civilian space program is now at a crossroads," the report states in its preface. After all the Ride panel's interviews among NASA officials and within the scientific community, two fundamentally inconsistent views emerge: "Many people believe that NASA should adopt a major visionary goal. They argue that this would galvanize support, focus NASA programs and generate excitement. Many others believe that NASA is already overcommitted in the 1990s; they argue that the space agency will be struggling to operate the space shuttle and build the space station and could not handle another major program."

Ride, who left NASA at the end of August to take up a fellowship at Stanford University's Center for International Security and Arms Control, had been asked by Fletcher to examine four possible space missions that might be undertaken in addition to already planned missions. She was told to avoid reopening the debates over the fourth orbiter and space station, even though these are key considerations for future ventures in space—if for no other reason than they would require large expenditures of money and talent that might otherwise go toward voyages of scientific exploration. The four missions Ride was asked about are:

- **Mission to planet Earth:** a series of orbiting platforms to study global processes and predict changes in the Earth's atmosphere, oceans and other life support systems. "This initiative represents an important opportunity for the US to exercise leadership in an increasingly significant area.... It shows a recognition of our responsibility to our home planet."

- **Exploration of the Solar System:** a

set of scientific missions including a rendezvous with the comet Tempel 2, a closeup flyby of Saturn and an unmanned study of Mars that would return a sample of the planet's surface. Noting that these have already been urged by a NASA advisory group, the Ride report says this initiative "offers opportunities to exercise leadership in the international arena.... Planetary exploration must be solidly supported through the 1990s."

- **Outposts on the Moon:** an initiative that would "send the next generation of pioneers to pitch their tents, establish supply lines and gradually build a scientifically and technically productive outpost suitable for long-term habitation." It would build on the legacy of Apollo, beginning with robot explorations in the 1990s and landing astro-



RIDE

nauts on the lunar surface in the year 2000. The first steps toward "living off the lunar land" would require extracting oxygen for propellants and life support systems as well as using the Moon's surface for construction materials. By the year 2000 astronauts would be able to stay the entire lunar night (14 Earth days), the report suggests, and by 2005 an outpost would be built to support at least five people for several weeks at a time. Ride's timetable calls for as many as 30 people living and working productively on the lunar surface for months at a time by 2010. "It is not absolutely necessary to establish this steppingstone, but it certainly makes sense to gain experience, expertise and confidence near Earth first," the Ride report declares.

- **Humans to Mars:** a "quick-sprint" mission to land an American on the Red Planet early in the 21st century and, after several more manned expeditions over a period of a decade, establishing a permanent base—the only

approach that the Ride group was asked to evaluate. Although her report admits it would be "a great national adventure," Ride argues that it would require a massive immediate national commitment and an approximate tripling of NASA's budget during the mid-1990s, possibly overwhelming other NASA projects, such as the space station and scientific spacecraft.

Instead, to the surprise of many, Ride's report calls on the agency to return to the Moon. NASA, it asserts, "should not rush headlong toward Mars." This recommendation is bound to be controversial in political circles, as well as in the scientific community and among the wider public, particularly after all the attention a mission to Mars, perhaps mounted jointly with the Soviet Union, received in Sunday newspaper supplements and television talk shows, even before the Challenger catastrophe.

Crash landing. The report warns that a crash project to Mars could easily turn into another "one-shot foray or political stunt" that loses public support and leads nowhere, similar to the Apollo Moon program. "It would not be good strategy, good science or good policy for the US to select a single initiative, then pursue it single-mindedly." For a few years a debate has been waged between those advocating a return to the Moon as a way station to the planets and those scientists and groups such as Carl Sagan and the Planetary Society, that plead for the more dramatic goal of sending astronauts to Mars. The Ride report comes down cautiously on the side of lunar-base enthusiasts, suggesting that manned exploration of the Moon is technically within NASA's grasp and would be a critical step if Mars is to be an ultimate goal. Ride sees a full-scale human odyssey to Mars as technologically risky and as likely to cause massive distortions in the space budget for the next 25 years. "Settling Mars should be our eventual goal, but it should not be our next goal," the report declares.

NASA's Fletcher, who has expressed support for a new manned mission as soon as possible, praised the Ride report but did not indicate it would be a blueprint for the future. Instead, he said that it will be used as a basis for further study and that the agency will not necessarily adopt all its recommendations.

Additional study of America's future in space also has occupied other agencies in the executive branch. For instance, the Office of Science and Technology Policy, which has yet to issue its long-awaited response to the 1986 report by the National Commission on

Space, recently began another review of space policy in conjunction with the National Security Council. Last July members of the House subcommittee on space science and applications criticized OSTP for giving little guidance or support to Fletcher and NASA. It is no secret in Washington that OSTP's director, William R. Graham Jr., has been at odds with Fletcher on NASA policy. Graham had suffered a frustrating period at NASA just prior to and immediately after the Challenger tragedy when he found himself elevated to acting administrator after James M. Beggs was forced out. Beggs had been indicted in a case involving a General Dynamics contract. When Fletcher was reappointed last year to head NASA—he served before in 1971–77—

one of his first decisions was to remove Graham as his deputy. Their differences became apparent recently on ABC TV's "Nightline" program when Fletcher admitted to Senator John Glenn, the Ohio Democrat who was the first American to orbit the Earth, that he and Graham are effectively out of touch on most space matters. In the circumstance, it is not likely that the Ride report will lead to meaningful corrections that will put the space program on course in the remaining 15 months of this Administration. What some observers believe will happen during this period of internecine warfare between NASA and OSTP is that the Defense Department will dominate the space frontier.

—IRWIN GOODWIN

Washington Ins and Outs:

Musical chairs at NASA and Smithsonian

Since the Challenger shuttle tragedy on 28 January 1986, NASA has experienced about a 60% turnover at its upper management levels. Of 33 NASA offices and other headquarters units that report directly to the administrator, now James C. Fletcher, 21 are headed by new managers since the Challenger explosion.

Musical chairs is apparently one of the games played at NASA's highest reaches. Among the latest changes:

Frank B. McDonald returned in August to NASA's Goddard Space Flight Center, which he left in 1982 to become the agency's chief scientist at headquarters. At Goddard, he is associate director and chief scientist. McDonald, who got a PhD from the University of Minnesota in 1955, taught physics and astrophysics at the University of Iowa before joining NASA in 1959. He was chief of Goddard's high-energy astrophysics laboratory and project scientist for the Explorer satellite series and the high-energy astronomical observatory.

On 22 June, **Noel W. Hinners**, who had been Goddard's director, became associate deputy administrator of the agency's management matters—a new position originated on the recommendation of an internal NASA management study group. In this job, Hinners is boss of bosses over some 22 000 NASA employees at all nine field centers, whose R&D budgets in fiscal 1987 ranged from \$12.5 million at the National Space Technology Laboratories to \$656.9 million at the Marshall Space Flight Center. Upon McDonald's departure, Fletcher named Hinners NASA's chief scientist.

After receiving his PhD in geochemistry and geology from Princeton Uni-

versity in 1963, Hinners climbed the career ladder at Bellcomm Inc, where he eventually headed the lunar exploration department. In 1972 he joined NASA as director of lunar programs, and in 1974 he became the agency's associate administrator for space science. He left NASA headquarters in 1979, striding across Independence Avenue in Washington, DC, to be director of the Smithsonian Institution's National Air and Space Museum. In 1982 he returned to NASA's fold as director of the Goddard Center.

The day Hinners departed Goddard, **John W. Townsend Jr** arrived to direct the center. Townsend had been executive vice president for corporate development at Fairchild Industries, in suburban Washington, DC, but he was no stranger to NASA or to Goddard. After getting an MA in physics from Williams College in 1949, he began working at the Naval Research Laboratory. He left in 1958 when his branch, which was responsible for the Navy's troubled Vanguard Project, shifted to the newly organized space agency. Townsend was appointed chief of NASA's space science division. A year later he became assistant director for space science and satellite applications at Goddard, and in 1965 its deputy director. In 1968, he was named deputy administrator of the Environmental Science Service Administration in the Commerce Department; when ESSA was absorbed into the National Oceanic and Atmospheric Administration in 1970, Townsend was appointed associate administrator. He ended 30 years of government service in 1977 to go with Fairchild, and he returned to NASA after only a decade.

Anthony J. Calio left the Commerce Department's National Oceanic and Atmospheric Administration in September to become senior vice president for management and operations at Planning Research Corp, a consulting firm in McLean, Virginia. Calio, who did graduate work in physics at Caltech in the mid-1950s, was a nuclear physicist at Westinghouse's Atomic Power Division and American Machine and Foundry before he joined NASA in 1963. Until 1984, he held a variety of jobs there, including deputy associate administrator for space science and associate administrator for space and terrestrial applications. He went to NOAA in 1985.

The Smithsonian Institution's National Air and Space Museum, which attracted some 9 million visitors last year, also attracted a new director on 17 August when **Martin O. Harwit** came on board. Harwit, an astrophysicist, was chairman of the astronomy department at Cornell University from 1971 to 1976, as well as professor of astronomy and codirector of the History and Philosophy of Science and Technology Program. Born in Prague, Harwit earned a PhD in physics from MIT in 1960. In the following decade he established research groups at the Naval Research Laboratory and Cornell that built the first telescopes cooled to liquid helium temperatures. These were launched by rockets to detect infrared radiation above the Earth's atmosphere.

Next 1 January, **Robert Hoffman**, director of the Smithsonian's National Museum of Natural History, will become the institution's assistant secretary for research—an important post for oversight of such research facilities as the Smithsonian Astrophysical Observatory (operated jointly with Harvard University) and the Smithsonian Environmental Research Center, as well as the organization's Office of Fellowships and Grants. Hoffman succeeds David Challinor, who served in the job for more than 20 years.

A zoologist who got his PhD from the University of California at Berkeley in 1955, Hoffman taught and served as associate and acting dean of arts and sciences at the University of Kansas until he was appointed director of the Natural History Museum last year. He has considerable experience in international science policy, having served on the US-USSR Joint Commission on Science Policy for the National Academy of Sciences between 1974 and 1982. Earlier, from 1970 to 1975, he was a member of the NAS advisory committee on the USSR and Eastern Europe. Hoffman speaks and reads Russian.

—IRWIN GOODWIN □