NEW BOOSTER TROUBLES DELAY SHUTTLE AS ADVISORY GROUPS BASH NASA

The latest series of troubles with the space shuttle's redesigned booster rocket have not yet resulted in the awful shock waves that followed the Sputnik surprises in 1957 and the Challenger calamity of 1986. But they are causing delays that are upsetting scientists, politicians and the wider public. The problems first appeared with the virtual disintegration of the outer boot ring of the nozzle that steers the booster rocket. The boot ring failure occurred during a test firing on 23 December at a range in Utah operated by the rocket's maker, Morton Thiokol Inc. Since then, NASA technicians have detected faulty welds in other parts of shuttle hardware—the aft skirts of the booster nozzle and the main engine turbopumps. The newest problems are unconnected to the booster O-ring seals that failed during the liftoff of Challenger. (See Richard Feynman's article on page 26.) Even so, the redesigned O-ring joints are undergoing additional ground firing tests before the booster is certified for the launch of the next shuttle, Discovery.

The flight of Discovery had been previously scheduled for 2 June, but the date has been postponed three times for mechanical problems—most recently on the eve of the anniversary of the Challenger explosion on 28 January to a so-called planning date of 4 August. The postponement practically eliminates any margin for error in scheduling several military and scientific missions. Three were planned for this year, including two secret flights for the Pentagon. US planetary scientists worry that the latest mishaps will place in jeopardy the long-awaited flights next year—notably the Hubble Space Telescope and the Magellan and Galileo missions.

Under the current schedule, Discovery will be rolled out to the launch pad at Cape Canaveral on 13 May and subjected to a readiness test firing of the main engines and other propulsion systems on 13 June. Processing the complete shuttle usually takes five months from the time all the segments reach the Cape until the launch pad countdown begins. NASA plans to speed up this procedure.

To be sure, if things go awry in Discovery's mechanical system, the shuttle could be delayed beyond 4 August. That would prevent the launching of the space telescope, which is still set to go on the sixth flight of the shuttle. Before the Challenger went down, the 2.4-m telescope had been waiting to fly in November 1986. After the Challenger accident, NASA's manifest called for the Hubble Telescope to go up in August 1988. Now it is scheduled for August 1989. Even on the ground, the telescope, built at a cost of $1.2 billion in 1984 dollars, runs up a bill of about $3.5 million per month more than what it takes to operate it in space. The cost increases in part because the mechanical components, such as gyroscopes, need to be "exercised" and its computers operated to keep tab on the whole complex system. Most of the added expense, however, is for engineers and technicians whom NASA's contractors cannot take off the job while the telescope is parked in storage.

On NASA's crowded manifest, Magellan is still marked for launching on 27 April 1989. It would begin mapping Venus by radar 16 months later. If it misses this launch "window," it will be 19 months before it could be outward bound again. Galileo, possibly the most sophisticated planetary probe ever built, was once scheduled to go up in May 1986. It is now expected to embark in October 1989 on a six-year voyage to Jupiter and its giant moons. When first proposed, Galileo's route would have taken it directly to Jupiter. Now its planners at Caltech's Jet Propulsion Laboratory have mapped a route that takes it by Venus, then hurtles it past Earth twice and swings it over both poles of the Sun, always gaining momentum from planetary gravity, on its journey to Jupiter.

Still another planetary probe, Ulysses, a cooperative venture with the European Space Agency, appears to be out of danger because its launch date of October 1990 is so far off. Ulysses is intended to whip around Jupiter, where it will be kicked by the planet's gravity into a polar orbit of the Sun.

Years of frustration

What is so frustrating to planetary scientists is that data from those robot voyages won't be in hand for years. "The way it is going, it will be the turn of the century before we get data back from some of these missions," observes Moustafa Chahine, JPL's chief scientist. The US has not sent a probe to the planets since Pioneer flew off to Venus in 1978. Space science would have been even more dismal and desperate if it hadn't been for the two Voyagers sent in 1977. In the heady Apollo years of the late 1960s, NASA scientists noticed that the planets would be in a rare position in the 1980s for some "grand tours"—first to Jupiter and Saturn, and then, as the spacecraft are affected by these encounters, redirected either out of the Solar System or past Uranus and Neptune. As it turned out, the Voyagers revealed so many surprises about the weird surfaces and satellites of Jupiter, Saturn and Uranus that planetary scientists remained busy and excited.

In political circles, few believe a shuttle launch is likely in 1988. Most reason that neither NASA nor the Reagan Administration nor Congress would dare put the lives of astronauts at risk during the political conventions this summer or just before the national election next November. After the nozzle problem came to light, Representative Manuel Lujan Jr of New Mexico, the top Republican on the House Science, Space and Technology Committee, said, "Experience tells me that . . . nobody in their right mind is going to launch just

before the Presidential election." Obviously riled by such remarks, NASA officials say they have assurances from the White House that no pressure will be applied to alter the launch schedule for political reasons. "The next launch of the space shuttle will be determined by one consideration . . . alone," NASA Administrator James C. Fletcher told news reporters in January. "We will fly when we are ready . . . when it's safe to do so and not before."

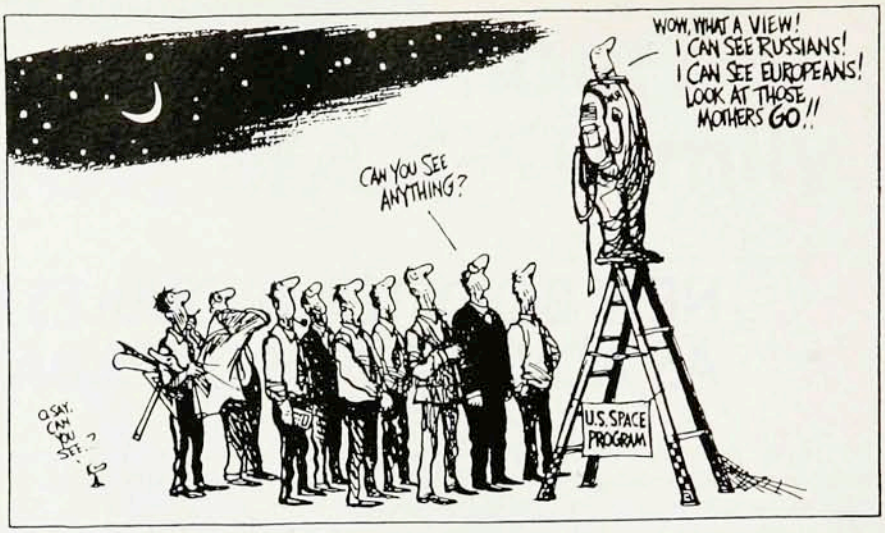
The shuttle crisis is, of course, only the most immediate limitation on US space research. Other, deeper, more persistent problems have been underscored recently by the Space Future Forum, called by Soviet scientists in Moscow last October (see page 69), as well as in a remarkably spunky report by a special task force of NASA's advisory council and a talk before the National Space Club last November by Representative Robert A. Roe, a New Jersey Democrat who heads the House science committee.

In his speech, Congressman Roe deplored the absence of any long-range goals for exploring or colonizing space once the US had set foot on the Moon. "We must establish our own goals," he said, "not adopt a knee-jerk reaction to the Russian program." He criticized NASA, the White House and Congress for not joining hands to shape attainable goals in space for the country. Roe argued that the decision to launch all US missions one way, by shuttle, "was where we went wrong in the first place. . . . But NASA bashing doesn't get us very far. . . . We've got to build some heavy-lift vehicles to reach into space—and build them fast. The goals determine the machines we need; the machines don't decide the limits to our ingenuity."

He and Congressman Lujan, said Roe, had sent a message to President Reagan urging him to declare that the US is prepared to join the Soviet Union in a mission to Mars. "I want to live long enough to know what's on Mars," said Roe, "and the only way we will fulfill my dream is in a cooperative program."

Common themes

The loss of US preeminence in space has been hammered at in dozens of hearings in Congress and in studies conducted by prominent specialists. Among the reports are those by the National Commission on Space, led by Thomas O. Paine, who was NASA's administrator when the first Americans landed on the Moon, Sally Ride's "Leadership and America's Future in Space" and the still-to-be-released "Space Science in the 21st Century," prepared by the National Research Council's Space Science Board, led by Thomas Donahue of the University of Michigan. One theme common to all the reports is the need for forcefully articulated goals for US space exploration reaching into the second decade of the next century and for an unreserved commitment to revitalizing the civilian program.



All the reports propose that NASA undertake a more ambitious mission to Mars than the Mars Observer project that it is developing for the 1990s, though none suggests that this necessarily should be done jointly with the USSR. When it comes to sending humans or just machines to Mars, however, the Donahue report concludes that robot devices are hardly adequate, though it admits that some committee members argue that the issue needs further study.

The message in these and in an internal report by a task force of the NASA Advisory Council is that the balance of leadership in space science is shifting rapidly to the USSR. The NASA task force, led by Herman Pollack of George Washington University, former director of the State Department's Bureau of International Scientific and Technological Affairs, visited six countries with varying competences in space and concluded that the US will face "aggressive" competition in commercial and scientific ventures in space by 1995.

The task force consisted of 15 members, including Richard DeLauer, former under secretary of Defense for research and engineering; Don Fuqua, until last year chairman of the House science committee; and John Naugle, a former NASA associate administrator for space science and applications. The adviser to the Pollack group was T. Keith Glennan, NASA's first administrator. Glennan was appointed to that post in 1958 by President Eisenhower, who expressed concern at the time that the new agency should be a strictly civilian enterprise, with no ties to the Pentagon's own ambitions and capabilities in space.

The Pollack report bears the title "International Space Policy for the 1990s and Beyond" and, not surprisingly, emphasizes cooperation with the Soviet Union and other nations in space exploration. Of its 11 recommendations, the one dealing with the USSR is last, though Pollack says the items are not listed by importance. The recommendation reads: "US space relations with the Soviet Union in the decade ahead should take the form of a flexible mix of competition, cooperation and collaboration, seeking synergism in scientific benefits and the avoidance of costly competitive distortions in US space priorities. The bars to the Soviet acquisition of militarily critical technology should not be dropped, but in the conduct of these relations the threshold of criticality should reflect a balance of all US national and international interests."

In its discussion of technology transfer, the task force declares that "a diligent search" uncovered no instance in which NASA's activities with the Soviet program led to any significant losses, contrary to repeated claims by the US intelligence community and the Defense Department. The report states, though, that "it is reasonably alleged that the Soviets did learn much [from the 1975 Apollo–Soyuz docking] about how the US manages large space programs." While admitting that the Soviets may have some access to US space technology "to the disadvantage of national

security," the task force sees it as more likely that this was gained by espionage, evasion of export controls and availability of open literature than by scientific and technical cooperation.

The Pollack report also recognizes that the Pentagon's attempts to dominate US actions in space "is far more serious than a simple struggle over turf." It observes that "the political battle between NASA and the DOD over the shape and scope of the US space program has already caused confusion in Europe, Canada and Japan over collaboration in the space station." Accordingly, the report urges the NASA administrator to take the initiative to establish with the Secretary of Defense new and workable terms for a productive relationship between their organizations.

Among the other recommendations is an eloquent appeal for top levels of government to provide "leadership in space as the product of excellence in goals and achievements rather than as an end in itself. . . . Unless a sense of purpose, vitality and long-term vision is restored to the US civil space program so that other nations find the US the most attractive partner for association and cooperation, they will be less interested in accepting US leadership."

—IRWIN GOODWIN

SEMATECH GROUP SELECTS AUSTIN, TEXAS, IN EFFORT TO REGAIN CHIP DOMINANCE

After a nine-month search for a suitable location for a research venture that would develop innovative ways of making semiconductors, the SEMATECH consortium announced on 6 January that it had chosen Austin, Texas. The decision for Austin ended a national shootout that came down to 13 finalists from a field that had originally attracted 135 sites in 34 states. Austin, which is already the home base of another electronics research cooperative, the Microelectronics & Computer Corp, was selected because the city offered an unused integrated circuit plant that had been built, in better times for US chip makers, by Data General Corp. Texas sweetened its bid with $68 million in state and university funds. Other factors in favor of Austin included a proposed new $20 million center seven miles north of the university campus for microelectronics and materials research, as well as MCC's presence, which provides a unique opportunity for synergism.

SEMATECH (a foreshortening of Semiconductor Manufacturing and Technology Institute) was conceived by top executives of major semiconductor firms during the industry's deep slump in 1986. The concept was backed in studies conducted independently by the Defense Science Board and the National Research Council as a way of sharpening the US edge to cut down Japan's startling growth in chip technology (PHYSICS TODAY, January, page 49). Since SEMATECH was launched last March, it has enlisted 14 top US companies, including such customary combatants in global electronics as AT&T, Digital Equipment, Hewlett–Packard, Intel, IBM, Texas Instruments, Motorola, National Semiconductor and Rockwell International. This group's goal is to develop state-of-the-art semiconductor manufacturing techniques that can be adopted by commercial companies. Members of the consortium would have first call on any successful production processes. All foreign participation in the venture is forbidden.

Congress appropriated $100 million in the Defense Department's fiscal 1988 budget for the consortium and has promised a similar sum for the next five years. SEMATECH's total annual budget is $250 million, which includes $100 million contributed by its member companies as well as something like $50 million from state and local governments, universities and other sources. The total cost of the project is figured at $1.5 billion through 1992.

Texas was a somewhat surprising choice because its offer of $68 million was modest in comparison with a $440 million package from Massachusetts, whose governor, Michael S. Dukakis, is campaigning for the Democratic nomination for President as a high-tech head of state. Some members of the SEMATECH board considered Massachusetts the front runner, though others favored Phoenix, Arizona, where several chip-making plants are located, and Research Triangle Park, near Raleigh–Durham, North Carolina. One reason for the intense competition is that SEMATECH is expected to employ 800 people, half from the member firms. Texas officials estimate that SEMATECH could create an additional 2100 jobs in related industries and services.

The idea of Austin as a high-tech center has been nurtured for decades by the faculty of the hometown university. One of the city's biggest employers, Tracor Inc, a maker of military electronics and analytical instruments, was begun in 1955 by three physicists and a mechanical engineer at the university. Tracor employees subsequently started some two dozen other companies in Austin, including Radian Corp, which produces robotics and waste management equipment, and Continuum Co, a developer of computer software. Then in the late 1960s, IBM became the first large corporation to set up a research and manufacturing center in Austin. After IBM was followed by Texas Instruments, Motorola, Advanced Micro Devices, Lockheed Missiles & Space Co and 3M Co, city officials spoke of Austin as another Silicon Valley or Research Triangle Park.

During this period, the University of Texas also grew. Its endowment is now more than $3 billion, second only to Harvard's. The university and private donors together set up 32 new faculty chairs, each endowed with $1 million or more, in physics and engineering, attracting such prestigious figures as Steven Weinberg, John A. Wheeler, Ilya Prigogine and Roman Smoluchowski. When the worldwide oil glut sent prices tumbling in the mid-1980s, the Texas legislature ordered the university to cut its spending to offset declining tax revenue from the oil industry. Last year, after the university lost some 30 professors, the cuts were restored.

SEMATECH's choice of Austin is likely to improve the area's chances of being a leading electronics producer. That Austin had the right connections on Capitol Hill also helped its chances. Jim Wright, the House Speaker, and J. J. Pickle, who represents Austin and is a leading member of the House Ways and Means Committee, both campaigned to oppose efforts to reduce or remove funding for SEMATECH during attempts last fall to hold down discretionary items in the fiscal 1988 Federal budget.

According to Charles E. Sporck, president and chief executive of National Semiconductor Corp and SEMATECH's chairman, the project will be operating by next fall. Its work will