

# Uncertainties Mark Space Program of the 1980's

*Space enthusiasts, suffering of late, want President Carter to speak up for imaginative programs*

*Problems with the space shuttle, described in Science on 23 November, have seriously weakened other programs of the National Aeronautics and Space Administration (NASA). The following article describes the agency's attempts in light of these problems to chart a path for its future, and a related article (p. 1288) outlines the special troubles ahead for planetary exploration.*

"What we see is a classic case of a program and agency in search of a mission." Nine years ago, then-Senator Walter Mondale used these words to describe the struggles of the National Aeronautics and Space Administration (NASA) to win approval for the space shuttle. Today, as the shuttle nears completion despite technical roadblocks, the words still ring true: NASA is in the midst of an identity crisis. Having successfully placed a man on the moon at the end of the last decade, NASA remains bewitched by the question, what next?

There is a growing realization that the shuttle was approved as the workhorse of the space program in the 1980's with little thought as to what work it would actually perform. Although its capabilities have been limited by design changes, its potential is still great enough to produce confusion and squabbling among NASA's constituents and planners. President Carter was asked almost immediately after his inauguration to step in and chart the agency's path, but to date he has refused to do so, and produced only an ordering of priorities without any commitments.

Lacking an outside mandate, NASA has repeatedly had its budget chopped by the Office of Management and Budget (OMB). Space enthusiasts on NASA's authorizing subcommittees have been unable to put back projects desired neither by the executive nor by NASA's legion of fiscal watchdogs and space critics. Although the agency's technical competence and morale is said to depend in part on a continuous string of new projects leading to space launches, no new projects were approved last year; with major cost overruns on the shuttle, NASA's new program requests for fiscal 1981 might all be rejected.

Cutbacks have been particularly severe in NASA's most basic scientific research—planetary exploration, whose slice of the NASA pie has been hovering around 5 percent for several years. Angelo Guastafarro, the program's director, notes that "we've had 22 planetary encounters in the last 10 years. We'll be fortunate if we can achieve seven or eight in the next 10." The only planetary encounter authorized at present is the Galileo orbiter and probe of Jupiter, which will not reach its destination until 1986 or later, given delays brought on by problems with the shuttle. The Pioneer and Voyager programs to orbit Venus, Jupiter, and Saturn will all have ended by fall 1981. Sam Dallas, a project manager of NASA's proposed imaging radar orbit of Venus, fears that during this 5-year hiatus in planetary encounters, "scientists and engineers will be forced into other areas, with talent lost to private industry or defense. It will hurt future recruiting, too, as graduate students look elsewhere for thesis topics." Larry Colin, deputy director of space sciences at NASA's Ames Research Center, says "We've got nothing to talk about but wishes and dreams. We'll see a grand-scale exodus from the field, with some of our best talent flying to the four winds."

The scientists are especially chagrined because, to the extent the hiatus is stretched out by the shuttle's inadequacies, it was all foreseen as early as 1975. Then, the National Academy of Sciences' (NAS) space sciences board, at the urging of Gerald Wasserburg of Caltech, recommended that "NASA maintain direct launch capability" (other than the shuttle) adequate for planetary programs, until the shuttle became fully operational. The advice was rejected, and the program is reaping the consequences now. Also, to the extent that the shuttle has eaten up money that would otherwise be available for divisions such as space science or applications, managers there have become embittered. The NAS space science board wrote in 1971, "It is clear that space science and applications by themselves are insufficient to justify the cost of developing the shuttle." As uncertainty grows concerning the uses to

which the shuttle may actually be put, this assessment seems borne out. There can at least be no dispute that the shuttle expense has set the chronology of anticipated science missions back by at least 5 years, and forced the outright cancellations of missions such as a lunar polar orbiter or a rendezvous with Halley's comet in 1986.

John Naugle, formerly NASA's top scientist and now an agency consultant, claims that the cutbacks, combined with the absence of a strong White House space policy, "have had a devastating effect on the morale of the agency." In contrast to the heady days when NASA's employees were almost spiritually motivated by the single purpose of reaching the moon before the Soviets, the agency is now in philosophical and motivational disarray.

Into what they claim is this breach of aggressive space leadership have stepped two senators who still share its passion, Senators Adlai Stevenson (D-Ill.) and Harrison Schmitt (R-N.M.), both of the subcommittee on science, technology, and space. Schmitt, who sprang into the Senate from his stint as an Apollo astronaut, comes by his space enthusiasm naturally; Stevenson's accrues largely from his position as subcommittee chairman. Both have introduced national legislation, cosponsored by 20 other senators, that would commit the United States to pursuit of specific goals in space. Stevenson's bill, the less ambitious of the two, orders continued research in communications and solar power satellites (*Science*, 23 November), stepped-up planetary exploration, and creation of a permanent office to operate so-called "remote sensing" satellites that use microwaves to survey land and water for government, private, and foreign clients. Schmitt's bill commits NASA not only to a program of remote sensing and satellite communications, but also to a space station or solar power satellite by the year 2000, and to additional manned planetary exploration (presumably to Mars) by 2010. Shrewdly, neither sponsor has attached a price tag to these goals.

Philip Handler, president of the National Academy of Sciences, backs the legislation, and suggests dire con-

sequences if it is not enacted: "We are doubtful that a coherent program can survive without a formal, long-term commitment; in the absence of such a commitment, if decisions were to be taken sporadically, each considered within the context of a single annual budget cycle, the losses to science could be substantial and of national proportions."

So far, his clarion call has fallen on deaf ears, and the legislation has moved nowhere. As a first step, Stevenson and Schmitt have agreed to work out a compromise, but with Stevenson's retirement from the senate next year, any momentum gained by then could slip away. Over in the House, where the committee often seems composed of would-be astronauts, and the chairman sits in the midst of smiling astronaut photos and plastic rockets enclosed in glass, the bills have not even been introduced. Concerted opposition from the White House and a lack of public support contribute to disinterest. White House science adviser Frank Press, expressing the official Carter policy in a statement that brings him toe to toe with Handler, told the Senate subcommittee that "it is more appropriate, I believe, that priorities be set depending on the promise of the science and technology available and the budget situation at a given time, rather than overspecifying now what the future needs will be."

This sentiment was not well received by the bills' sponsors. "I sense that this administration has as its objective reorganization, study, and restudy, and that is one of the reasons it is such a small achiever," Stevenson responded tartly. Schmitt added, "I can't tell from this [Carter's policy] where this country is headed in space, Frank. I just can't see it in there. Right now, the people that are going to have to carry out a space policy won't get anything out of this document other than a statement 'we're going to continue to look at it and then maybe we'll make some decision.'"

But Press knows that the senators have not got enough support to mount a serious threat to the President's deliberate nonpolicy. In the era of limits, space is perceived as well within the outer reaches of the earth's atmosphere; fiscal pressures fall particularly heavy on such high-visibility basic research. There is a tendency to approach each new space project leading to a launch as a new federal program, notes Guastafarro. And the programs are not small. The lead time to develop a technological base for the more complicated planetary missions has become stretched and the cost has gone up, to a point where planetary en-

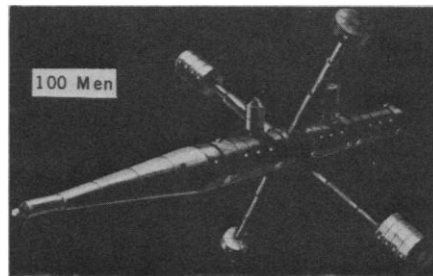
counters currently may require 10 years of planning and development, costing as much as \$500 million. Since flaws in the spacecraft obviously are beyond repair, the risks attendant to such large expense can be enormous. The \$95 million Seasat, launched into orbit last June to monitor ocean conditions, operated for 99 days before an avoidable electrical short ended its life 9 months too soon. With no huge manned program such as the Apollo behind which to hide, such failures in space science and applications achieve notoriety.

Thus, the task facing NASA becomes one of almost continuous salesmanship, both public and congressional, at which it has done especially poorly since Apollo ended. The agency, for example, spends enormous sums for public relations and on the graphic illustrations and simulations of space that one encounters everywhere throughout NASA's installations. But sales efforts work better with some programs than with others. Whereas Earth-orbiting satellites with direct and useful applications may be easy to sell, planetary exploration is really only large-scale, short-duration basic research. As such, it shares the vulnerability of all basic research. Charles Hall, who directed the recent Pioneer probe of Saturn from NASA's Ames Research Center, explains, "I can point to no immediate, tangible benefits from planetary exploration that are easy to get a hold of. You have to be honest with yourself. Some of the statements about applications will be hard to prove in the long run; controlling weather on Earth, for example, is obviously not possible." Hall adds that studies of ozone on Venus are an exception to this generalization, but that such exceptions are few.

Knowing this to be an obstacle, NASA's officials rarely attempt to sell the program as purely basic research. Noel Hinners, formerly NASA's top scientist and currently director of the National Air and Space Museum, notes that "even scientists don't understand that a lot of the space program is not being done just for science. If you were competing for all of the science money, you would never spend a billion dollars to do a Viking planetary program; it's not a pure kind of science trade-off." Instead, the engineers and scientists mention other values, few of them quantifiable in a benefit-cost analysis of the type fashionable at OMB.

The most prominent nonscientific goal that NASA used to crow about, for example, was technological and psychological dominance over the Soviets; this polemic fell victim, however, to the agen-

cy's clear, decisive 1969 victory and is rarely mentioned anymore. So officials such as Naugle now invoke the "basic need for challenging things to keep a society like ours healthy." As soon becomes evident with this sort of thing, many of the agency's directors suffer from what might be described as the intrinsic inarticulateness of men who climb mountains. "We explore the planets for more than just science," says Tom Young, the associate director at Ames. "The primary reason is new knowledge, but there is also the need to explore new



After the notorious Agnew report in 1969, NASA's goals for the 1980's included a space station (above) and a Mars base.

frontiers and the stimulation of national pride and prestige. But I don't want to sound like Madison Avenue." Perhaps feeling some inadequacies, the agency has recently recruited James Michener, the novelist; Norman Cousins, the longtime editor of *Saturday Review*; Ray Bradbury, the science fiction writer; and Jacques Cousteau, the underwater explorer—committed and eloquent space buffs all—to testify before congressional committees and the public about the value of its million-dollar science projects.

But even if the agency has learned *how* to sell, it still may not know *what*. The confusion stems in part from the fact that technical capabilities in space have outpaced the national ability to spend, so the choices are many and the decisions difficult. Compounding the problem is the inherent unwillingness of the agency's engineers to be practical. Bruce Murray, director of the Jet Propulsion Lab (JPL) in Pasadena, likes to say that "NASA has the only federal charter for institutionalized imagination." Unfortunately, the same imagination that results in impressive breakthroughs may also result in absurd ideas. Hinners notes "the agency is often pulled along by the dreamers, obsessed with the fascination of building these unusual things. The engineering gets done before one considers adequately the use to which it would be put." The shuttle is an example of this, he says. "Too often, it is very late in the

game that scientists are called in to see how they would use what is being built." The process only exacerbates scientist-engineer differences and leads to internal squabbling over what the agency ought to be doing.

The problem as it relates to NASA's lack of success at selling itself is twofold: One, the agency fails to present a unified, identifiable theme, and two, the agency's wild ideas have a way of bubbling to the top at almost exactly the wrong moments, demonstrating an em-



Mars base as envisioned in 1969.

barrassing lack of restraint. The agency is still living down the classic example, which occurred as long ago as 1969. In the midst of clamor for more attention to domestic troubles, a special commission led by Vice President Spiro Agnew produced a report that suggested building a 50-man space station, a manned base on the moon, a shuttlecraft that would run in between, and a manned flight to Mars by 1985. Reaction was so extreme that even today the agency is chary of discussing its badly desired unmanned mission to return a rock sample from Mars, a mission that would itself cost at least \$1 billion. Sam Dallas attributes the Agnew proposal to "simple greed, following the Apollo success."

It is not clear, however, that the agency and its constituents have taken his sentiment to heart: Many observers consider the contemporary example of the Agnew proposals to be the highly discussed solar power satellite, which may cost more than \$100 billion. Peter Glaser, an executive of Arthur D. Little, Inc., who holds a patent on the concept, explains that it was conceived as a competitor to the fast breeder reactor for power generation. He would like to see a pilot solar satellite plan completed by the mid-1980's, a prototype by the mid-1990's, and construction shortly after the year 2000. The project would require—at the least—severe modifications of the soon-to-be-completed shuttle. "Of course, we already know that the Soviets, the Japanese, and the British may be interested in building this if we don't," Glaser says.

Other thoughts prevail in Congress. Representative George Brown (D-Calif.), chairman of the House subcom-

mittee on science, research, and technology, cautions that "the program could totally devour all the effort, capital, and technology available to move forward in near space." Others feel it might devour the credibility of the agency's enthusiasts, on which much smaller proposals depend.

A particularly sharp critic of the proposal, and of the space community's other grand-scale ideas is Senator William Proxmire (D-Wis.), chairman of the appropriations subcommittee that must approve NASA's budget. Proxmire's views are more extreme than those of the members of his subcommittee, but his sentiments about NASA and its ideas are clearly shared by many. "I think the agency has its priorities wrong, much of the time," he told *Science* in an interview. The space telescope, a darling of the space astronomers that is currently nearing completion, "could have been built 5 to 10 years from now just as easily as today. The end of the universe will be there for a long time, and considering that light from outside the galaxy has already been traveling millions of years to get here, a few more years will not hurt. Every federal program is under great pressures, and NASA's are no different; as a spending priority, space pales in relation to education, transportation, or health. It's been a kind of fad, this intense competition with the Soviet Union. Then, when a huge bureaucracy was constructed to get us to the moon, it conceived of the shuttle just to save some jobs. I'd like to see it oriented in the most practical direction possible, probably in earth applications, and work that will increase productivity. Then we hear about the proposals for a Beverly Hills in the sky [Gerard O'Neill's space station]; to build anything like that would cost trillions of dollars."

Agency employees surveyed at three of NASA's centers almost uniformly derided such views as parochial. Fiscally conservative congressmen and budget planners at OMB were labeled nothing more than "bean counters." A common line, in which even new NASA employees are well tutored, is that NASA's budget has plenty of room for growth because HEW and several of the larger agencies spend the equivalent of its annual budget every week. Murray of JPL asserts that "the interest of the people in space exploration is enormous. The Washington process is a cynical one, and out of touch. It's just not popular to vote for imaginative things. Neither OMB nor Congress has a cubbyhole for imagination."

The only way to circumvent such

thinking, Murray continues, is for the President to speak out vigorously on behalf of the space program. "The President's the only one that can testify to it's viability. Carter believes in space exploration—the only problem is that he doesn't project this," Murray says. "As a southern preacher, he thinks we have to suffer for a better future, and he doesn't articulate the exciting opportunities. His policy is nothing more than a utilitarian program 8 years too late—it's the Republican space program. You can see that it was written by staff people. It lacks fire and pizzazz; what he doesn't realize is that the country's mood has changed."

Without more concerted attention at the top, Murray and his sympathizers are planning what any disaffected interest group would do in similar circumstances: to aggressively enlist grass-roots public support and to build a special-interest lobby on space to garner more federal funds. Lou Friedman, an advanced mission planner at JPL, is contemplating a 6-month's leave of absence to get the ball rolling. "I don't know that we want to influence legislation," he says, "at least not directly."

This might run afoul of proscriptions on political involvement by government employees. "What we'd like to do is increase the public's general level of interest." One idea he mentions is to broadcast the Galileo encounter with Jupiter as a miniseries on television, and ask viewers to nominate which of the planet's poles or moons they would like it to visit. "Out of ten to 20 encounters with the moons, we could give one or two to the public," he says. "Now I know that scientists may cry, 'oh Jesus, they picked the wrong one,' but I think it's important that space be considered a public program in the truest sense." Friedman says he is uncertain where the sponsorship would come from and leaves that as a detail to be worked out along the way.

Some might consider this an extreme reaction on the scientists' side, but there is widespread interest in building up a base of support that will insulate the agency from the vicissitudes of the annual budget authorization process. Several space scientists suggest the best way for this to happen would merely be for the agency to develop an integrated program of small-scale projects, and to forgo large shuttle-type expenditures. More money would then be available for earth-orbiting satellites, and planetary exploration, too. NASA has labeled the 1980's "A Decade to Learn." The question is, how painful a lesson will it be?

—R. JEFFREY SMITH

SCIENCE, VOL. 206