Planetary Science on the Brink Again

Researchers may be able to tide themselves over the shuttle-induced gap in data from spacecraft, but bigger problems loom in the 1980's

From 1982 through at least 1985, scientists will receive no new data from U.S. spacecraft visiting other planets. The major reason for this unprecedented lull in the exploration of the planets is the space shuttle and its gargantuan appetite for public money (*Science*, 14 December, p. 1284). Development costs, initially estimated at about $5 billion, are now expected to exceed $8.4 billion and other National Aeronautics and Space Administration (NASA) programs are suffering as a result. The squeeze from the shuttle should ease in a few years, optimists say, and the exploration of the solar system should regain some of its momentum in the second half of the 1980's. Others fear that planetary science even now faces a real threat to its continued health. That fear was underlined last week when word got out that the funding for NASA's next new mission, the first exploration of comets, is in trouble. Whatever the immediate outcome, everyone agrees on one thing: planetary scientists face a difficult uphill battle in the next decade of selling less glamorous but scientifically vital missions with ever-increasing price tags.

Several factors have worked together to reduce the number of planetary missions being initiated and to create the upcoming data gap. These include a general fiscal restraint and the strain on the goodwill of Congress created by the shuttle.

A more subtle but important cause of space program troubles, many say, is a decrease in the public's support of planetary exploration. Whether "public support" resides in the man in the street or in the halls of Congress and OMB is a matter of debate among planetary scientists, but generally enthusiasm for planetary studies would seem to have slipped during the 1970's. "We've done the exciting things well," says Geoffrey Briggs, deputy director of the Planetary Division of NASA, "and people seem to be starting to take things for granted."

Researchers are admittedly a bit mystified. They see no lack of spectacular discoveries or sound science, which supposedly create public support. The views of the orange, rock-strewn plains of Mars were stunning. The 6-kilometer-high volcanoes seen from the Mars orbiters seem nearly as striking as any imagined canals. And the recent mind-boggling tour of Jupiter and its satellites, especially the sulfurous inferno of Io, has had no parallel among planetary missions.

Scientists had hoped for similarly ambitious missions in the coming decade. The Space Science Board of the National Academy of Sciences–National Research Council has proposed goals for the next 10 years* that would require orbiters and landers at Mars and Venus, a lunar orbiter, and the possible return of samples from Mars. Jupiter, Saturn, and Uranus among the outer planets would receive particular attention. And a forthcoming report on strategies for the exploration of small bodies in the solar system may call for visits to comets and asteroids.

Such plans, Briggs observes, are now more appropriate for the next 20 years than for the next decade. What planetary scientists will actually get in the next decade, if all goes well in Congress and with the spacecraft, are two Voyager flybys of Saturn and one of Uranus (all of which are already en route), the Galileo orbiter and probe at Jupiter, a surface-mapping radar orbiter of Venus (called VOIR), and visits to Halley's Comet and Comet Temple II.

Although most planetary researchers see themselves in the midst of another funding crisis, few seem to know what to do about it. The planetary community met its most recent crisis, the imminent demise of the Galileo project in a congressional committee, with prompt attention that was credited with helping to save the day. The current crisis was unexpected. The next turning point in the planetary program, authorization of funding for further development of the new propulsion system for the Halley-Temple II mission (and many future planetary missions), approached with little fanfare. If the dual comet mission (which is preferred by scientists over separate missions) is to fly at all, support for the solar electric propulsion system (SEPS), better known as the ion drive, must be in the President's fiscal year 1981 budget in January.

Although NASA officials had been reasonably confident of receiving the SEPS funding, *Aviation Week* reported last week that OMB has killed it, leaving only an appeal to the President as an alternative. Even development of the booster, called the inertial upper stage, that would lift the SEPS and its payload out of Earth orbit is in trouble. Like the shuttle, it is reportedly experiencing cost and schedule problems. Without the SEPS, only the high-speed flyby of Halley's Comet would be possible, which by itself is seen as scientifically inadequate.

Part of the reason for the inaction by planetary researchers up to this point may have been that there was no clear idea of the minimum funding needed to maintain a healthy planetary science community. The 600 or so planetary scientists in the United States are now supplied with new data at a cost of about $200 million a year. If this is near the acceptable minimum, as some say, it could probably be maintained by the program that NASA hopes to follow in the 1980's. If Congress and the President do not cooperate by filling NASA's requests, planetary scientists and engineers might begin to disperse into other fields. Although the breakup of research teams is seen as undesirable, some observers point out that skilled engineers, who make it possible to collect the data without costly failures, may be a more critical commodity in any funding crunch.

Even if the Halley-Temple II mission funding and propulsion development go smoothly, investigators will still have to get through at least 4 years without new spacecraft data before the drought is ended. One way to get through this period, some suggest, is to analyze thoroughly the data that are already in hand or will be obtained shortly. "There's more data available than some people think," according to Timothy Mutch,

**Strategy for Exploration of the Inner Planets: 1977-87* (National Academy of Sciences, Washington, D.C., 1978); *Report on Space Science 1975* (National Academy of Sciences, Washington, D.C., 1976).

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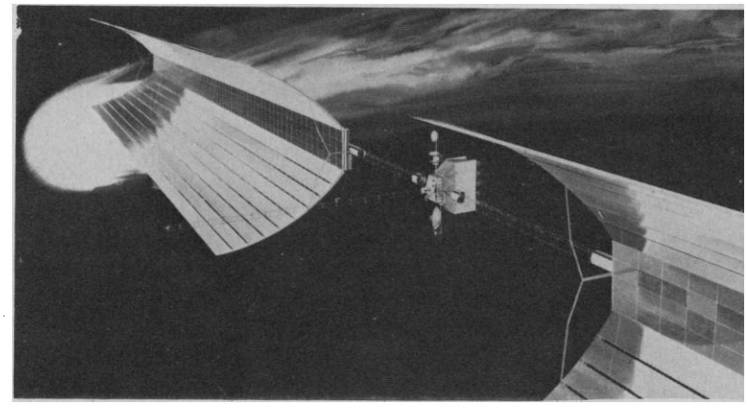
associate administrator of the Office of Space Science. Among the data that remain to be looked at in great detail are 50,000 images of Mars from Viking (more continue to be made) and about 18,000 images from each of the two Voyager flybys of Jupiter and its satellites. American and Soviet data from Venus are still being intensely studied, and an American global mapping project being carried out by the Pioneer Venus orbiter is not yet complete. In addition, the two Voyager spacecraft that provided a flood of data from Jupiter will arrive at Saturn in 1980 and 1981 with the cameras clicking. "We have more data than we know what to do with at the moment," one administrator concedes.

The strategy for analyzing these data is still being developed, but NASA planners are hoping to spread the work over the first half of the 1980's. At present, about $25 million is spent each year analyzing data returned by spacecraft. Most researchers agree that there will be a tremendous amount of data to analyze in the next few years, but many are worried that NASA will not be able to provide sufficient funds. That happened in fiscal year 1979 when Congress slashed NASA funding for moon rock analyses from $5.7 million to $1.0 million. The National Science Foundation took up some of the slack, but the total funding was still only $4.7 million, $1 million below the original request.

Spacecraft are not the only source of new planetary data. Geochemists will be analyzing more moon rocks, the meteorites recently found preserved in Antarctica, and cosmic dust collected in the stratosphere. Ground-based telescopes can be expected to continue to fill in where spacecraft are not, as in the 1977 discovery of the Uranian rings (*Science*, 5 October, p. 38) and the recent observation, in between Voyager flybys, of a volcanic eruption on Io. Telescopic observations will be supplemented by the Space Telescope, which should be in orbit by 1984.

The spacecraft data gap, no matter how severe it actually turns out to be, may not be the biggest problem the planetary science community has to face in the 1980's. Many scientists are concerned that NASA's string of glamorous firsts in the solar system cannot go on indefinitely. There will be fewer and fewer first pictures from orbit, first pictures from landers, and first samples returned, they say, while a tremendous amount of good but less spectacular science remains to be done. "We are the victim of our own success at firsts," says Noel Hinners, associate administrator for Space Science and now director of the National Air and Space Museum, "and there aren't many left to be done."

The Lunar Polar Orbiter is an example of the tug of war between firsts and less spectacular follow-up scientific work. Intended to expand the geochemical and geophysical findings of the Apollo missions to a global scale, the Lunar Polar Orbiter has been indefinitely shelved by NASA. Although relatively low-cost and widely regarded as scientifically important, it lost out in the next decade to the first comet flyby, the first probe of the atmosphere of Jupiter, and VOIR, which would provide the first clear images of the surface of Venus. The Lunar Polar Orbiter's greatest obstacle, according to one NASA official, was the amount of work already done on the moon. "The attitude seemed to be 'but you've already been there.' "



Artist's conception of a solar-electric-propelled spacecraft passing Halley's Comet. [NASA]

One thing that planetary scientists must accomplish if spacecraft are to continue to do good research, Hinners contends, is to educate the public and especially Congress and OMB about how science advances toward its goals. An example might be the exploration of Mars. With the first flybys, a fuzzy ball with light and dark splotches exploded into a panorama of towering volcanoes, gaping chasms, meteorite craters, and other terrains that could hardly have been predicted.

In addition to taking the public on fantastic voyages of exploration, those flybys and later orbiters and landers showed scientists that Mars is quite different from Earth. Mars has experienced a change in its climate, from wet to dry, far more dramatic than the coming of any ice age on Earth. The huge volcanoes of Mars show that its crust does not move about as Earth's does. And the martian changes in weather can throw a veil of dust over the entire planet, which in turn probably affects future weather. All of these phenomena add to our knowledge of Mars, researchers point out, but that knowledge is only the first step toward understanding why Mars evolved as it did.

Contrary to the view often given to the public through the press, such reconnaissance and exploration missions cannot answer the more basic questions that interest scientists—how the solar system originated and why the planets appear as they do today. Hinners fears that the simplification required to sell missions has distorted the picture of how and when those goals can be achieved. Only the moon and Mars have even entered an intensive phase of investigation, but it appears that they will be ignored in the next decade. The Space Science Board recommended extensive missions to Mars and the Lunar Polar Orbiter, but none of these missions is expected to be flown in the 1980's. Hinners and others believe that the expectation of applying new knowledge about other planets toward understanding Earth, while valid, has been oversold as well. "We didn't go to Venus and Mars to understand Earth, we went to understand Venus and Mars," he says.

In the absence of a specific national policy, planetary science is likely to hobble from one apparent fiscal crisis to another with uncertain results. "We've done the tough jobs well in the past," Briggs notes, "and now many seem to feel we can do it again anytime we feel like it. But it takes big teams of dedicated people. The risk is that they won't be as good next time."

A 4-year data gap is seen by most researchers as a strain that planetary science could handle. But these researchers agree that an indefinite hold on new projects, as threatened by OMB, would be a staggering blow. If OMB carries out its threat, the minimum funding needed for the competent exploration of the solar system may be found the hard way.

—RICHARD A. KERR