A Soviet Plan for Exploring the Planets

The Soviets are increasingly ambitious, while budgets have forced the Americans to move slowly; cooperation might help both programs.

At the 16th Lunar and Planetary Science Conference in Houston last March, a delegation of Soviet space scientists led by Valeriy Barsukov of Moscow's Vernadsky Institute gave a surprisingly detailed presentation of upcoming missions to Mars, to the Moon, and to the asteroid Vesta. Considering the Soviets' reticence about their space plans in the past, their candor in Houston was seen as a testament to their program's increasing confidence.

It also underscored the desire among scientists on both sides for a renewal of the U.S.-Soviet space cooperation agreement, which was allowed to lapse in 1982 after the imposition of martial law in Poland. Although data from planetary spacecraft have long been freely shared between the two countries on a scientist-to-scientist basis, many researchers believe that the productivity of both programs would be enhanced if they were planned and operated in a more coordinated way. The trick is to make it happen.

The Houston meeting struck an especially responsive chord among American scientists because it came at a time when the United States, for budgetary reasons, is restricting itself to a series of relatively modest planetary missions (*1*). "My perception is that [in recent years] the Soviets have gotten back into planetary missions in a serious way," says Geoffery Briggs, head of the National Aeronautics and Space Administration's (NASA's) planetary science program. "They've brought themselves up to the Voyager level, while we've been pulling our horns in, asking what you can do for Voyager-level costs. So the programs are now at a rough parity—which suggests to me that we can't afford to diddle around."

"If you just stand back and look at their program, abstracted from the individual missions," says Eugene Levy of the University of Arizona, former chairman of the National Academy of Sciences' Committee on Planetary and Lunar Exploration, "you see that it is well thought out and well planned. One has a sense that their program is animated by a policy that understands how to do science, that there has to be a sustained commitment."

The outstanding example of that commitment is Venus, where the Soviets have systematically been sending orbiters and landing craft for more than a decade; the landers have in turn sent back numerous photographs of the surface. (The U.S. Pioneer Venus mission in 1978 included one orbiter, which is still operating, and four atmospheric probes.) Most recently, in 1983, the Soviets placed a satellite equipped with synthetic aperture radar into orbit around Venus; the payoff was a detailed map of the cloud-wrapped planet's northern polar regions, showing a variety of volcanic and tectonic features.

"It was state-of-the-art radar data," says Briggs. The American response was to upgrade NASA's Venus Radar Mapper mission, which is a simplified version of an earlier radar mission to Venus canceled in 1981. As currently planned, the U.S. mission will cover virtually all of Venus at a somewhat higher resolution than the Soviet spacecraft, Briggs points out. Nonetheless, it will not fly until 1988, 5 years after the Soviets.

> "First you need to set up a framework for a relationship."

The Soviets' success at Venus, together with their good experiences in space collaborations with France and other nations, seems to have led to an increasing openness about their plans for future missions. "It's a long-term trend," says James Head of Brown University, who has close ties with Soviet space scientists. Much of the material presented at Houston, for example, had already been discussed last summer in Graz, Austria, at a meeting of the international Committee on Space Research (COSPAR). Nonetheless, the Houston meeting opened a lot of American eyes to just how far the Soviet program has come:

• The Mars/Phobos mission, scheduled for 1988, starts with two identical spacecraft launched into orbit around Mars. After some period of observing the planet itself, one spacecraft will attempt to match orbits with Phobos, the larger of Mars' two tiny moons. (Phobos, like the smaller moon Deimos, is thought to be a captured asteroid; it is less than 30 kilometers across, and its gravity is so weak that an astronaut could jump completely free of it with legpower.) Hovering some 50 to 100 meters from the surface, the spacecraft will use its television camera to record details on the scale of centimeters, while its laser and ion beams vaporize material for analysis by an onboard mass spectrometer. (One Soviet scientist jokingly rates the laser power at "10^{-8} Star Wars.") Meanwhile, a landing craft will descend the remaining few meters and will begin to hop from point to point, measuring x-ray fluorescence spectra and the physical properties of the rocks.

The second spacecraft will serve as a backup if the first fails at Phobos. If the first spacecraft succeeds, however, the second will be sent to repeat the process at Deimos.

The Mars/Phobos mission, which is already under development, will be the first Soviet mission to Mars since 1973. (The last U.S. mission was Viking, which placed two landers on the Martian surface in 1976.) As described, the new Soviet effort seems roughly complementary to the U.S. Mars Observer, a much simpler orbiting spacecraft that will study the planet's geochemistry and climate. However, the Mars Observer is not scheduled for launch until about 1990, 2 years after the Soviet mission. Recent congressional action for a NASA budget freeze may delay that even further.

• A Lunar Polar Orbiter, scheduled for launch in 1989 or 1990, will use a television camera, a gamma ray spectrometer, an infrared reflectance spectrometer, and ten other instruments to produce a geochemical map of the lunar surface. It will be the first Soviet mission to the moon since the the Luna 24 sample return mission in 1976.

Planetary scientists consider a surface map to be a critical element in understanding the origin and subsequent evolution of the moon. In fact, U.S. scientists tried three times to get such a mission approved in the 1970's, and three times it was rejected on the grounds that "You've already been to the moon."

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NASA currently has a Lunar Polar Orbiter penciled in for a new start in fiscal year 1988, with launch in 1992 or 1993. However, since the U.S. mission as now planned is almost identical to the Soviets', and 3 years later to boot, one has to ask whether NASA should rethink the whole thing.

"At this point nobody knows," says Briggs. "One question is how capable their payload will be." The United States still has the edge in spacecraft instrumentation, he points out. "The two key instruments for a Lunar Polar Orbiter—the gamma ray and infrared spectrometers—are quite tough; we've been spending a fair amount of money developing them in recent years." On the other hand the Soviet instruments may be perfectly adequate. In that case, NASA might want to upgrade the U.S. mission to include, say, a second satellite, which would relay precise tracking data from the far side of the moon and thus would allow for a much better analysis of the distribution of mass. The irony is that a two-spacecraft, joint U.S.-Soviet lunar mission was being discussed in 1982 when the cooperative agreement was allowed to lapse.

• The Vesta mission, unlike the other two, is still awaiting official approval from the Soviet government. As proposed, however, it would start with the launch of a single spacecraft toward Venus in 1991. The spacecraft would then split in two, with one portion continuing on to a rendezvous with the bright asteroid Vesta, where it would drop a landing craft to analyze and photograph the surface. The other portion would swing by Venus to drop an advanced landing craft before continuing on to another asteroid; this second lander would photograph the Venusian landscape from a height of several thousand meters during the descent.

Vesta, whose diameter of 550 kilometers makes it the third largest asteroid in the solar system, is in many ways the most intriguing of them all. Not only is it by far the brightest of the asteroids but, more important, its spectrum resembles that of basaltic lava, which suggests that it has been heated and geochemically differentiated. This makes Vesta unique: other asteroids, including the largest, 1000-kilometer Ceres, seem to consist of material that has remained unchanged since the origin of the solar system 4.6 billion years ago. "It's a basic intellectual puzzle in solar system science," says Levy: Why the difference? Is Vesta the core of a larger body that later broke apart?

The United States will attempt an asteroid flyby in 1986, when the Galileo spacecraft passes 29 Amphitrite on its way to Jupiter (*2*). However, the first U.S. mission to rendezvous with an asteroid is not scheduled until the mid-1990's. This raises the possibility of collaborating in the Soviet Vesta mission. (The Soviets are already said to be talking with the French about participating.) It is the only one of the three missions discussed at Houston that really has enough lead time to be a serious possiblity.

Yet collaboration seems unlikely without a renewal of the formal agreement on space cooperation. And the barriers to that are obviously formidable. Quite aside from the poor state of superpower relations in recent years, and the Reagan Administration's hard-line attitude on technology transfer, the U.S. planetary science community itself is split, with a vocal minority opposing any formal cooperation until the Soviet government improves its behavior on human rights.

On the other hand, the prevalent view in the community is that there is a lot more to be gained in the long run by formal cooperation in space. Moreover, an optimist could point to some glimmers of hope. On a scientist to scientist level, for example, the Soviets themselves seem more than willing. Witness their VEGA missions to Halley's comet: thanks to some quiet work by German intermediaries, the twin spacecraft carry dust detectors built by the University of Chicago's John Simpson.

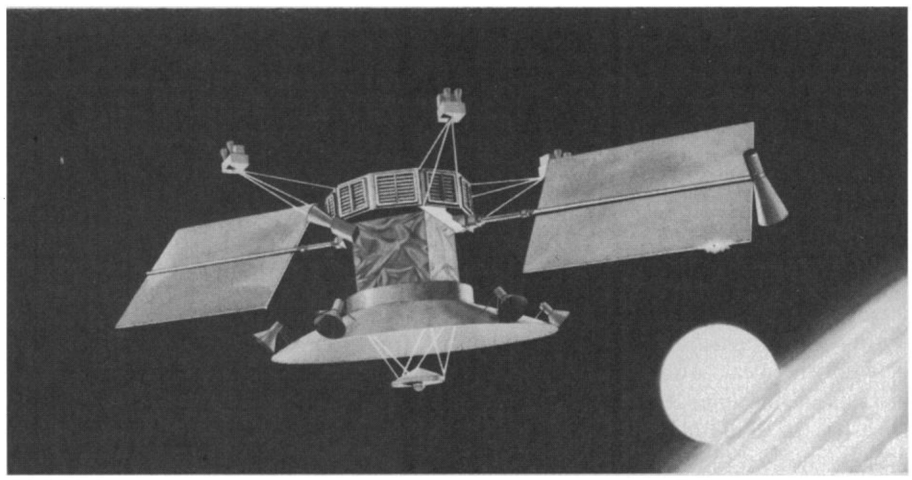
Perhaps more important, the U.S. National Academy of Sciences and the Soviet Academy of Sciences have agreed in principle to renew their formal ties and to begin work on a number of cooperative projects. This would at least provide a high-level forum for the discussion of planetary missions (*3*).

A revival of the space cooperation agreement might also be an attractive symbolic gesture if and when President Reagan meets with Premier Gorbachev this fall. Indeed, on 30 October 1984 Reagan signed Senate Joint Resolution 236, which called for a renewal of the agreement.

Looming over everything, however, are the arms control talks. "It all depends on what happens at Geneva," says Briggs. If the negotiations are making substantial progress, the psychological momentum might ease the way for other agreements. If the talks break down, or if they even remain stalled, the chances for a space agreement will probably remain slim.

Assuming that a new space agreement is reached, what form might this hypothetical collaboration take? One early symbolic gesture would likely be a joint manned mission, perhaps a rendezvous between the space shuttle and the Salyut 7 space station (*4*). Some enthusiasts have even suggested a joint manned mission to Mars as a symbolic alternative to the "Star Wars" Strategic Defense Initiative.

But Levy, for one, thinks that an interplanetary collaboration ought to start with something a little more modest. "We could certainly coordinate our [unmanned] missions," he says. "Or one side might be able to fly a moderately separable instrument package on the other's spacecraft. But at this point I don't see any reasonable path to something like a joint manned Mars mission. First you need to set up a framework for a relationship."—**M. Mitchell Waldrop**



The U.S. Venus radar mapper

More capable than the Soviet version—but 5 years later.

References and Notes

1. M. M. Waldrop, *Science* **218**, 665 (1982).
2. ———, *ibid.* **225**, 1380 (1984).
3. J. Walsh, *ibid.* **224**, 696 (1984).
4. M. M. Waldrop, *ibid.* **227**, 394 (1985).

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