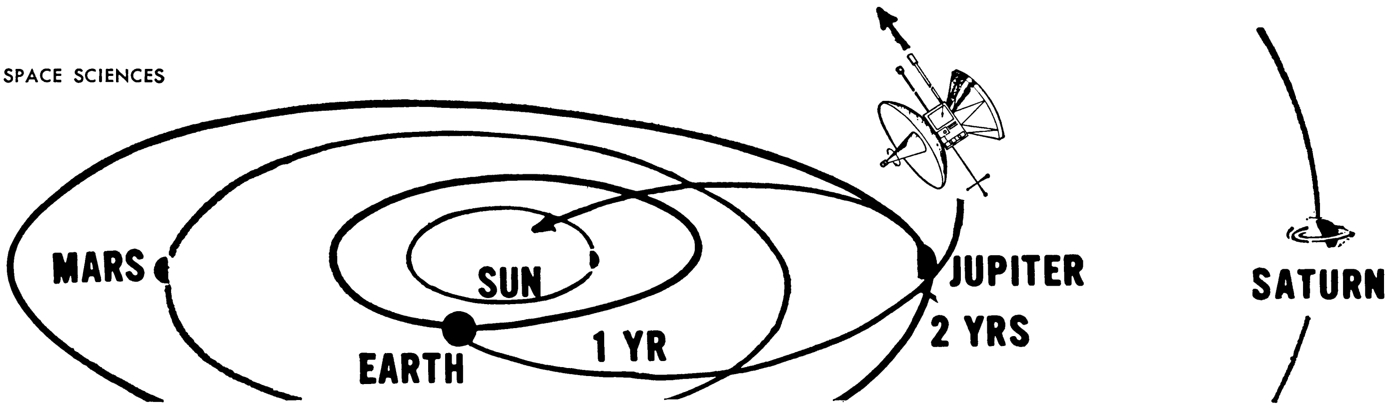


Three years out from earth, one planetary probe will whip out of the plane of the ecliptic, just to see what's there.

NASA's Post-Moon Pitch: Research

With time running out for the astronauts-and-glamour program the space agency is getting down to the science of it all.

by Jonathan Eberhart

The Gemini program is over, having made its splash in the ocean and on nationwide television, and the future of manned space flight, at least for the next decade, will come to a shuddering halt on the moon. The only troops left to defend the National Aeronautics and Space Administration Fort Knox—the glittering annual budget of more than $5 billion, are the thinkers in the Office of Space Science and Applications.

The "long-hair tennis-shoe types," as one of them calls some of his colleagues, are basic researchers, a profession that is rapidly becoming officially unpopular in Washington.

Last week, NASA space sciences chief, Dr. Homer Newell felt compelled to warn about the evils of Project Hindsight, a Defense Department study which has been interpreted by some officials to show that basic research plays only a very limited role in the development of useful hardware.

"Project Hindsight will be misused to the national detriment," Dr. Newell said, unless people are made aware that basic research works, even though it takes longer than applied engineering. "We have to keep hammering home the point," he said. There must be enough research carried on to create "continuing disciplines," he declared. "It's not enough to support a single experiment now and then."

NASA once before, in its infancy, touted the benefits to science of the space program. Few were convinced, however, and the glamour of the moon race early replaced knowledge as the chief support of NASA's budget.

Now, with the race underway and Congress and the public more sophisticated, if not jaded, NASA is turning back to its first line of defense. Last week it brought together its most important research directors and planners for a full-dress press briefing on the scientific merit of a still-vigorous, post-Apollo space science program.

Back in fiscal 1961, when the first bills for Project Mercury were being paid, the country's manned space flight budget was about 15 percent higher than the space sciences budget. Since that time the science budget has grown, but men are more expensive than machines; the immense costs of Gemini and Apollo have pushed up the manned flight budget five times as fast. This has increased the percentage spread between the two programs by a factor of 24. Today, the budget stands at $3 billion for manned flight, and only $650 million available for the robots.

But the picture is starting to decay around the edges. Space projects cost the most in their early development stages, and Apollo is virtually set. As a result, NASA's money is starting to blow away. Fiscal 1967 is the first declining year in the agency's history, with about $152 million less going for manned space flight than the year before, and almost as big a bite coming out of space science.

Now is OSSA's big chance. This is hardly the year in which the administration would want to embark on long, costly programs such as putting a man on Mars—not, at least, in a hardware-building way. Space science is cheap, however, and OSSA has a list of varied projects that will make NASA the general store of space research. The space agency is holding back some of its ideas for years to come, in order to make the package seem even more inviting.

As the numbers grow, so do the missions. NASA's potential distance champion would be a "Galactic-Jupiter Probe," 400 pounds of spacecraft carrying 40 pounds of instruments on a two-year trip to Jupiter, five times as far away from earth as is the sun.

Anything that goes farther out than Mars, however, and that includes Jupiter probes, will face a new problem that has so far bothered no one but an occasional comic book space hero: the asteroid belt. Between Mars and Jupiter is an orbit filled with chunks of rock believed by some scientists to be the remains of a planet. The biggest ones, many miles across, have been mapped; the small ones are space dust.

The first probe would thus be a pathfinder, equipped with micrometeoroid sensors to count the little ones, and guided by maps to see if it can dodge the big ones. Later flights would be equipped to report on gravitational and magnetic fields around Jupiter, cosmic rays from the sun, galactic cosmic rays from outside the solar system, the extent of the solar wind and other deep space data.

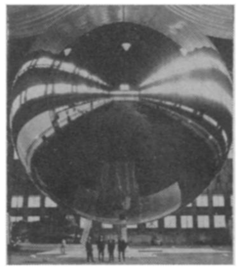
After two or three of those, a probe would be launched to perform the biggest coup in unmanned space flight: a trip out of the plane of the ecliptic. This means finally escaping from the plane of the sun's path through the universe, in which the orbits of all the planets in the solar system are located. No spacecraft has ever gotten out of it —they've been confined like ants on a table—so scientists are anxious, to put it mildly, to see what they'll find above and below the tabletop.

To find out, the earth scientists must get the help of Jupiter itself.

"We might call the mission 'By Jove'," said OSSA's chief astrophysicist, Jesse Mitchell.

. . . Post-moon pitch

Powered by a super-booster stronger than anything now in the U.S. space arsenal, including the Saturn 5, a probe would be sent out to Jupiter, where the mighty planet's gravity would seize it swing it around like a rock on the end of a string and let fly. The maneuver itself takes no extra power, but because the total mission might last more than five years, a 100-watt SNAP generator is a likely candidate as a power source.



NASA

PAGEOS satellite

Long missions pose a problem for NASA. A few satellites such as the Canadian Alouette 1 have been operating for as long as four years, but the "breakdown rate" of present instrumentation is still too high for such luxuries as a sun-orbiting probe capable of lasting through an entire 11-year solar cycle.

OSSA sees another kind of solar probe, an "interplanetary sounding rocket" called Sunblazer. A tiny spacecraft weighing from 15 to 60 pounds could be launched from an inexpensive five-stage Scout rocket, presently set for its first checkout flight in 1968.

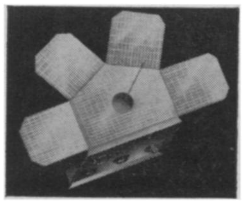
Sunblazer's biggest job would be to fly around to the opposite side of the sun from the earth, then send radio signals back through the solar corona. This is the same sort of occultation experiment that Mariner 4 did with Mars, providing valuable information about its atmosphere. By modulating the signal—causing it to vary in regular cycles—Sunblazer could tell scientists about the cosmic rays and magnetic fields in the area of the corona.

Mars and Venus will really get the treatment in the early 1970's if NASA gets its way. An assortment of Mariner and Voyager probes are variously being approved, lobbied for and prayed for as parts of a program almost as complicated as the flyby-orbiter-lander mixture fluttering around the moon.

The first one would be a Mariner spacecraft launched in 1969 as a Mars flyby. Adding a hard-landing crash-capsule to that design creates another Mars mission for 1971. Then by jacking up the capsule and building a new spacecraft under it, we'll have a Voyager soft-lander for the following year. There are more, including a pair of atmospheric sounding (hard landing) missions for Venus, and the whole thing is so hairy that OSSA has been trying to get it organized for three years, to the tune of $1.3 million just for the paperwork.

Doing anything with an astronaut takes a national decision, but OSSA has it easier with a variety of bio-space plans involving lesser living things. The Biosatellite program is already going ahead, with the second flight now down at Cape Kennedy. Monkeys, frog eggs, wheat and other flora and fauna are in the lineup (SN, 12/17/66, p. 511).

OSSA's next idea is the Biopioneers, a series of flights carrying plants and animals through interplanetary space. After that would come the biggest bio-satellite ever built, the Automated Primate Research Laboratory, which would carry a big, big primate, instrumented to the hilt, in orbit for three full months. These studies would by no means all be basic research, since such problems as loss of bone calcium in astronauts and increased breakage of chromosomes in white blood cells are among those to be solved.



RCA

Resource watcher

Outside the cloistered walls of NASA, most of the attention (and, perhaps the budget) will go to the practical projects—the Applications part of OSSA. Most controversial of these is the direct broadcast satellite, capable of transmitting programs right to home receivers without ground relay stations. Sponsors are nervous about controlling their regional markets; networks are worried that programming from distant areas may hurt their local listenership; and the industry is worried that people will be put out of work.

While lawyers lose sleep over such matters, NASA is studying satellite designs. Four are being looked at so far, fitted with various combinations of FM, UHF, VHF and short wave. The satellites may be placed in medium altitude orbits, or hung in the sky over fixed points, 22,300 miles up. One version calls for 15,000 watts of power, which would requires a solar cell array as big as the side of a house.

Following in the footsteps of the Geodetic Observation Satellite and PAGEOS, passive GEOS that it has already launched, NASA also proposes a Worldwide Geodetic Reference System, so accurate that it could be used to locate any point on earth to within a yard. NASA says it is needed for manned deep space flights in order to maintain precision alignment with tracking stations, but the Defense Department would certainly not turn its back on the most accurate target-spotting tool of all time. There is a problem here, however, which is simply that a system for geodetic measurement around the world needs, at least at present, the cooperation of countries around the world.

Another NASA plan with worldwide possibilities is the Navigation and Traffic Control Satellite. A few of these could provide voice and data communications as well as position fixes for both ships and aircraft. NASA has a chart a yard long showing uses for such a system, including intercontinental traffic control; search and rescue operations; collision avoidance; bad weather avoidance; and even data relaying for lunar and deep space probes. Satellite communications with aircraft have already been demonstrated with the Syncom III and ATS-1 satellites, while the navigation idea is still on paper.

ATS-1 is also the proving ground for another NASA budget hope, a synchronous (fixed-position) meteorological satellite. Equipped with the spinning cloud camera that has provided spectacular pictures of earth from ATS, the proposed satellite could do what no other now can: provide a continuous weather-watch from one position.

Another weather idea would be part of the currently successful Nimbus series. NASA envisions a worldwide grid feeding an electronic computer, with atmospheric data measured every 500 miles. Nimbus and other systems would combine to enable weather maps to be drawn two weeks in advance.

Other ideas call for satellites to help spot diseased crops, polluted water, possible oil fields and perhaps even migrating whales. The ultimate plan, however, is for the United Space Applications Mission, a huge, do-everything satellite equipped for weather-watching, mapping, communications and the rest. Though it is so far in the future that NASA doesn't even known what it might look like, there are half a dozen engineers working on it already.

Interior

Infrared volcano

The manned space flight people are working feverishly on the Applications Program, a series of miscellaneous earth and moon missions whose hoped-for budgetary charm lies in the fact that they would use existing, and hence cheaper, Apollo gear. Again, however, a manned moon-orbiting mission, for example—even one using comfortable old hardware designed 5 to 10 years before—would cost more than a completely new unmanned solar probe.