Mariner To Test Mars Life Theories

Expert opinion leans increasingly toward the existence of plant life; spacecraft will probe in '64

by William Beller

THE VENUS AND MARS fly-by program—*Mariner B*—on which the National Aeronautics and Space Administration wants to spend $74 million in Fiscal 1963, may have a spectacular payoff if it verifies recent speculations by an internationally known biologist.

This scientist believes Mars may have a flourishing plant life, some of its forms resembling our own higher plants. If this is true, he declares, we should expect to discover Martian mobile forms comparable to our plant-eating animals.

"From there it is but one more step—granted, a big one—to intelligent being," says the biologist—Dr. Frank B. Salisbury, Professor of Plant Physiology at Colorado State University.

The existence of life on Mars seems to be the only explanation for certain Martian phenomena, Dr. Salisbury maintains. Writing in a recent issue of *Science*, publication of the American Association for the Advancement of Science, he suggests that we be prepared for some interesting surprises in biochemistry—water perhaps acting as vitamins, and the decay products of Martian life being iron oxides.

- **Mars in '64**—The *Mariner B*, designed to fly on *Centaur* in 1964, will not only be capable of fly-by missions to Mars and Venus—it also will be able to carry a small planetary atmospheric entry capsule.

The first goal of the *Mariner* project was to send *Mariner A* fly-bys to Venus during 1962. However, problems with *Centaur* persuaded NASA officials to terminate *Mariner A* and replace it with a lighter version of the *Mariner* spacecraft—Model R—to be launched by an *Atlas-Agena*. Waiting for *Centaur* would have meant at least a year's delay in the program, since the next favorable time for a Venus launch is 1964.

As a result of the two flights of *Mariner R* planned for this year, NASA hopes to have enough data to design and test-fly a vehicle on an interplanetary mission in 1963. The trajectory will be chosen to check out the spacecraft subsystems expected to go on the *Mariner B* fly-bys in 1964.

NASA concurs with Salisbury that the basic question about Mars is whether life exists there. Early experiments are therefore being designed to solve the appropriate detection problems: an infrared spectograph will be carried to determine the existence and location of organic molecules. The upper atmosphere will be examined for ozone, to see whether Mars' surface is protected from ultraviolet radiations which in large doses are damaging to terrestrial life.

Since the Martian atmosphere is clear, the spacecraft will carry an optical system mated to a vidicon capable of taking and transmitting photographs of the terrain.

The hitch-hiking capsule on board the spacecraft will carry pressure-accelerometer instruments to probe the nature of the planetary atmosphere, and other instruments to detect the existence of life.

Mariner A funding terminates in Fiscal 1962 because of its replacement by *Mariner R*. Much of the hardware developed for the *Mariner A* is being used on *Mariner R;* similarly, much of the development effort on the various *Mariner A* subsystems will be used in *Mariner B*.

Mariner R funding peaks sharply in Fiscal 1962—reflecting the fact that almost all work must be completed by the end of the fiscal year in order to meet the launch opportunity date.

The *Mariner B* request for Fiscal 1963 reflects the heavy hardware requirements, since it is in this year that equipment must be purchased for both the test flight late in calendar 1963 and the planetary missions early in calendar 1964. Fiscal 1962 funds met the *Mariner B* pre-hardware requirement; the Fiscal 1963 request is to cover prototype and flight hardware, the necessary ground equipment for check-out and test, and the testing phase itself.

- **Unearthly life**—As near as astronomers can make out, the Martian atmosphere shows the following features:

—At the planet's surface, an atmospheric pressure between 6 and 10 centimeters of mercury—about 0.1 the earth's atmospheric pressure.

—A carbon dioxide content twice to 13 times that of the earth's atmosphere, with the higher value being the more likely.

—No oxygen, ozone or water vapor present—although on occasion there may be ice crystals.

—The bulk of the planet's atmosphere made up of nitrogen plus some argon.

—Temperature varying between −101°C and +30°C, depending on season and latitude.

These characteristics would undoubtedly discourage life as we know it. However, there is no reason to assume that life on Mars would resemble Earth's.

Most of the evidence strongly suggesting life on the planet is based on the changing colors of the Martian surface, somewhat in rhythm with the changing seasons. The colors are described as also varying from year to year.

The dominant color of the dark areas on Mars is gray, although some observers believe they see a greenish hue mixed in. With spring, the color darkens, much like regions of the Earth when forests take on new foliage. At the rim of the receding ice cap the colors appear to change to delicate pastels. When winter comes, the areas become less sharply defined, lighter, and begin returning to the dominant gray.

Another strong argument in favor of life on Mars was recently given by the American astronomer William Sinton. Using the 200-in. Mount Palomar telescope, Sinton reported, he secured infrared spectra of Mars showing absorption bands characteristic of the organic molecules found in terrestrial living organisms.

Sinton's discovery was hailed by Dr. Gerard de Vaucoulers, Associate Professor of Astronomy at the University of Texas, as being "the most direct evidence of life on another planet yet offered. . . ." As an afterthought, de

NASA Requested Funding for Mariner

(in millions of dollars)

MARINER A	FY 1961	FY 1962	FY 1963
Project Management and Support	0.498	0.431	…
Systems Analysis & Integration	0.740	0.409	…
Structure Design & Development	0.891	0.195	…
Documentation & Reports	0.369	0.090	…
Data Reduction & Processing	0.803	0.735	…
Scientific Experiments	2.569	1.871	…
Environmental Requirements & Testing	0.432	0.465	…
Communication & Telemetry	1.562	1.928	…
Guidance & Control	3.638	0.951	…
Power Systems & Energy Control	0.765	0.250	…
Pyrotechnics Design & Development	0.185		…
Instrumentation Services & Facilities	0.143	0.197	…
Computer Support	0.473	0.098	…
Total, Mariner A	**13.068**	**7.620**	…
MARINER R			
Project Management and Support	…	1.370	0.270
Systems Analysis & Integration	…	1.038	0.457
Structural Design & Development	…	0.851	0.145
AMR Facilities & Administration	…	0.099	0.090
Documentation & Reports	…	0.239	0.080
Data Reduction & Processing	…	0.365	0.280
Operations	…	0.238	0.340
Scientific Experiments	…	1.310	0.285
Environmental Requirements & Testing	.	1.232	…
Communications & Telemetry	…	2.949	0.450
Guidance & Control	…	2.065	0.350
Instrumentation Service & Facilities	.	0.201	0.050
Power Systems & Energy Control	…	0.697	0.028
Computer Support	…	0.832	0.175
	…	13.486	3.000
Atlas-Agena Launch Vehicles	…	10.292	6.240
Total, Mariner R	…	**23.778**	**9.240**
MARINER B			
Project Management and Support	…	0.765	3.100
Systems Analysis & Integration	0.157	1.022	4.900
Structural Design & Development	0.278	1.635	4.050
AMR Facilities & Administration	…	…	0.260
Documentation & Reports	0.047	0.190	0.360
Data Reduction & Processing	…	0.296	3.600
Operations	…	…	0.520
Scientific Experiments	0.410	2.320	8.845
Environmental Requirements & Testing		0.142	3.495
Communications & Telemetry	0.183	1.268	7.030
Guidance & Control	0.594	3.202	10.757
TV Systems		0.364	1.700
Power Systems & Energy Control	0.048	0.509	6.543
Instrumentation Services & Facilities	.	0.101	0.875
Computer Support		0.070	0.585
	1.717	11.884	56.620
Centaur Launch Vehicle	…	1.074	17.100
Total, Mariner B	**1.717**	**12.958**	**73.720**

Vaucoulers said, ". . . although a narrow margin of doubt remains until proof is obtained by direct exploration of the Martian surface."

• **A new way of life**—Salisbury suggests that it is easier to envision higher plants as being capable of living on Mars than it is to accept the often-discussed lichens as possibilities.

He points out that ultraviolet light probably is the least serious of the adverse environmental conditions to be met on the planet; he observes that "we would only have to add some sort of shielding pigments to our Martian organism to avoid this difficulty—pigments such as are found in certain fungi in Death Valley. . . ."

Modification of the plants so they can survive under the temperature extremes on Mars is also considered by Salisbury to be a relatively simple matter: the Martian organisms could present a broad, flat surface to sunlight during the day—a thin organ such as a leaf would appear ideally suited for the job. "If this leaf could roll up into a small cylinder at night—a phenomenon not without precedent on Earth—this would cut down night-time heat loss by radiation," he explains.

To conserve heat under the sub-zero temperatures organisms would experience during the Martian nights, "it is simplest to imagine that the plants freeze every night and thaw out the next day—and are not hurt by this."

"I have wondered if water on Mars might not act more like a vitamin than like a primary solvent," says Salisbury. "A certain amount of hydrogen and oxygen would be supplied for essential reactions, but Martian biochemistry might not depend on these elements as extensively as our own does."

On Mars, oxygen appears to be tied up in iron compounds on the deserts. Salisbury asks how life can proceed if oxygen produced by photosynthesis is immediately tied up and made unavailable for future use in respiration. He suggests that this is the most difficult of the dilemmas in our speculations.

He sees one possible solution: the oxygen might be replaced by nitrogen, with its many oxidation states. He also recognizes the alternate suggestion that "the Martian organisms may split off oxygen from iron oxides in the desert soils in a manner analogous to the way in which oxygen is split from water through photosynthesis in terrestrial plants."

The consequence, according to Salisbury, would be that oxygen would be used in the organism's metabolism, and the decay process might involve a direct return to the original combinations with iron—a final descent to rust. ⌘