Tidewater Has a Role In Search for Life on Mars

By Marsha Bartusiak

Special to the Virginian-Pilot

IS THERE life on Mars?

To science fiction fans, that question has long been answered through vivid tales of little green men and Martian goddesses residing in crystalline cities rising out of the red Martian desert.

Its been answered ever since author Edgar Rice Burroughs had Earthman John Carter fall in love with the Martian princess Dejah Thoris, or sci fi master Robert Heinlein brought Valentine Smith down from the Red Planet to teach earthmen to grok.

But to the scientific community, it has been a controversial yet fascinating mystery that only now is on the verge of partial solution through the Viking project to Mars, the United States' most ambitious unmanned space mission yet.

If all goes according to plan, the first of two 7500-pound Viking spacecraft will be launched from Cape Canaveral atop a Titan-Centaur rocket on August 11. A second identical unmanned probe will be launched ten days later.

The journey for both will be long. Traveling 440-million miles through space for almost a year, the first spacecraft will arrive at Mars in June, 1976. Once captured by Mars' gravity, it will circle the planet for about two weeks to survey the planet's makeup. Then as soon as landing conditions are at their best, a 2400-pound lander will separate from a 5100-pound orbiter. The orbiter will stay in orbit around Mars to continue surveying and photographing the planet while the lander descends to the Martian surface.

However, the landing was planned with some other considerations in mind. Using parachutes and retrorockets, it's hoped the lander will achieve that soft landing on July 4, 1976.

As one project observer was heard to note: "It will be one small step for science, one giant leap for the Bicentennial celebration."

Tidewater is playing a vital role in the Viking project. The entire mission is being managed for the National Aeronautics and Space Administration by its Langley Research Center in Hampton. Heading up the scientific end of the program is Dr Jerry Soffen, Viking's project scientist.

As launch time draws closer, Soffen has been spending more and more time traveling to Viking's contractors and research teams throughout the country, especially to Cape Canaveral where the scientific package aboard the spacecraft is going through last-minute testing.

But recently he was able to sit back and relax in his rambling Victorian home in Old Hampton to discuss the project's scientific mission. His book-and-art-filled living room would suggest a university professor, but a large spacecraft model in a corner and a comic sculpture of a Viking warrior on a bureau link him right away to the upcoming Mars project.

Soffen believes it was those Buck Rogers and Flash Gordan stories that gave birth to his interest in extraterrestrial life. He says, "It was a dream I grew up with, and then it became real with my interest in the origin of life."

In 1961, Soffen was only one of a handful of scientists who were seriously studying the question of life forms on planets other than Earth. Nobel-Prize winning geneticist Joshua Lederberg had recently coined a word to describe their work—exobiology—which is not found in some dictionaries even today.

Working at the Jet Propulsion Laboratory of the California Institute of Technology, Soffen was trying to develop an automated microscope that could be included on the first lander to Mars. Unfortunately, those first experiments were being designed with the idea that the Martian atmosphere was one-tenth that of Earth.

In 1962 an experiment on Earth showed that the Martian atmosphere was actually much less, only about one-hundreth that of Earth — and composed mostly of carbon dioxide, small amounts of water vapor, and traces of carbon monoxide, oxygen, and ozone. This changed the entire concept of the program. So in 1965 a new mission was developed which became known as the Voyager project.

Like the Viking project, Voyager was to use two spacecraft but this time launched by the gigantic Saturn

rocket. Soffen says, "It was much bigger than Viking. It included everyone's experiment. But like a house of cards, it collapsed around 1967." Voyager became a victim of the race to the moon and a gloomier economic picture for NASA.

This was the first time a major space mission had been canceled, and it shook the entire scientific community. But it didn't mean an end to the attempt.

In 1968, a sort of contest emerged between the Jet Propulsion Laboratory and NASA's Langley Research Center to develop a new Mars lander mission. JPL was very conservative in its design. It was basically a landing test and not much more. But according to Soffen, Langley leaped into the contest with a sort of romantic vision with a design that included a special biological package to test for Martian life forms.

Soffen was working for JPL at the time but switched to Langley because of its more interesting concept. "All my friends thought I was crazy," says Soffen, "because JPL was the undisputed leader in the field up to that point and didn't think Langley had a chance."

But in 1969 Langley's gamble won out with the result now ready for launch in mid-August.

Virginian-Pilot Photo by S. H. Ringo

Dr. Jerry Soffen with model of Mars

When the two Viking landers finally arrive at Mars next year, they'll be setting down in two low-lying regions which scientists believe could be conducive to Earth-like life forms. The landing sites are both in the temperate zone of Mar's northern hemisphere but in no way could they be compared to Earth's temperate regions.

Since Mars is about 50 million miles further out from the sun than Earth, it receives much less sunlight. The temperature can rise to 32 degrees Fahrenheit or even up to 80 degrees in some areas during a Martian afternoon but then drop to a drastic 190 degrees below zero at night.

An astronaut looking over the Martian landscape whipped by winds reaching up to 200-miles-per-hour would find it cold, arid, and oxygen-poor. Without protective equipment, he could asphyxiate in the exceedingly thin atmosphere, die of thirst, or be scorched by ultraviolet light.

From the description of those conditions, it sounds like it would be hard for any life form to develop on the planet. But many scientists believe that's only the result of terrestrial prejudices, and they can imagine certain organisms slowly evolving in the harsh Martian environment into forms quite adapted to it.

For a film documentary on extraterrestrial life, Soffen was once asked to describe a possible Martian organism. Soffen says he suggested a rockeater. "Image an organism, low to the ground, attaching itself to a Martian rock and slowly chewing it up to extract the water it needs. A fish on Earth, surrounded by water all its life, would find it hard to think of life existing on land," says Soffen. "So we might go to Mars and find forms deemed impossible by Earth standards."

Though Viking scientists aren't discounting the possibility of a Martian "kangaroo" hopping past the lander's camera lens, they're actually expecting smaller game like tiny microorganisms, moss, or lichen-type plants, life forms which could adapt well to Mars' severe environmental conditions.

"To understand the biology of Mars," says Soffen, "is to understand all of Mars." So the landers will include instruments to study both the geology and meteorology of Mars, similar to the equipment left on the moon by the Apollo astronauts.

Photographs will identify land forms and rock types while a seismometer will detect volcanic activity and "Marsquakes." Other lander instruments will measure the weather conditions around the lander, identify basic elements in the soil, as well as analyze the Martian atmosphere for its moisture and chemical content.

Mars is truly a geologist's paradise with its immense volcanoes, massive canyons, sinuous channels, and lunar-like craters. But there's no doubt the biological experiments will be the center of attention for they may prove to man that life does exist on another planet. Soffen says, "It would be the scientific discovery of the 20th century."

Those tenative first steps in the search for extraterrestrial life will be done by a special life-detection laboratory aboard the Viking lander that is a triumph in miniaturization. One cubic

foot of space (no bigger than a breadbox as the cliche goes) contains three automated chemical labs, a computer, tiny ovens, radioactivity counters, filters, sun lamp, gas chromatograph to identify chemicals, 40 thermostats, 22,000 transistors, 18,000 electronic parts, and 43 miniature valves. The same equipment in standard size would take up an entire laboratory room.

While higher life forms could be detected by camera photos of the landing site area, the minilab will search for microscopic life in soil samples. The samples will be scooped up by a ten-foot lander boom that shoots off from the tri-pedal spacecraft like an extra-long arm.

The entire spacecraft will be sterilized before the launch to make sure the scoop won't be picking up any Earth microorganisms that could have survived the long trip through space and settled onto the Martian surface after landing.

Once the scoop picks up a sample, it will deposit it into a funnel atop the lander where the soil will then be distributed to three different chambers, each no bigger than a thimble, for separate biological tests.

The first will be a test for photosynthesis. Plants on Earth use light energy from the sun to combine carbon dioxide from the air, water, and inorganic salts from the soil to form carbohydrates and proteins. Since the thin Martian atmosphere is composed mainly of carbon dioxide, Viking scientists assume Mars also will support such photosynthetic organisms. So the first biological chamber was designed to specifically test for their presence.

Soffen calls it their "pure Martian" experiment. "We're making no assumptions in this test about what type of air or food the Martian organisms could like. We're simply letting the organisms that might be present in the soil sample take in the carbon dioxide within the chamber while basking under a lamp that simulates Martian sunlight."

Some of the air in that test chamber will be radioactive. If there are indeed Martian organisms in the soil consuming the carbon dioxide, the radioactive tracers will become a part of them.

After a suitable incubation period, the soil sample will be heated to about 1100 degrees Fahrenheit, hot enough to vaporize any organic materials in the soil. If radioactivity is detected in that vaporized material, it will be strong evidence that plant-like organisms are present in the Martian soil sample.

While the first experiment may be pure Martian, Soffen describes the second as more Earth-bound. "The second chamber will feed a special nutrient solution, a sort of 'chicken soup', to the soil sample within a carefully measure atmosphere." Not tasting like any brand of chicken soup on Earth, the solution will consist of amino acids, vitamins, and other organic compounds. "I call this our more earthly experiment," says Soffen, "for the simple reason that the Martian organisms might not like our type of nutrients. We're assuming that what Earth organisms like to eat, Martian organisms will be able to eat too. We have to begin our study of Mars by starting with what we already know about life and that means life on Earth."

The atmosphere in the enclosed chamber will be closely monitored for about two weeks to see if any gases are given off by the sample. If there are significant changes in the composition of the air, it will be assumed it was because of biological activity, evidence of respiration by the organisms in the soil. They would have eaten the food and given off the gases as waste products.

Like the first experiment, the third biological test also depends on radioactive tracers. This time the soil samples will be fed a sugar-based nutrient which bears some radioactive chemicals. If there are organisms present in the soil and if they eat the food, radioactive gases would be given off and monitored by a detector.

One other test will be searching for organic material, but it will be a chemical rather than a biological experiment. A pinch of soil will be ground to a very fine powder and heated in a tiny oven until the various soil components are literally boiled off. The vaporized material will then be analyzed by a complex instrument known as a gas chromatograph-mass spectrometer.

Through this method, they hope to identify the building blocks of life such as simple alcohols or amino acids. Soffen says, "Once we identify the basic organic compounds found in that Martian soil sample, it will take some clever detective work back on Earth to put the building blocks together and surmise what was there to begin with."

Though the lander is a scientific achievement in itself, it's equalled by the computerized system developed to relay all the photographs and experimental information back to Earth. If you can imagine how hard it would be for a scientist to run an experiment just a room away from his equipment, you can imagine the difficulties in running a whole series of tests 200 million miles away on another planet. The radio signals alone will take 20 minutes to travel that great distance between Earth and Mars.

During the 90 days that the two landers and orbiters will be probing, analyzing, and photographing the Martian surface, billions upon billions of bits of data will be relayed back to Earth computers. It will be their long, arduous task to piece the very complex puzzle back together.

The importance of the Viking project will be measured in scientific data alone. It will also produce some profound philosophical implications. If indeed the scientific instruments discover any organisms or plants on Mars—life that formed independently of Earth—it will lend further proof to the theory that the origin of life is not unique but rather a common occurrence in the universe.

This first United States landing on Mars will be merely a brief hello for Earth scientists. A full acquaintance will have to come with other landings.

Just when those missions will take place will depend on the political and economic climate. But Soffen suggests a third possibility.

"Perhaps we'll be spurred on by a mysterious shadow that moves in front of the Viking camera lens, briefly appears on our television screen, but then cannot be explained."