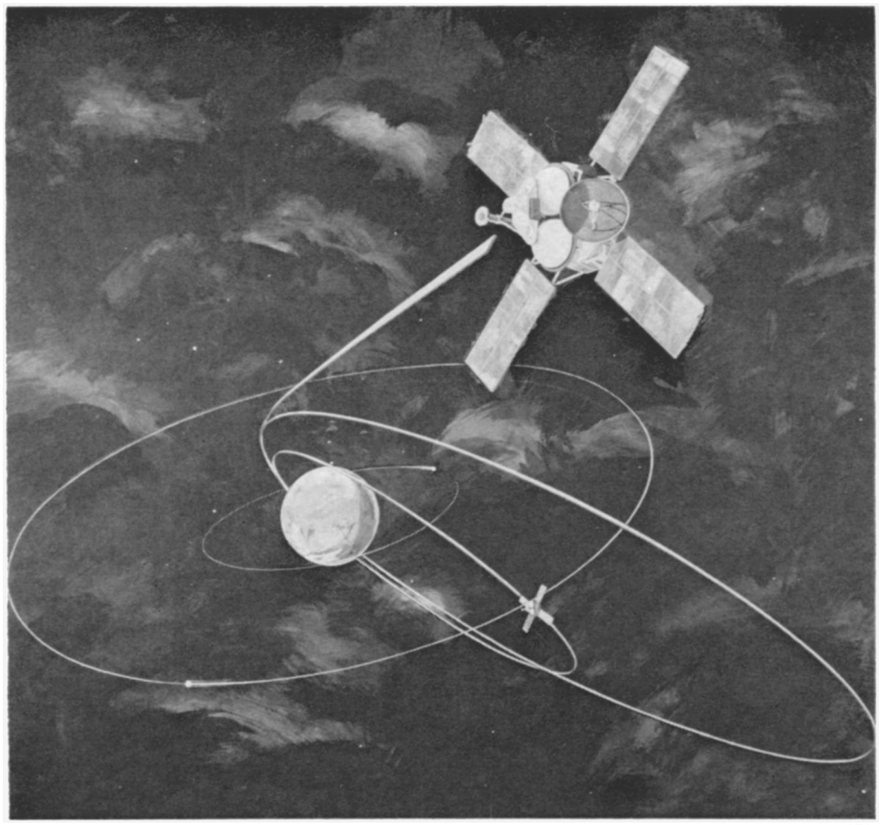
A lingering look at Mars

Two 1971 Mariner craft will orbit the planet for three months, yielding a continuous flow of data from as close as a thousand miles

by Everly Driscoll



JPL

Topography, seasons, atmosphere and life will be explored by the orbiters.

Of the many motivations to explore the solar system, one of the strongest is man's quest for extraterrestrial life. Whether it is because of a subconscious desire for a proof that he is not alone in the universe, the desire for a reprieve from his treatment of the earth, or a search for an understanding of existence, man has been persistent in the search.

For over a century, the planet Mars has been a focal point in the quest. It began when an astronomer, in the late 1800's, saw what looked like manmade canals on the planet. The intrigue was intensified by the appearance and observations of the planet itself: its reddish tint, its color variations, and the indications that it had an atmosphere.

The canal-builder theory is generally discredited, but the interest remains. At the time that the National Aeronautics and Space Administration was sending unmanned probes to the moon in 1964 it also sent a spacecraft past Mars: Mariner 4. Then on the heels of the first lunar landing, Mariners 6 and 7 flew within 2,100 miles of the planet. Over 2,500 pictures were transmitted. Scientists got a close look at Mars for several days (SN: 8/9/69, p. 111); the craft detected no nitrogen gas or ozone (a form of oxygen), but they did detect evidence of carbon dioxide, water ice, fog, water vapor and some carbon monoxide. They picked up evidences of surface silica or silicate rocks and temperatures that rose to about 60 degrees F.

However, just as 13 unmanned probes, three manned orbital flights and two lunar landings have just begun to yield data to unravel the mysteries of the moon, the three Mariners to Mars were merely a beginning. Scientists want to know some basics about the planet: details about the atmosphere and clouds, topography, seasonal variations, surface and internal structure and the possibilities for life.

The next step on the journey to Mars will occur between May 6 and June 3 of next year. Two spacecraft, launched about 10 days apart, will encounter the planet between Nov. 12 and Nov. 24, 1971.

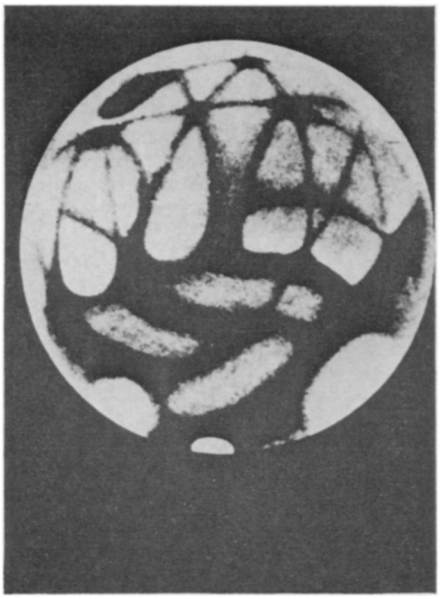
Whereas the Mariner flybys of 1964 and 1969 yielded brief glimpses of the planet, the three-month orbits of two spacecraft, known jointly as Mariner Mars '71, will provide the longest continuous flow of data yet to come from the space program.

The year 1971 is ideal for the flight: At the time the spacecraft are to be launched, Mars will be on its closest approach to earth since 1924, 34.9 million miles.

The first spacecraft, Mission A, will encounter Mars at 76 million miles from earth. After insertion into a 12-hour orbit of 10,500 by 1,000 miles, with an inclination of 80 degrees, it will map the planet. Spacecraft B, arriving a few days later when Mars is 84 million miles away, will go into a 33-hour orbit of 25,600 by 1,000 miles. Its objective: to enable scientists to study the variable features of the planet. Over 70 percent of Mars will be mapped by the two.

Aboard each Mariner will be two television cameras, an ultraviolet spectrometer to measure the chemical composition of the atmosphere, and an infrared interferometer, spectrometer and radiometer to measure surface and atmospheric temperatures.

Seasonal and annual variations will be studied from 1,000 miles away. One such variation is the color of Mars, which varies from dark gray to brown in the winter, blue-green to black in the late spring and purple, brown to gray in the summer. Cloud covers vary as well, both annually and as related to possible transient events. White clouds observed could be frost, fog or vapor; they seem to reach a peak when the polar caps are small. Some, as large as 1,200 miles across, have lasted for



Early observers saw manmade canals.

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Pounder: Prompt data analysis needed.

weeks. Dark gray clouds have been observed less frequently. Two, seen in 1950 and 1952, stretched 500 miles. These, along with bright spots or flares observed in two areas of Mars, are thought to be the results of volcanic activity. A bluish haze has also been observed in the planet's atmosphere.

Other phenomena, seasonally related but more consistent, will be dissected by the instruments. The craft will orbit Mars during winter in the Northern Hemisphere. At that time, the composition of the polar caps will be analyzed, and attempts will be made to detect any constituents that may be of biological significance. The polar caps, believed to be deposits of solid carbon dioxide and possibly small amounts of solid water, condense during the fall and winter in each hemisphere, and vaporize during the spring and summer.

Another mystery, which may be related to polar cap activity, is the so-called wave of darkening, or albedo decline. This decline starts in the springtime, beginning at the edge of the vaporizing polar cap and moving toward and across the equator. Some scientists believe that the dark areas, the maria, darken in the spring. Whether this is the result of the wave from the pole is argued as well as the polar effect.

Knowledge of the topography of Mars could open answers to its origin and history. Some features, such as the lunar-like craters, were photographed on the flybys. But the popular canals, observed from earth to become more prominent in the spring, were not detected by the three Mariners. Nor is much known about the internal structure of Mars. Some argue that there is no core, or that if there is, it is small and solid. The planet's shape, the mean density and the moments of inertia can be derived in part by precise tracking of the spacecraft in orbit, and visual observations for three months.

And the search for the evidence of life will continue. Living organisms exchange materials with the atmosphere; this interreaction could be detected by the Mariner instrumentation. The presence and composition of outgasing would give clues to the Martian state of development.

While the spacecraft are marking firsts around Mars, other significant firsts will be achieved in earth-based hardware. The system designed for the 1971 flights may be a giant step toward solving the problem of mounting stacks of unanalyzed data.

Four large general-purpose computers will be in action at California Institute of Technology's Jet Propulsion Laboratory, Pasadena, Calif., during the flights. Three communication channels with the spacecraft will feed data to produce raw pictures each day. Every fourth orbit of the craft will be a repetition of the first, giving scientists an opportunity to look again at an interesting spot. This means that the activity of each day in orbit will be the result of the previous day.

"For these planetary missions to pay off," says Edwin Pounder, Assistant Project Manager of the flights at JPL, "we have to do immediate data reduction." This process will be a first.

Such an adaptive mode of operation, and real time reduction and analysis of data, "is one of the most ambitious things ever undertaken by NASA," asserts Earl Glahn, Mariner '71 manager at NASA headquarters.

Just as Mariners 4, 6 and 7 laid the foundations for this project, so the two orbiters of 1971 will pave the way for the two Viking orbiters and landers that are scheduled for launch to Mars in 1975. The Vikings will analyze the soil and carry biological experiments to aid in man's search for life in the solar system.

It is most likely that if an American walks on another planet in the solar system, Mars will be the first. It is no longer a question of how, but when. □