Mariners VI and VII showed the planet to be cold, dry, and rugged. But does anything live there?

Mars—A New Mystery

by Bill Becker

Mars south polar cap—believed to be a layer of frozen carbon dioxide a few feet thick.

Just the day before yesterday, as time is measured by astronomers, Mars seemed to be a friendly place to go. If any of the neighboring planets was like Earth, it had to be Mars.

Then came the space era. Mariner IV flew by the red planet in 1965, sent back the first non-Earth-based photographs of Mars—and most scientists revised their opinions: Mars was like the moon. Now, in the eventful summer of 1969, Mariners VI and VII have forced a further reevaluation. The cameras and sampling instruments aboard the Caltech Jet Propulsion Laboratory's latest Mariners indicate that Mars may prove to be unlike any other planet in our solar system.

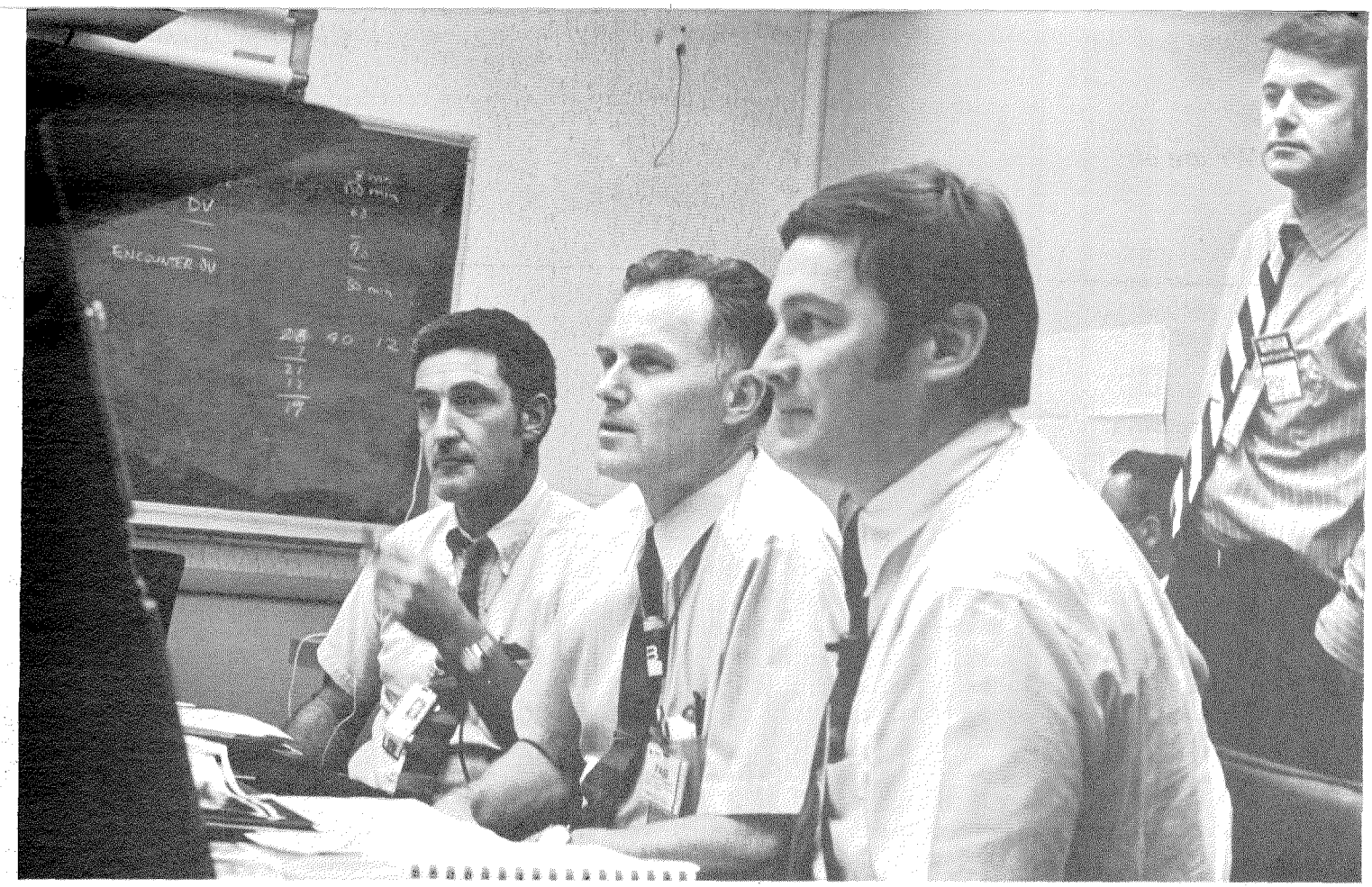
Mariner VI swept by the Martian equatorial zone on July 30 at an altitude of 2,131 miles, following a 241-million-mile flight in 156 days. Mariner VII made a south polar pass 2,130 miles out on August 4, after a shorter flight of 197 million miles in 130 days.

Yet, in spite of the resulting advances in our knowledge of Mars, the planet remains a tantalizing mystery that is seemingly, although not conclusively, inimical to life. "There is nothing in the new data that encourages us in the hope that Mars is the abode of life," says Caltech biologist Norman Horowitz, a member of the television experiment team. "However, there is nothing that excludes that possibility, either."

If there is some form of life on Mars, it would have to be a unique species able to exist on vapor or ice, Horowitz adds. Mars may have some warm spots, but basically it is "a very cold desert," with a scarcity of water an inhibiting factor to growth.

The dual camera systems aboard the Mariners transmitted 200 pictures, including 57 high- and medium-resolution views. The photographs reveal a heavily cratered, ice-covered south polar cap; a remarkably uncratered desert in the Hellas region; a jumbled, chaotic terrain near the Margaritifer Sinus area; and, alas, for die-hard romantics, no canals.

The giant's footprint—two adjacent craters foreshortened by oblique viewing of the south polar cap of Mars. The sun is eight degrees above the local horizon off to the upper left; the area shown is approximately 85 by 200 miles.



As they receive pictures from Mars, JPL's Al Hibbs and three members of the television experiment team (leader Robert Leighton, Caltech professor of physics; Bradford Smith, New Mexico State University astronomer; and Bruce Murray, Caltech professor of planetary science) evaluate them for thousands of home TV viewers.

The anomaly that seemingly puts Mars in a class by itself is an area of wild hills and valleys, covering several hundred square miles, in an area that appears bright to Earth telescopes. Caltech geologist Robert Sharp, also a member of the television experiment team, says this area resembles features caused on Earth by landslide slumping, but on a much greater scale. The jumbled terrain also registered two degrees warmer than nearby areas, but Sharp finds no evidence that surface volcanoes are active or that they produced this wild region.

In other areas, most of the surface is heavily cratered, and some of the craters are more than 300 miles wide. Sharp says Mars, like the moon, was impacted and "roughed up" early in the history of the solar system.

One notably different area studied in detail is the circular desert, Hellas, near the equator. This bright region, 1,200 miles wide, is devoid of craters even in the closeup pictures. Sharp suggests that the surface material of Hellas may be like pumice or tiny bits of popcorn. Such fine-grained matter would be easily distributed by wind, and any craters that might exist could be filled by it.

Pictures taken of the planet's limb (or rim) indicate that a layer of haze hugs the surface and goes up to 10 to 30 miles above it. This might be an aerosol of fine particles, according to meteorologist Conway Leovy of the University of Washington, another television experimenter.

Aside from the jumbled terrain and the blandness of Hellas, topographical highlights of the photographs are few and disillusioning, in the main, to exobiologists. For example, the historic wave of darkening which, from Earth, seasonally seems to pass over the face of Mars does not appear in the pictures. Many scientists once hoped that such darkening might be linked to vegetation.

Nor did the "blue haze" long seen by Earth's astronomers materialize in the Mariner photographs. As for the canali, first named by G. V. Schiaparelli in 1877, the best photographic evidence is in—and canals are out. Three suspected canals proved to be strings of craters giving the impression of a linear indentation.

Caltech physicist Robert Leighton headed the TV experiment team, which also included geologist Bruce Murray of Caltech.

While the pictures were being received and evaluated, other experimenters were getting different kinds of data back. The infrared and ultraviolet sensors revealed that the Martian atmosphere consists almost entirely of carbon dioxide and substances (oxygen and carbon monoxide) formed by the breakup of carbon dioxide molecules in sunlight.

Although small amounts of water vapor were detected,

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no nitrogen was found in the air of Mars. Moreover, the polar cap appears to be frozen carbon dioxide—dry ice, not water ice. The infrared radiometer experiment directed by physicist Gerry Neugebauer and astronomer Guido Munch, both of Caltech, showed temperatures as low as −193 degrees Fahrenheit. If polar temperatures had exceeded −170 degrees, there would be stronger hope for water ice. Temperatures at the equator ran as high as 60 degrees in the daytime, with minima dropping to under −100 degrees on the night-side of the planet.

George Pimentel of the University of California, head of the infrared spectrometer experiment, reports possible fog or hoarfrost, and evidence of dry ice particles over warmer areas. However, he now withdraws a preliminary report that the instrument had detected methane and ammonia gas in the atmosphere over the south polar cap. The presence of those gases could have increased the possibility that life might exist at the fringes of the south polar ice.

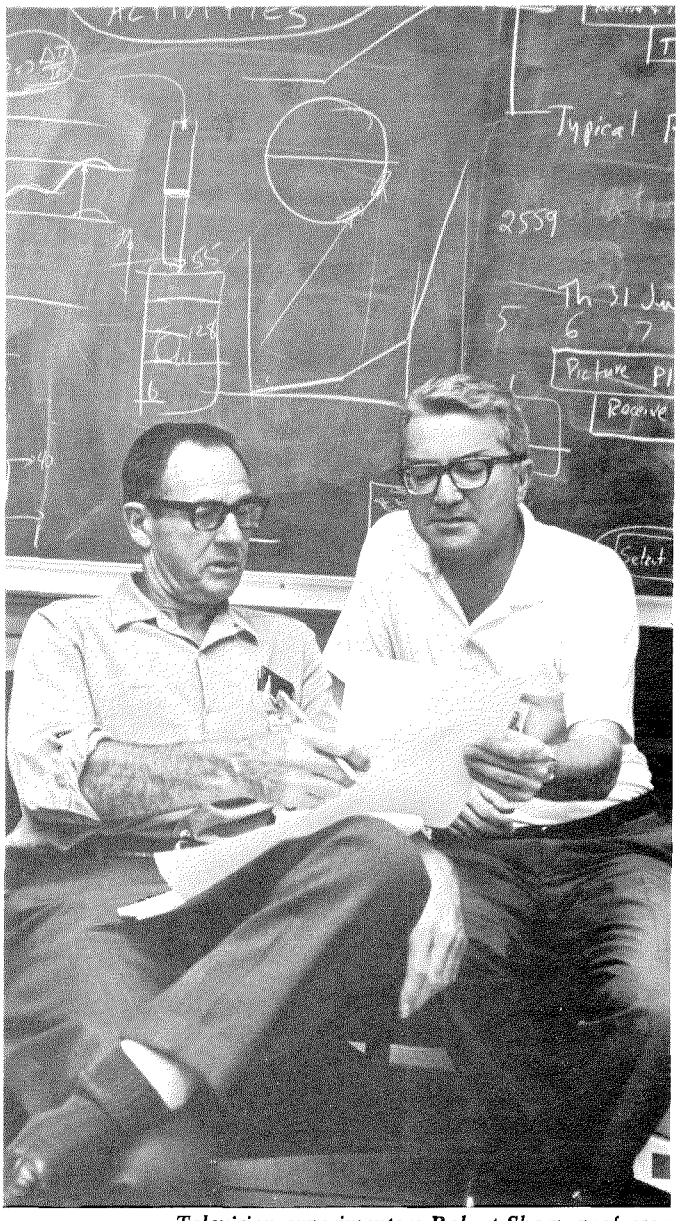
While the infrared spectrometer concentrated on the atmosphere from the Martian surface to a height of about 75 miles, an ultraviolet spectrometer analyzed the upper atmosphere, out to 600 miles. This experiment, headed by C. A. Barth of the University of Colorado, revealed no nitrogen at that altitude, but atomic hydrogen and atomic oxygen were found, along with the expected carbon dioxide and carbon monoxide.

The surface pressure of Mars was measured at about 6.5 millibars in the Mariner VI radio occultation experiment conducted by JPL's Arvydas J. Kliore and his colleagues. However, Mariner VII gave figures of 3.5 and 7 millibars, indicating that one region near the south polar cap may be four miles higher than the average. The 6.5 millibar figure is equivalent to the pressure at 100,000 feet in Earth's atmosphere. An ionosphere about 82 miles above the planet was also detected by each experiment.

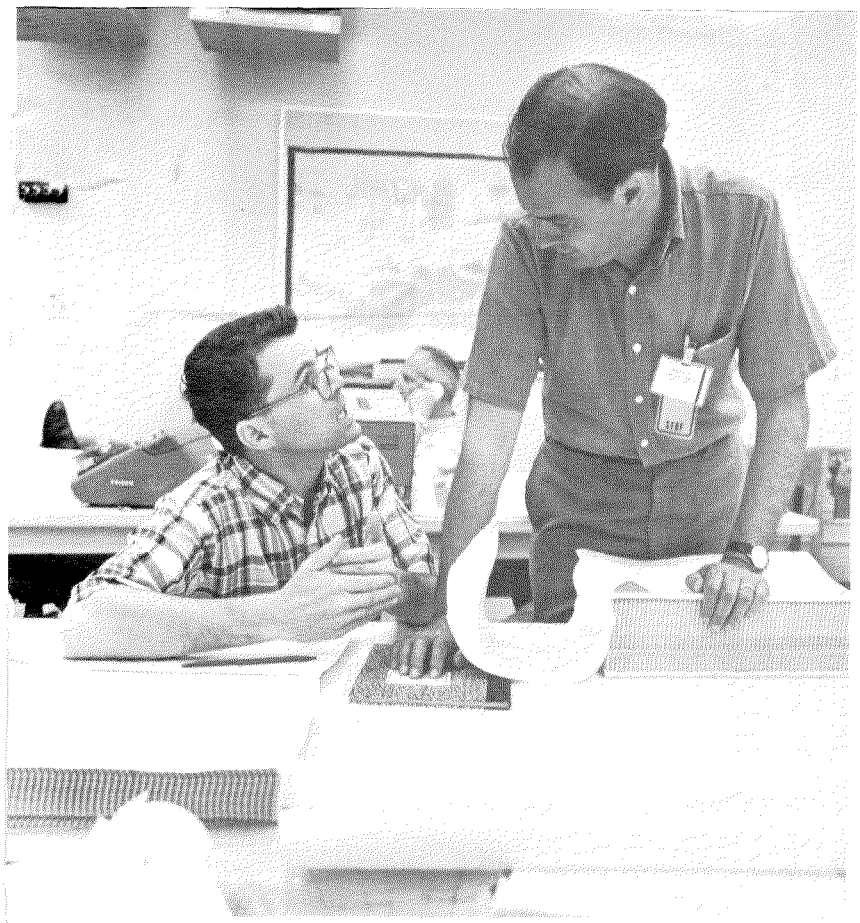
Even as 1969 Mariner studies continue, NASA is pushing ahead with plans for two Mariner-like craft to orbit and photograph Mars for three months in 1971. One of these orbiters will approach to within 1,500 miles of the planet—600 miles closer than the 1969 Mariner flybys. Then in NASA's Project Viking in 1973-4, two capsules are to land on Mars to sample the planet's surface and air.

Norman Horowitz expresses the consensus of Mariner scientists when he says that "We are obliged to continue the search for life. We have to test our current notions about how life started in the solar system. We have to get to Mars to make a direct test."

And Robert Leighton adds: "It is a remarkable fact that each of the three Mariners revealed a new and interesting kind of terrain not seen by its predecessors. Could it be that Mars has even more tantalizing secrets in store for us in 1971 and 1973?"



Television experimenters Robert Sharp, professor of geology, and Norman Horowitz, professor of biology.



Infrared radiometer experiment team—Gerry Neugebauer, associate professor of physics, and Guido Munch, professor of astronomy.

Caltech President Harold Brown watches incoming pictures at JPL with Robert Sharp.

Caltech's Mariner Men