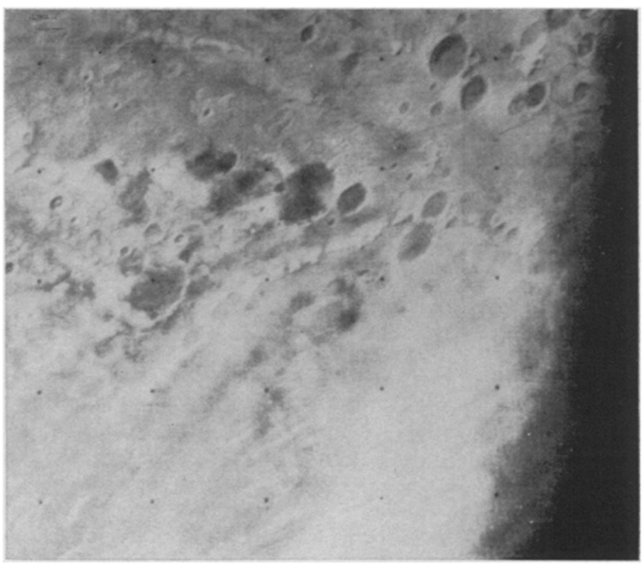
MARINER 6 AND 7

Mars: A closer look at a nearby world

The heavily cratered planet apparently lacks nitrogen in atmosphere, reducing the chance that life exists there



Wide World

Mars' south polar region: Frost-covered, crater-scarred.

While rock samples brought back from the moon were still undergoing preliminary scrutiny, other scientific eyes this week turned to Mars and the rest of the solar system.

Mariner 6 and 7 (SN: 3/8, p. 233) skirted past Mars five days apart, giving man his first closeup looks at the planet since Mariner 4 surprised the scientific world in July of 1965 with views of a cratered Martian surface.

And an advisory panel of scientists issued a report recommending a program for exploration of the planets beyond Mars—Jupiter, Saturn, Uranus, Neptune and Pluto—that included a pair of grand tour missions in the latter half of the 1970's.

What the two new Mariner spacecraft revealed with their television cameras and other sensors was a planet seemingly more inhospitable and alien than had been expected. The mission was not designed to detect indications of any primitive life forms on the planet, but the information gathered about the conditions was, on balance, not encouraging to those who have felt that simple, rugged organisms such as lichens might exist on Mars.

First from Mariner 6 came the photographic transmissions. The early pictures showed little more detail than contained in good-quality photographs taken through telescopes on earth. But as the craft approached nearer and then skimmed within 2,130 miles of the planet, the photos from the two TV cameras revealed a heavily cratered, moon-like surface.

Dr. Robert B. Leighton of the California Institute of Technology, principal investigator for the TV experiment, called the pictures spectacular. He and co-investigator Dr. Bruce Murray say they show that Mars has been battered by material impacting from space over long periods of time. Many of the craters were between 30 and 50 miles wide. Some were so large, says Dr. Leighton, that they must have been formed by asteroid collisions.

A gigantic crater 300 miles wide was identified at a location, called Nix Olympica, observed over the years from earth to vary markedly in brightness. A bright spot in the center is perhaps a central peak. A light-colored band around the outside of the crater, pointed to the possibility that it is a bullseye formation, like the spectacular Mare Orientale on the far side of the moon.

Many other craters bear close resemblance to some on the moon. They have steep sides that have slumped, forming the type of concentric terraces seen in Copernicus and Aristarchus. Avalanche chutes down the sides are visible. Long, sinuous rills like those on the moon were also photographed.

But the TV pictures constitute only one of six scientific experiments carried by the Mariner craft. Possibly the most important finding from the others is a negative one—the apparent lack of nitrogen in the upper Martian atmosphere.

Initial study of the data returned from the on-board ultraviolet spectrometer indicate no nitrogen, the element that comprises 78 percent of the earth's atmosphere and is an essential constituent of all living molecules on earth.

"If additional intensive analysis substantiates this conclusion," says Dr. Charles A. Barth of the University of Colorado, "a very key chemical compound is missing from the Martian environment. If this is true any life chemistry on Mars will have to be much different from what we know on earth."

Since the earth's atmospheric nitrogen comes from the planetary interior, generally from volcanoes, the absence of the element on Mars also would tend to imply a history without volcanic activity.

The ultraviolet spectrometer did detect the presence of atomic hydrogen and atomic oxygen in the upper atmosphere as well as the expected constituents of carbon dioxide and carbon monoxide.

The infrared spectrometer, designed to study the composition and temperature of the lower equatorial atmosphere, recorded wide thermal variations, with temperatures up to 75 degrees F., and revealed that the darker spots on Mars are warmer than the bright areas. "Perhaps the most exciting result," says Dr. George C. Pimentel, "is that the spectrum of ice was recorded. It seems unlikely that this could be in the spectrometer, the only possible misinterpretation, and we tentatively attribute it to a very thin ice fog." This finding tends to increase estimates of the volume of water on Mars.

Dr. Pimentel says the instruments found no traces of methane, ammonia, or nitrous oxide.

The spacecraft's infrared radiometer measured surface temperatures ranging from 60 degrees F. at Martian noon down to lower than minus 100 degrees during the night. "Preliminary analysis,"

says Dr. Gerry Neugebauer, "suggests that the surface is a very good heat insulator, in fact, better than any known solid material on earth."

Radio signals transmitted through the Martian atmosphere as the spacecraft passed behind the planet showed that the surface atmospheric pressure was about six and one-half millibars, in comparison with the 1,000-millibar pressure on earth. Thus the atmosphere on the Martian surface is about as thin as earth's at elevations of 100,000 to 150,000 feet. The occultation experiment, says Dr. A. J. Kliore, also observed an ionosphere at an altitude of about 82 miles plus a smaller ledge of ionization at an altitude of 63 miles.

This week Mariner 7 was returning the first close photos of the cratered south polar cap; it appeared to consist of frozen carbon dioxide.

While this new information on Mars from the probes was being analyzed, the Space Science Board of the National Academy of Sciences issued a report of a 23-man study panel calling for a vigorous national program of unmanned exploration of the outer solar system. Two recommended grand tour missions beyond Jupiter will probably prompt the most discussion, but they actually were rated only third and fourth in order of scientific significance among five missions recommended.

More important for now would be a 1974 Jupiter flyby mission to drop a probe into that planet's atmosphere, and a mission in 1976 to place a spacecraft into orbit about Jupiter. The atmospheres of Jupiter and Saturn hold extreme interest for scientists because they are thought to have remained nearly the same since the formation of the solar system. Lighter planets like the earth lost their original atmospheres before producing their present ones.

The grand tour concept is based on an unusual orientation of the planets in the late 1970's. A spacecraft can use the gravitational attraction of each of the outer planets to swing on toward the next one at a remarkable saving in energy. The identical situation won't exist again for 179 years.

The scientists suggest at least one spacecraft be launched in 1977 to Jupiter, Saturn and Pluto and two in 1979 to Jupiter, Uranus and Neptune. A fifth recommended mission would be to send a probe into Uranus' atmosphere in the 1980's.

Because of the massive technological difficulties to be surmounted, say the scientists, detailed planning must begin now. They suggest the National Aeronautics and Space Administration present to Congress a balanced long-term program for outer-planet exploration in its 1971 budget proposal. ◇

ATOMS FOR PURITY

Redirecting a national lab

As nuclear power becomes less of a research problem and more of a commercial reality, the need for vast Government laboratories in the atomic field will decline. And although nuclear engineering still has a lot of pioneering to go through (see p. 113) those concerned with the labs are looking to a possible future when they will have nothing to do.

Argonne National Laboratory is a prime example. Without new top priority challenges to justify the capital investment of over $400 million and an annual cost of more than $120 million, the laboratory could find itself in the untenable position of having outgrown its usefulness. However, salvation may be close at hand.

Last week, at a Chicago convention of the Argonne Universities Association, the independent controlling body of the Argonne Lab, more than 300 scientists, university presidents, students, industry leaders, Congressmen and public officials supported a proposal to set a new course for the Argonne organization. The new mission would pioneer a unique interdisciplinary approach to problems caused by the impact of the technological revolution upon the environment.

National concern for environmental problems has resulted in a runaway proliferation of fragmented efforts to cope with the lengthening list of troubles, but the total effect is that of a medusa-headed, flailing activity which is failing to stem the continuing deterioration of the earth's life-support systems.

Things have not gotten any better since Congress conducted a survey three years ago which vividly demonstrated the disjointed, scattered activities concerned with environmental pollution control and abatement conducted in 196 laboratories operated by nine different Federal agencies or departments (SN: 3/12/66, p. 471). The policy-makers for Argonne believe they have both the organization and technical-scientific capability to provide the continuity and competence necessary to help close the widening gaps in the nation's attack on environmental problems.

And it is research that is needed. Dr. Rene J. Dubos, microbiologist at the Rockefeller University, points out that while cost is often cited as the major obstacle to pollution control, "in fact, we could not formulate really effective control programs even if we had limitless resources because we know so little concerning the origin, nature and effects of most . . . pollutants."

Dr. Philip N. Powers, AUA president, says there is no way to tell how large this effort may become, nor just what relationship it will have with the Argonne National Laboratory. "But of course," he says, "we hope it will grow." On the question of funding, Dr. Powers says that no source would be overlooked, including Federal, state, industry and foundations.

From Congress, where some money must come, there was positive reaction to the new direction planned. Rep. Chet Holifield (D-Calif.), chairman of the Joint Committee on Atomic Energy, says the AUA plan could produce a "valuable model" for coordinating the resources of universities, Federal laboratories and Government to improve the environment. And Rep. Melvin Price (D-Ill.), also a JCAE member, says one of its best points is that it would lead scientists into the kind of involvement and excitement with environmental problems that "is sure to yield results."

SCIENCE AND ENGINEERING

Disenchantment with Apollo

Hess: Science takes the second seat.

"We . . . have the scientific program for the next several lunar missions well organized," wrote Dr. Wilmot N. Hess, director of science at the Manned Spacecraft Center in Houston.

Well organized, perhaps, but apparently not very well fed. Despite the vast knowledge that stands to be gained from the lunar rocks brought back by Apollo 11 and its successors, the National Aeronautics and Space Administration's manned flight effort is by any standard an engineer-dominated undertaking. Space scientists agree that it is an engineering marvel which has made their opportunity possible, but a number of them have nonetheless been dissatisfied that science's role is such a meager one.

Dr. Hess's seemingly optimistic state-