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SCIENCE

Viking 1

In the relatively short period in which Viking 1 has been in the vicinity of Mars much information has been gathered. This issue contains 13 reports arising from the mission.

A notable aspect of the venture has been the overall success of the engineers in preparing a relatively reliable spacecraft and in placing the lander on a smooth area of Mars. A related engineering triumph is the high quality of the pictures of Mars' surface. Results of scientific measurements on the martian atmosphere and surface are particularly interesting.

The total weight of the Viking lander at separation was 1185 kilograms. This had to suffice to provide space, power, and computer controls for 14 different experiments, as well as to provide for communications with the orbiter and Earth and the gentle placing of the lander on a chosen area of Mars. In a spacecraft with about 1,450,000 parts operating in a hostile environment, it was essential to build in the capability of meeting many contingencies and to provide a large number of redundancies to cope with unpredictable failures. A major contingency arose when close examination revealed that the original landing site was too rough and hazardous, but the Viking system had the capability of identifying and moving to a more suitable site.

The pictures transmitted to Earth in black and white and in color are much more rich in detail than those of Mariner 9. As more of them are received they will provide a basis for tackling the complex history of the evolution of the planet. Mars has experienced innumerable meteorite impacts that have left their mark. The interior of Mars has been molten! There has been volcanism with lava flows. There has been flowing water that left deeply incised channels.

On Mars, as on Earth, melting of the interior led to the evolution of volatiles. Part of these volatiles remain on Mars, and the Viking experiments have provided measurements of them. At present the total atmospheric pressure at the landing site is about 7 millibars. The principal constituents are carbon dioxide, 95 percent; nitrogen, 2 to 3 percent; argon, 1 to 2 percent; and oxygen, 0.3 to 0.4 percent. The composition of the atmosphere is influenced by condensation on cold surfaces near the poles, where temperatures as low as 134°K were observed. Under such conditions the vapor pressure of H_2O is very small (about 0 to 3 precipitable micrometers) and that of carbon dioxide is also limited.

A crucial observation is the abundance of argon. This element does not react or condense and presumably does not escape from Mars. Most of it is argon-40 derived from decay of potassium-40. On the likely assumption that the potassium abundances of the earth and Mars are roughly equal, the observations indicate that the outgassing of Mars has been only about 1/100 as complete as that of Earth.

One of the important experiments was a determination of the composition of the atmosphere as a function of height through observations made by the lander on its way from the orbiter to the surface. At an altitude of 130 kilometers, O_2^+ is the major constituent. Carbon dioxide, CO_2^+, is less abundant by a factor of 9. Recombination of O_2^+ with an electron can provide an important source of atomic oxygen, some of which might escape the planet.

It seems certain that atomic oxygen is also produced by action of short ultraviolet light on carbon dioxide throughout the atmosphere. This oxidant is extremely reactive and it combines rapidly with organic matter at temperatures comparable to the lowest seen on Mars.

The history of Mars has many parallels to that of Earth, but it is clear that there are differences. Through examination and interpretation of the similarities and differences between Earth, Mars, Venus, and the moon we will eventually better comprehend the early history and evolution of the solar system and our knowledge of Earth will be enriched.

—PHILIP H. ABELSON