ground, and may still be there."

NASA associate administrator for space science Wesley Huntress stated, at the same press briefing, that the discovery that life exists just about anywhere on Earth today "where there's a source of chemical energy and liquid water," leads one to ask, "why wouldn't it [life] have evolved also on other places in the early Solar System, where one might have had liquid water and sources of chemical energy?"

Today, Mars is a frozen planet, where the temperature stays below zero. The north and south poles are covered with water ice and frozen carbon dioxide, and the atmospheric pressure is so low, that when water evaporates from the polar caps, it does not become liquid, but sublimes directly into the atmosphere as a gas.

There are many theories about what happened to the once-plentiful flowing water on Mars, which has produced the channels, canyons, lake beds, and now-dry riverbeds that are visible today. Some of the water is clearly frozen at the poles. Some of it, undoubtedly, went into space. Ground ice, or permafrost, represents the greatest potential reservoir of water on Mars, and, according to some estimates, may indicate that there is liquid water deep within the planet.

While we are preparing for the more sophisticated unmanned, and then, manned, missions to go to the red planet for *in situ* research, there is another way that Earth-bound scientists can examine the history of life on Mars, beside investigating pieces of that planet that make their way to Earth.

Chris McKay, a physicist and exobiologist at the NASA Ames Research Center, has been approaching the question of whether primitive life developed earlier in the history of Mars, and whether or not it may still be there in some form, by looking for terrestrial, or Earth-based, analogues for the conditions that exist on Mars.

McKay has stated that when the results from Viking first came in, in 1976, he could not understand why, if the chemical ingredients for life were there, no life was found. He later determined that only one ingredient for life—water—is "nonnegotiable," and water was not present, at least not in the dry regions from which the Viking landers examined their samples. McKay has described water as a "metaphor for life."

McKay and his colleagues have been exploring places on Earth that share some of the extreme characteristics of Mars, in order to observe how life emerged, how it has survived in hostile environments, and what mechanisms can be used to discover more about Mars. This has taken him to Siberia, the Antarctic, and under the sea.

In 1990, McKay made his first expedition to northeastern Siberia, along with members of the Soviet Academy of Sciences, to explore what he termed the "best terrestrial analogue to the Martian permafrost." Freezing conditions have persisted in Siberia for over 3 million years, where temperatures fluctuate between 10 and 14°F.

Preserved in the ice, about 30 feet under the surface, the scientists found large numbers of bacteria, which, when thawed out, resumed their life functions. As McKay remarked in an interview with *Omni* magazine in 1992, "On Earth, wherever there's a niche that life can expand into, it

Meteorite trove in Antarctica

The first discovery that there were concentrations of meteorites in the Antarctic was made by Japanese scientists in 1969. Since that time, more than 16,000 pieces of meteorites have been collected in Antarctica, and since 1977, frozen meteorites have been returned to NASA's Johnson Space Center Meteorite Processing Laboratory for curation, and distribution to scientists for study. Scientists at the Johnson Space Center gained experience in extraterrestrial geology, by studying the rocks brought back from the Moon by the Apollo astronauts.

The meteorites, which are pieces of rock from space, have been preserved in the ice of Antarctica and are concentrated in areas characterized by stagnant, snow-free "blue ice." It is estimated that most of them fell to the Earth over the past 1 million years.

Most of the fragments are of asteroids, from the "belt" made up of pieces of an exploded planet between Mars and Jupiter. The two classes of meteorites that can definitely be classified by their origin are those from the Moon and Mars, because they can be matched against the rocks brought back from the former, and the chemical composition of the atmosphere of the latter, as determined by the Viking landers.

The annual hunt for meteorites in Antarctica is a joint endeavor by the National Science Foundation, the Smithsonian Institution, and NASA. The annual meteorite field visit to Antarctica by the United States is led by Dr. Ralph Harvey, a planetary geologist from the University of Tennessee.

Last year, Harvey noted that a Martian rock that he is studying—one of 12 found in Antarctica—contained carbonate, an unusual mineral for a meteorite. He said that the find had "staggering implications," in that the material would have been deposited by fluids travelling through the Martian crust. Such analyses can give scientists a new window on the development of the planet's climate, over billions of years. The Antarctic meteorites, Harvey said, provide "new and exciting ideas about our Solar System."—*Marsha Freeman*