Did NASA Find Life on Mars in the 1970's?

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When the Viking landers touched down on Mars in 1976, the search for life on the Red Planet was said to be inconclusive. Before human beings head to Mars, we should make sure we know if life is already there.

The idea of life on Mars has fascinated people since Percival Lowell first recorded features that he believed to be channels of water on the Red Planet. He named his perceived features *canali*, the Italian word for channel. These reports were badly translated by the media of the time as canals, suggesting that the astronomer had discovered an artificial system of manufactured waterways on the Red Planet.

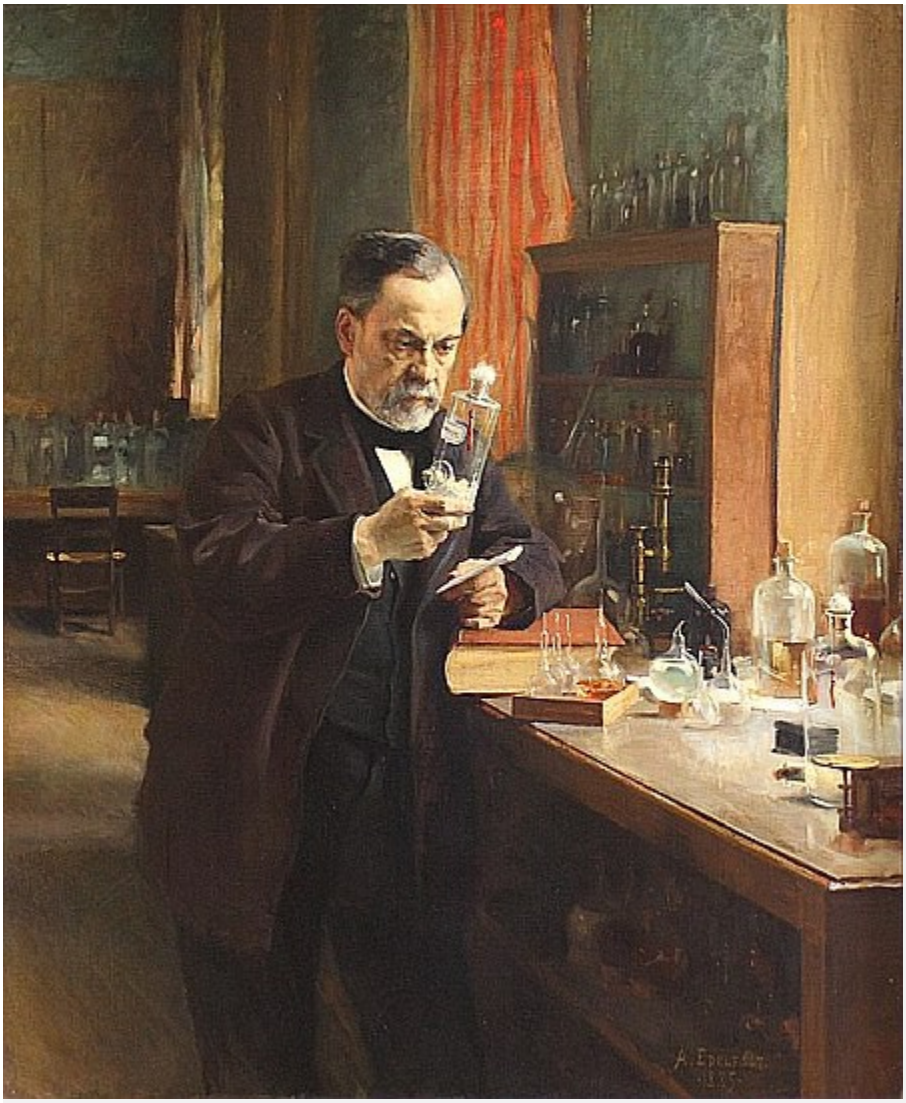
In 1975, NASA sent the Viking mission, a pair of twin rovers, to Mars to examine the geology and environment of Mars, as well as to look for signs of microbial life. The Labeled Release (LR)

experiment on the Viking mission, designed to look for signs of respiration, returned positive results, exciting researchers hoping to find the first-ever signs of extraterrestrial life.

Famed science author Carl Sagan was a driving force behind the Viking missions to Mars, where a curious result from an experiment in 1976 could suggest that primitive life may still be eking out an existence on, or just underneath, the surface of Mars. Image credit: NASA

"On July 30, 1976, the LR returned its initial results from Mars. Amazingly, they were positive. As the experiment progressed, a total of four positive results, supported by five varied controls, streamed down from the twin Viking spacecraft landed some 4,000 miles apart. It seemed we had answered that ultimate question," Gilbert Levin, principal investigator on the LR experiment, wrote in *Scientific American*.

Putting Pasteur Past Your Eyes



Louis Pasteur in his laboratory, painting by A. Edelfeldt in 1885. Public domain image.

In 1864, chemist Louis Pasteur (the brilliant mind behind pasteurized milk) allowed microbes to grow in a broth of hay. Bubbles developed soon after the microbes were introduced to the infusion. Pasteur deduced that the bubbles were the result of respiration of the microscopic creatures. Today, a similar process to that early experiment (substituting standardized microbial nutrients in place of hay broth) is used in hospitals and laboratories worldwide.

The LR experiment on Viking was essentially this same standardized test, with a few added features for use on Mars (including testing for unknown lifeforms). A thermostat was added, to test if any positive result was from life or chemical processes. Second, the number of possible nutrients was widened, making it possible to find more diverse lifeforms. Lastly, these nutrients were tagged with radioactive carbon to mark respiration.

“The importance of the issue, especially when viewed against the harsh environment on Mars, requires careful consideration of possible nonbiological reactions that may have produced false positive results,” Gavin and LR co-experimenter Patricia Ann Straat reported in a 1981 article published in *Icarus*.

A direct test to find primitive life currently living on Mars has not been carried out since the Viking program 43 years ago. Image credit: NASA/JPL-Caltech/University of Arizona

When the Viking Molecular Analysis Experiment about the landers failed to detect organic compounds on Mars, however, the results from the LR experiment were deemed to be inconclusive. Before long, NASA researchers concluded that the LR experiment produced results which only mimicked life.

Each LR experiment on the Viking spacecraft ran for seven days, and each positive sample was sterilized by heating before being tested again.

Both before and after launch, the LR process was tested on Earth thousands of times under extreme natural and laboratory

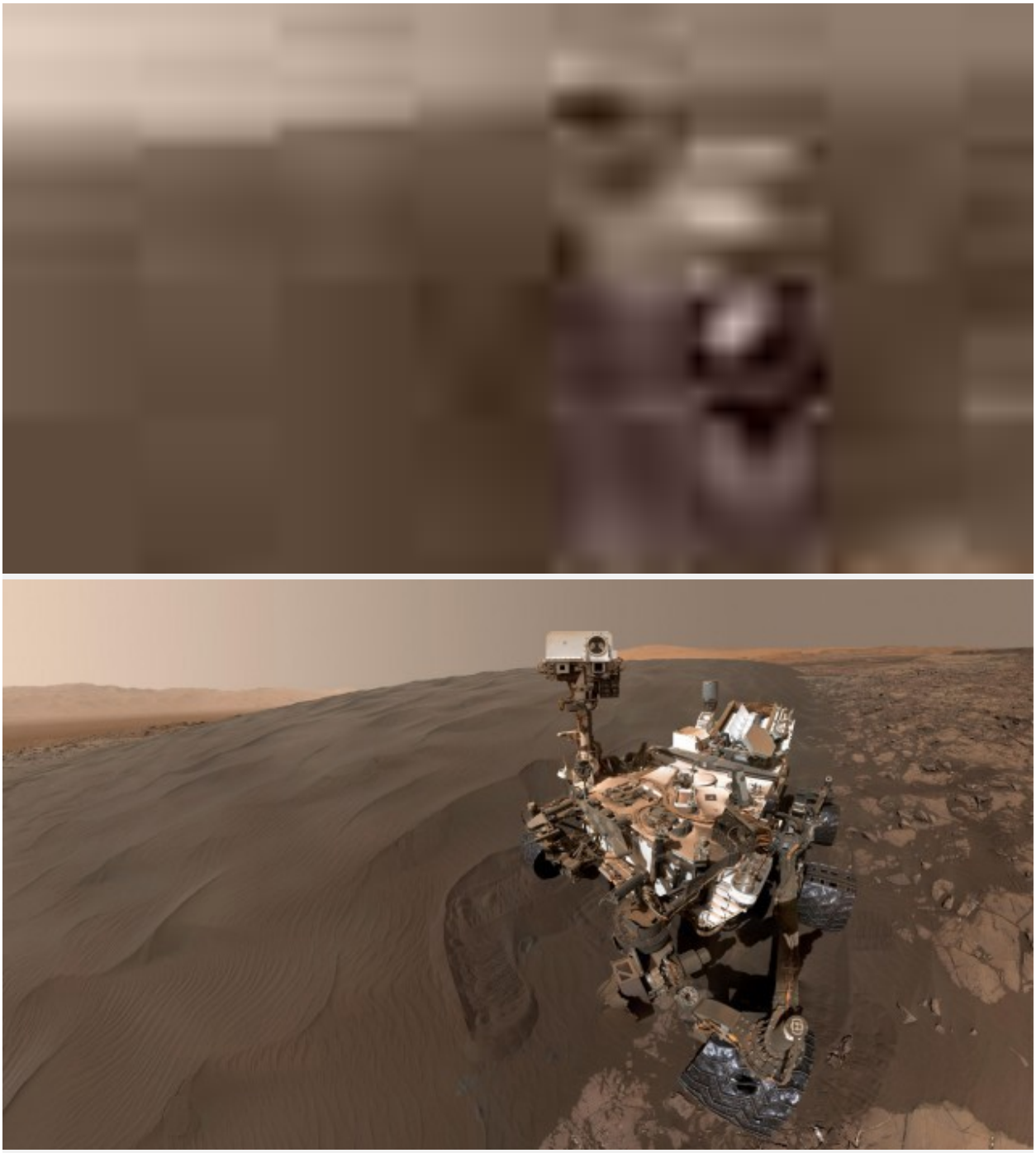
conditions. Never once during the testing did the respiration test fail, providing strong evidence of the reliability of the process.

Chemical reactions may still be responsible for the positive results seen from the LR experiment aboard Viking, but the ultimate cause of the findings remains unanswered.

Touchdown!

Four missions — Viking, Pathfinder, Phoenix and Curiosity — have shown that Mars possesses enough (frozen) water near its surface to sustain simple life.

Reports soon after the Viking results were announced concluded that ultraviolet light from the Sun may have resulted in a false positive result. However, a sample of the Martian crust found under a rock (which would have protected it from UV radiation) showed similar levels of respiration-like reactions in the LR experiment.



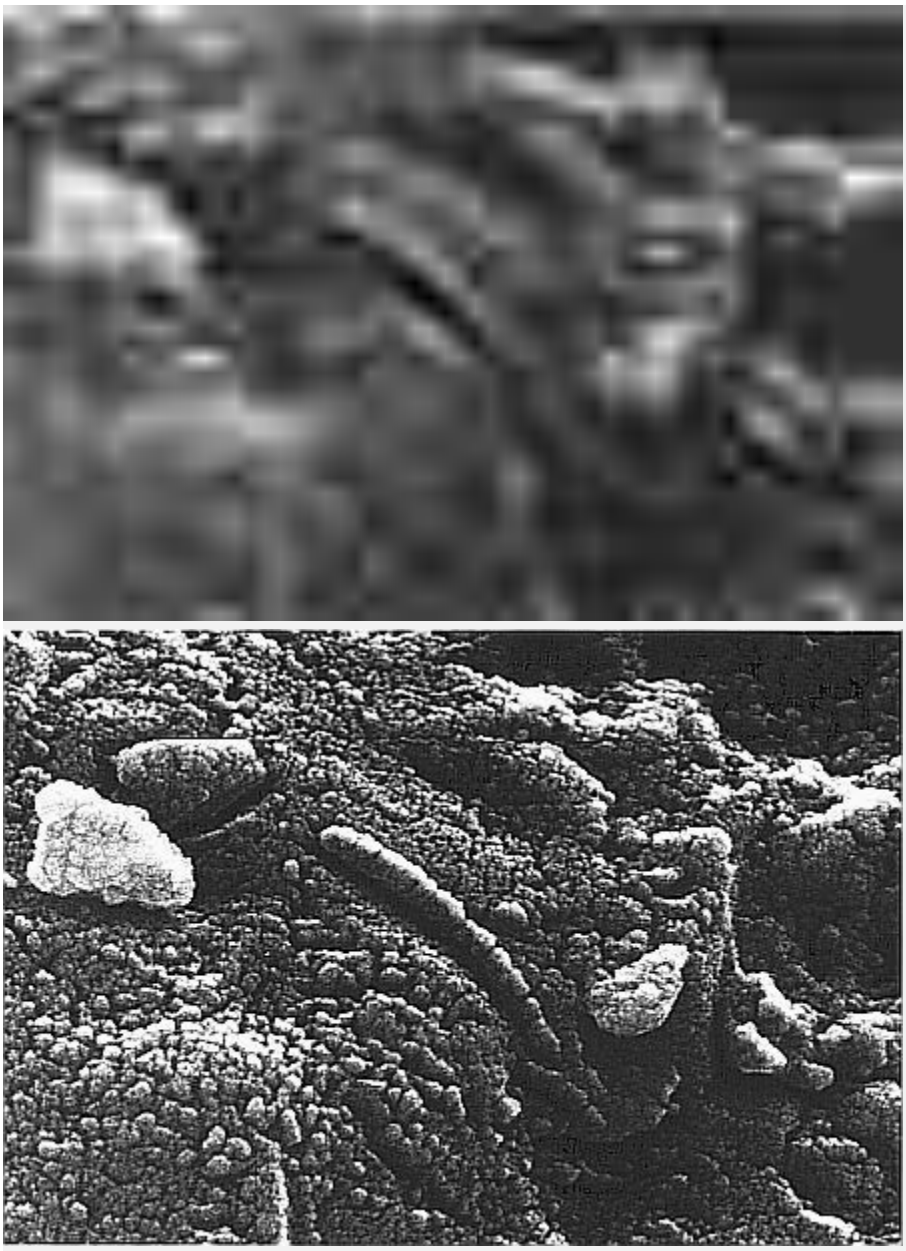
The Curiosity rover on Mars was stunningly successful, returning loads of science from the Red Planet. Image credit: NASA

The Curiosity spacecraft found complex organic molecules, including kerogen (a waxy, organic substance often associated

with life on Earth). Both Curiosity and the Phoenix lander found signs that Mars may have once had a far more temperate environment than that found today.

The Martian atmosphere also contains more carbon dioxide than should be the case if there were no life on Mars. Ultraviolet light from the Sun converts carbon dioxide (CO_2) into carbon monoxide (CO). This, the researchers conclude, suggests something unknown (possibly microbes) is regenerating CO_2, releasing the gas into the atmosphere.

Unusually high levels of methane in the Martian atmosphere may also be the result of biological activity, as it is on Earth. A theoretical balance may have evolved on Mars, between bacterial methanogens producing methane, and methanotrophes, turning that methane into carbon dioxide and other by-products. This would explain the rise and fall of methane levels detected by robotic explorers on Mars.



An asteroid from Mars, discovered on Earth in 1984, shows features which could be fossils of ancient, primitive life. Public domain image.

It may also be possible that life from Earth populated Mars in the ancient past, as material passed from our world to our tawny neighbor. For billions of years, debris has flown between Earth and Mars, and it is possible that life from one world landed on the surface of the other planet.

Some microbes from Earth have been shown to survive the harsh environment of Mars, at least under laboratory conditions. The hardiest microbes have been known to survive the harsh conditions of outer space, on the outside of the International Space Station (ISS), and tardigrades — those hardy love-em-or-leave-em creatures — may be currently living on the Moon, following the crash of the Beresheet mission.

Methane flares have been seen on Mars, and evidence has been found for both formaldehyde and ammonia. Each of these findings could be, but are not necessarily, the product of biology in the Martian atmosphere.

Do You Think We Have Chemistry?

A look at the Viking mission which marked tremendous advances in our understanding of the Red Planet. Video credit: Khan Academy Labs

"The possibility of life on Mars has excited human imagination since well before the time of Percival Lowell and has been depicted in countless works of imagination by such authors as H. G. Wells, Edgar Rice Burroughs, and Ray Bradbury. But an empirical test of this possibility had to await the Viking mission to Mars in 1976," Straat and Levin wrote (with Joseph D. Miller).

Levin and Straat (author of *To Mars with Love*) suggest a future experiment to launch to the Red Planet. This proposed test would be much like the one sent on Viking, with one additional feature.

Molecules can form into mirror images of each other, like your two hands. They fit over each other perfectly when placed palm to palm. However, they cannot be overlaid in such a way that both palms, or both backs, can be seen at the same time. In chemistry, this is known as chirality, and the difference between the two forms can make huge differences in how they react in biology and medicine.

In addition, non-biological chemical reactions do not differentiate between *right-handed* and *left-handed* molecules. However, nearly all biological processes treat the two forms of a given chemical differently, depending on the handedness. A reaction which favored right- or left-handed molecules would strongly suggest the presence of life.

The proposed Chiral Labeled Release (CLR) experiment would extend, and possibly confirm, the results of the LR experiment conducted at a time when the U.S. had just finished celebrating its bicentennial and Jimmy Carter was newly-elected to the Oval Office.

Space agencies around the world are planning new generations of spacecraft designed to explore Mars, including NASA's Mars Helicopter. A dual mission between the European Space Agency (ESA) and Roscosmos (the Russian space agency), the ExoMars 2020 project, will feature a rover named in honor of groundbreaking biologist Rosalind Franklin, and the Kazachok

laboratory, which will carry out detailed analysis of samples collected by the rover.

The descent module for ExoMars 2020 from the European Space Agency and Roscosmos will place the Rosalind Franklin rover on Mars, which could provide insights into the search for life on Mars. Image credit: Roscosmos

Still, future missions will be needed to properly confirm or deny the uncertain results obtained in 1976. The idea of a follow-up experiment to Viking has been discussed by NASA researchers.

“Our study shows the Viking instruments from the 1970s may have been unable to detect low levels of organics on Mars, due to the presence of iron in the soils, because the soil was heated in the presence of this iron. Future Mars missions should use methods that do not involve heating the soil, such as liquid extraction,”

said Christopher McKay, a scientist at NASA Ames Research Center in California.

A small CLR has been designed, and the principle science successfully tested, researchers report.

As NASA and other organizations ready plans to send human beings to Mars, it becomes ever more imperative to know if life already exists on that world. First, any such lifeforms could, theoretically, infect human beings. Second, like the crew of the Enterprise in *Star Trek: The Wrath of Khan*, we don't want to place new life on a world that already has its own native species, however primitive.

The results of the LR experiment onboard Viking provide intriguing evidence for an answer to one of the greatest questions in astronomy — are we alone? We won't know the answer for Mars — one way or another — until a spacecraft touches down, once more, to search for life on the surface of the Red Planet.