The background of the entire cover is a vibrant, colorful nebula or cosmic cloud. It features a mix of fiery reds, oranges, and yellows, transitioning into cooler blues and greens on the right side. A bright, multi-pointed star or distant galaxy core is visible in the upper left quadrant, casting a soft glow. The overall texture is ethereal and dynamic, typical of astronomical imagery.

# **LIFE ON OTHER WORLDS**

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**THE 20TH-CENTURY  
EXTRATERRESTRIAL LIFE DEBATE**

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**STEVEN J. DICK**

# *Life on Other Worlds*

## *The 20th-Century Extraterrestrial Life Debate*

STEVEN J. DICK



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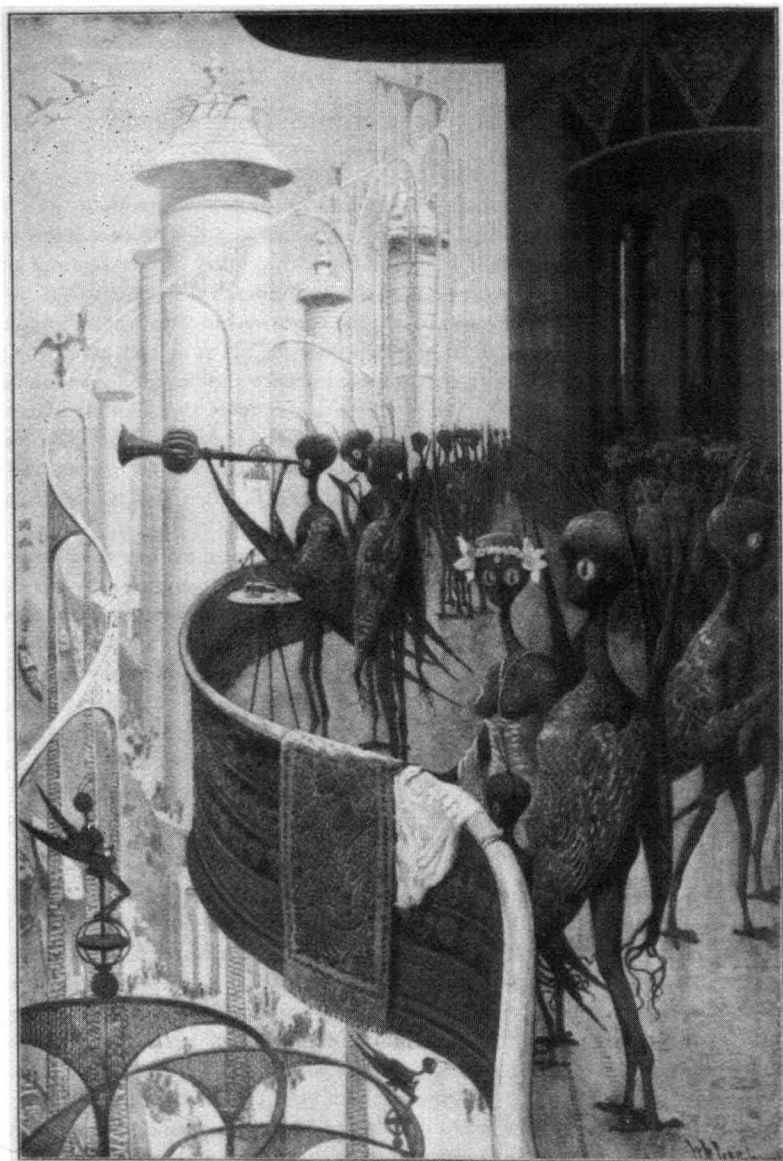
## *Life on Other Worlds*

### The 20th-Century Extraterrestrial Life Debate

The recent discoveries of extrasolar planets and possible microfossils in Martian meteorite ALH 84001 are only the latest developments in a debate that spans millennia and that has been especially heated in the 20th century. From the furor over Percival Lowell's claim of canals on Mars at the beginning of the century to the biological experiments of the Viking spacecraft, the controversial "Mars rock," and the sophisticated Search for Extraterrestrial Intelligence (SETI) at its end, otherworldly life has often titillated and occasionally consumed science and the public. So too have crucially related areas such as the search for planetary systems, the quest for an explanation of UFOs, and inquiries into the origin of life. The theme has been elaborated by science fiction writers from H. G. Wells to Arthur C. Clarke and has resulted in some of the most popular films of all time, including *E.T.*, *Alien*, *Independence Day*, and *Contact*.

*Life on Other Worlds* details in a readable and nontechnical manner the history of the 20th-century extraterrestrial life debate, one of the pervasive themes of our century. Unlike other works on the subject, it places the current debate in historical perspective, showing how the concept of extraterrestrial intelligence is a worldview of its own, a "biophysical cosmology" that seeks confirmation no less than physical views of the universe. It is, however, a subject at the very limits of science, and scientific attempts at confirmation therefore illuminate the nature of science itself. This history is not only important for an understanding of the nature of science, but is also central to any forward-looking concept of religion, philosophy, and numerous other areas of human endeavor. Extraterrestrial life will be one of the predominant themes of science in the 21st century.

Steven J. Dick is an astronomer and historian of science at the United States Naval Observatory in Washington, D.C. He is the author of *Plurality of Worlds: The Origins of the Extraterrestrial Life Debate from Democritus to Kant* (Cambridge University Press, 1982), *The Biological Universe: The Twentieth-Century Extraterrestrial Life Debate and the Limits of Science* (Cambridge University Press, 1996), and numerous articles in both scientific and historical journals, including *Space Science Reviews*, *Journal of the History of Ideas, Technology and Culture*, and *Journal for the History of Astronomy*. Dr. Dick has served as historian for NASA's Search for Extraterrestrial Intelligence (SETI) program and was a member of a NASA workshop examining the cultural aspects of success in SETI, including the short-term and long-term implications of contact with extraterrestrials. He was a member of the panel convened by Vice President Al Gore in 1996 to examine the implications of possible fossilized life in the Mars rock.



"THERE ARE CERTAIN FEATURES IN WHICH THEY ARE LIKELY TO RESEMBLE US. AND AS LIKELY AS NOT THEY WILL BE COVERED WITH FEATHERS OR FUR. IT IS NO LESS REASONABLE TO SUPPOSE, INSTEAD OF A HAND, A GROUP OF TENTACLES OR PROBOSCIS-LIKE ORGANS"

Frontispiece. Illustration by William R. Leigh from H. G. Wells, "The Things That Live on Mars," a nonfiction article that appeared in *Cosmopolitan Magazine* in March 1908 at the height of the Martian canals furor.

*To those who search for the meaning of Life*

Glendower: I can call spirits from the vasty deep.

Hotspur: Why, so can I, or so can any man;  
But will they come when you do call for them?

Shakespeare

*Henry IV, Part I*

Act 3, Scene I, 52–58

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# INTRODUCTION

*The eternal silence of these infinite spaces frightens me.*

Pascal, *Pensées*

Deep in the summer of 1996, a startling announcement came from the National Aeronautics and Space Administration (NASA), the American space agency. Life had been found on Mars! Maybe. The very possibility set the world afire, igniting media hype, public imagination, and scientific curiosity alike.

On August 7, with little more than a day's notice, reporters descended on a hastily called NASA press conference, to which the participants themselves had been hurriedly summoned. A carefully planned announcement for the following week had been upstaged by a three-paragraph leak in the industry newspaper *Space News*, and the exhausted scientists had flown in from around the country. Among the many officials in the audience were the heads of the National Science Foundation (NSF), and the National Academy of Sciences, and Gerald Soffen, the project scientist for the Viking spacecraft, which had landed on Mars 20 years earlier. First to the podium was NASA Administrator Dan Goldin, who had already briefed President Bill Clinton and other top political officials. He waxed eloquent about NASA, American science, and the breathtaking conclusions about to be announced, and reported that the president had asked that the discovery be given top priority and that Vice President Al Gore call a space summit to examine its significance. Indeed, President Clinton professed, "I am determined that the American space program will put its full intellectual power and technological prowess behind the search for further evidence of life on Mars."

NASA Associate Administrator for Space Science Wes Huntress then turned the podium over to the scientists, a team of nine led by geochemist David McKay of NASA's Johnson Space Center. Now they presented their evidence to a hushed audience. Organic molecules had been found in a meteorite that was blown off of Mars 16 million years ago, had landed in the Antarctic 13,000 years ago, was found there by a meteorite-collecting team funded by NSF and the Smithsonian Institution 12 years ago, and had been recognized as Martian only 2 years ago. Two years of exhaustive study had led the researchers to their momentous conclusions. The claim of organic molecules on Mars was already a step beyond the Viking results. But there was much more: mineral "carbonate globules" of possible biological origin; evidence of tiny magnetic minerals that on Earth are secreted by certain bacteria; and finally, pictures

of strange elongated, hauntingly wormlike structures that they argued might be microfossils. In short, the assembled scientists suggested, life had existed on Mars sometime in the planet's distant past, when Mars was warmer and wetter.

This was not exactly the Martian civilization some had hoped for, but compared to the dry results of Viking 20 years before, it was little short of miraculous. The result had already been peer-reviewed and was scheduled to appear in the August 16 issue of the prestigious journal *Science*. Yet, as always in the debate over life on Mars, there was a "maybe," and NASA had arranged for skeptical University of California at Los Angeles (UCLA) paleobiologist William Schopf to comment at the news conference. He agreed that the evidence of Martian origin was good, and that the evidence of organic molecules was good though not proved to be extraterrestrial. But he argued that the fossils were 100 times smaller than the smallest such fossils found on Earth and were not proved to be fossils at all. He quoted Carl Sagan, the pioneering exobiologist who died only a few months later, that "extraordinary claims require extraordinary evidence" and concluded that incontrovertible evidence for life (e.g., a cell) had not yet been found. Thus began yet another debate over Martian life, a subject that has exerted a peculiarly romantic pull on popular and scientific imagination for more than a century.

In subsequent months, British scientists confirmed the existence of organic molecules in a much younger Martian meteorite. But the claim of Martian fossils proved to be a much harder sell, especially when critics claimed that the carbonate globules had been formed at temperatures so high that life could not have been associated with them. Nevertheless Sagan and others proclaimed a new era, and most Americans, at least, were ready to follow. Whether or not the Mars rock proved in the end to harbor life, one thing was clear: the rock dramatically drew the attention of millions to the fact that Mars had once been warmer and wetter, the kind of place where life might have developed. Life on Mars, a subject practically dead since the Viking missions of 1976, was given a new lease on life and seemed destined to be one of the major themes of the 21st century. Already in 1997 the Pathfinder spacecraft landed on Mars with its roving Sojourner, and the Mars Global Surveyor arrived to chart a new world. And these were only the vanguard of many more spacecraft to come, always with that tantalizing question of life in mind.

The year 1996 was a turning point in other areas related to the extraterrestrial life debate. Even as the significance of the Martian meteorite was being pondered, the Galileo spacecraft returned high-resolution pictures of the enigmatic Jovian satellite Europa, showing a surface likely to be cracked ice, probably floating on an enormous ocean, which could contain life. Beyond the solar system, 1996 also saw the confirmation of one of the Holy Grails of

astronomy of the 20th century: the discovery of not only 1 but 8 (and possibly 10) planets orbiting other Sun-like stars. Although not Earth-like, they fueled further the fires of extraterrestrial expectation. More generally, life was increasingly found flourishing on Earth in extreme environments – notably in hydrothermal vents at temperatures of 110°C, inside rocks, and several kilometers below the Earth's surface, requiring energy sources and metabolisms alien to our usual ways of thinking. If life could survive in such extreme conditions, exobiological optimists asked, could it not thrive in a variety of planetary environments in outer space? It all seemed very logical even to the most jaded skeptic.

All of these events were only the most recent manifestation of a debate that stretches back through millennia of history. My own interest in these discoveries was sharpened because my history of the extraterrestrial life debate during the 20th century had been published only a few months before. *The Biological Universe: The Twentieth-Century Extraterrestrial Life Debate and the Limits of Science* said very little about fossil life on Mars because it had simply not yet played an important part in the debate. While European seas had received some treatment among scientists and the press, the idea had not yet received the widespread attention it now commands in science and will command in history. Nor was the outcome of the planetary systems debate at all as clear as it now seems to be. With the conviction that historical perspective is essential to understanding the current debate, I have with this volume abridged *The Biological Universe* in an attempt to reach a wider audience and have also taken the opportunity to integrate the new discoveries into the story. Altogether, *Life on Other Worlds* offers not only an interpretation of the events in the debate, but also an interpretation of their significance, which in my judgment constitutes a world view comparable to the Copernican and Darwinian worldviews.

Meanwhile, the influence of extraterrestrial life on popular culture, already a major theme of the 20th century, shows no sign of flagging. The movie *Independence Day*, in which humanity fights off the invading aliens, was by far the most popular movie of 1996, even as *Men In Black* and the movie version of Carl Sagan's *Contact* were among the most popular movies of 1997. The suicide in California of 39 individuals who believed they were going to beam aboard an alien spaceship following in the wake of comet Hale-Bopp in the spring of 1996 shows the tragic outcome of a cosmotheology gone wrong. The Pathfinder landing on Mars on July 4, 1997, was juxtaposed with media coverage of the thousands who gathered in Roswell, New Mexico, to celebrate the 50th anniversary of the supposed crash of an alien spaceship. And as we approached the new millennium, unidentified flying object (UFO) reports were once again on the rise, and major polls showed that most people believe them to be spaceships piloted by extraterrestrials. It is a long way