

All These Worlds Are Yours

The Scientific Search for Alien Life

Jon Willis

Yale U. Press, 2016. \$30.00 (232 pp.). ISBN 978-0-300-20869-6

In *All These Worlds Are Yours: The Scientific Search for Alien Life*, Jon Willis poses an unusual challenge to his reader: Given a budget of \$4 billion, take a major step forward in the search for life beyond Earth. To prepare readers for the task, Willis introduces them to astrobiology, a subject predicated on the assumption that Earth is not the only incubator of life in the universe.

As a reader, you essentially become a student in Willis's astrobiology class for nonscience majors. Your guide lowers the lights and takes you on a journey from Mars to the nearby stars and draws from his own experiences as an astronomer to answer some of the most important questions scientists are grappling with. Readers are invited to propose missions to far-away solar systems or spend their funds on new high-powered telescopes to examine distant exoplanets. For the farthest of those, we can only hope to monitor atmospheric gases as we look for evidence that respiration is upsetting the expected gas equilibrium.

The first chapters read like a tour through the Library of Congress's science section, narrated by Bill Nye and conducted while speeding through on roller skates. This quick romp through the fields of cosmology, geology, biology, and the entire history of life on Earth leaves the reader breathless. Amazingly, the important and controversial topic of evolution, part of every astrobiologist's conception of life, is given a mere two-sentence explanation with a footnote that instructs the reader to refer to *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe without Design* by Richard Dawkins (Norton, 1987). So be forearmed and read Dawkins first, for astrobiology cannot be properly understood without knowledge of how evolution allows life to adapt to any habitable environment.

Once Willis has gotten his readers up to speed as amateur astrobiologists, he presents the most enjoyable part of the

book, chapters 4–8. There, he reveals the current status of the search in our galaxy for habitable zones—the locations in the solar system and nearby star systems that have a chance of maintaining the complex chemistry that is the basis for any reasonable notion of life. In particular, he explores current data sets from the astronomical locations where the chances of finding alien life are highest. He starts with Mars, progresses to the water-rich moons of Jupiter and Saturn, and finally examines the plethora of exoplanets that are being cataloged and studied.

Through well-posed questions, the reader is prompted to think about how to spend his or her imaginary budget on missions to each of these recently discovered habitable zones. Choices must be made because the budget—just like the actual NASA budget—is not large enough to do justice to every potential habitable site. Willis is not reticent in giving his own opinions on how the funds should be allocated, but he understands that the reader may not agree.

The book ends with a discussion of SETI's speculative search for intelligent life and the huge interest that would come from the interception of intelligent radio signals from a distant star. However, Willis does not give SETI much chance of success; two-way communication would be nearly impossible for all but the closest stars.



As much as I like Willis's descriptions of planetary destinations for future missions, I find several weaknesses in this book. First, it has no illustrations, even though well-chosen figures would make remarkable phenomena like the geysers of Enceladus a visual reality; nor are there references to webpages that contain such images.

I also found the introduction to be too broad and shallow. Willis could have omitted the cosmology and concentrated on the development of the solar system and history of life on Earth and, yes, dedicated a section to the theory of evolution. Once the chemistry of the cell is explained, the reader will be able to understand the role of the mutations and adaptations that enable the famous survival of the fittest to proceed. The footnotes and reference books recommended are a bare minimum from the vast library that is available. Also, although the delivery is meant to be amusing and fun, it often falls flat, and the jocular tone can distract and annoy the reader.

For a more scholarly but still readable approach to the subject for the beginner, I recommend *Astrobiology: A Very Short Introduction* by planetary scientist David Catling (Oxford University Press, 2013). Catling fills in some of the gaps in the Willis book; for example, he gives a fuller treatment of complex topics like greenhouse warming. However, the wide range of scientific explorations that make up astrobiology require more than one quick read. For you nonscientists interested in the subject, a variety of books—including Willis's—and a search of the latest images online will make all these worlds yours.

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Placing Outer Space

An Earthly Ethnography of Other Worlds

Lisa Messeri

Duke U. Press, 2016. \$23.95 paper (248 pp.). ISBN 978-0-8223-6203-6

Photographic panoramas from Mars and flyby shots of Pluto often give lay observers the illusion that they are witnessing planetary exploration firsthand. But such images offer no view of the actual human work of planetary

exploration. The scientists and engineers who work on planetary missions tend to be eclipsed by the technologies they have developed or the discoveries they have made. That



situation is not helped by the fact that all of planetary exploration is undertaken by large, bureaucratic space agencies. The women and men who explore the planets remain mostly unknown.

The human side of planetary science and exploration is difficult to capture. Studies of planetary scientists suffer from the standard problems of describing scientific activity in general. It is hard to explain the motivations of scientists working in areas of arcane knowledge and even more challenging to demonstrate how that knowledge and the practices that produce it connect to the world at large. The problems are exacerbated by the special nature of planetary science, in which robotic spacecraft and rovers do so much of the work remotely.

In light of those problems, Lisa Messeri's new book, *Placing Outer Space: An Earthly Ethnography of Other Worlds*, is a welcome addition to the literature on planetary science. Not only has Messeri achieved what has eluded so many writers—putting humans at the center of the account—she has also succeeded in crafting a compelling narrative of discovery.

Messeri, an anthropologist at the University of Virginia, describes her research field as “social studies of outer space.” She has a background in aerospace engineering, which comes in handy when she interacts with scientists and engineers. But the primary toolkit she brings is the theory and methodology of science and technology studies. Her focus is not on how a probe takes a picture of a planet and sends it home for analysis, but on what the human activities surrounding the probe can tell us about our culture and our way of understanding the world.

Readers unacquainted with sociology or anthropology need not fear. Messeri's book is informed by theory but is not limited to theoretical discussions. It is a journey through the terrestrial places of planetary exploration, places populated by the scientists Messeri meets and colored by the stories they tell. One of the book's great strengths is its clear and energetic narrative style. Messeri has a rare talent for bringing readers along, in a sense allowing them to witness the interactions with her research subjects, which inform her analysis and conclusions.

Placing Outer Space focuses on the sci-

entific efforts to make distant planets into tangible sites of scientific investigation. She proposes that four activities dominate the work of planetary scientists: narrating, mapping, visualizing, and inhabiting. This work produces stories that connect Earth to the solar system, domesticate the strange and unfamiliar, make visible the invisible, and imagine life on other planets.

The four main chapters of the book explore those activities in four research centers. In the first, Messeri visits a simulated Mars habitat in the Utah desert, where she joins a team of space-suited explorers enacting a Mars mission. In the next, she visits NASA's Ames Research Center, where she observes a team of computer scientists working to produce high-resolution three-dimensional maps of the Martian surface. Then she heads to the lab of exoplanet researcher Sara Sea-

ger to observe the discovery of planets orbiting other stars and the study of their possible characteristics. The final chapter looks at the effort to find potentially habitable worlds among the exoplanets and examines observatories' efforts to connect life on Earth to life elsewhere.

Messeri's work suggests that the imagining of planets as places to be visited and explored is a mode of understanding in its own right. It produces a perspective that connects Earth to its sister planets in the solar system and to solar systems around other stars. Those places are beyond human reach, at least currently, but the activities of science have connected them to our understanding of our own world.

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A Global Warming Primer

Answering Your Questions about the Science, the Consequences, and the Solutions

Jeffrey Bennett

Big Kid Science, 2016. \$15.00 paper (128 pp.). ISBN 978-1937548780

People interested in the science of climate change often ask me where they can go to learn more. The obvious answer is the internet, since a tremendous amount of scientific information is available online. However, many sources present misleading information about climate change—sometimes intentionally—and it is certainly possible to be hoodwinked.

Now I can direct my questioners to an excellent new book: *A Global Warming Primer: Answering Your Questions about the Science, the Consequences, and the Solutions*. The author is Jeffrey Bennett, an astronomer and accomplished science communicator who brings wide-ranging expertise to this book. *A Global Warming Primer* is a uniquely powerful resource for people who are interested in the science of climate change and want to know what they can do about global warming.

One major reason I liked this book is that it gets the science right. Bennett presents the science of climate change clearly, in a way that will be understandable to readers without scientific training.

But perhaps more importantly, he uses a three-step process to help readers come to incontrovertible conclusions. He opens

the book by asking two key scientific questions. How do we know that carbon dioxide and other greenhouse gases can trap heat? And how do we know that human activity is increasing the amount of those gases in the atmosphere? Answering the two questions leads to the inevitable conclusion that human activity is warming the planet and is expected to continue doing so.

In the next chapter, Bennett gets into current debates over climate change. Rather than handle the increasing multitude of contrarian views, he picks the central objections that interested readers should be aware of. First, he shows that even scientific contrarians understand the greenhouse effect and the evidence that humans are causing global warming. The naysayers usually argue that Earth will not warm up as much as most

