REPORTS OF THE NATIONAL CENTER FOR SCIENCE EDUCATION

Published bimonthly by the National Center for Science Education

REPORTS.NCSE.COM
ISSN 2159-9270

REVIEW

The Stardust Revolution: The New Story of Our Origin in the Stars

by Jacob Berkowitz
Amherst (NY): Prometheus Books, 2012. 376 pages

reviewed by David Morrison

This is a terrific introduction to the science of astrobiology, written for the lay reader. Berkowitz, a prize-winning science writer, takes as his starting point Carl Sagan's famous assertion that we are all made of stardust: hence his title, *The Stardust Revolution*. He characterizes the search for our cosmic origins as a third great scientific revolution, comparable in importance to the Copernican Revolution that dethroned Earth as the pivot point of creation, and the Darwinian Revolution that placed us in the ebb and flow of all terrestrial life. He calls the "stardust revolution" a merging of astronomy and evolutionary biology, a synthesis of astrobiology and astrochemistry. The stardust revolution is about bringing biology into the space age.

In his introduction, Berkowitz calls this story the greatest genealogical search of all time, going back to the birth of the elements in exploding stars. The elements are stardust, our cosmic heritage, which is still recognizable in our blood and bones. He begins with NASA's program called Origins, quoting a 2005 National Academy study that stated, "a full and complete picture of the origin and evolution of life must take into account its astrophysical context." In calling this new interdisciplinary study not astrobiology or origins science but stardust science, he has coined a less formidable piece of jargon that recognizes the sense that stardust is also the term for "the stuff of fantasy, intangible and elusive."

This book presents the science primarily through the scientists who are or were themselves the stardust revolutionaries. These include astrochemist Lucy Ziurys of the University of Arizona; Willy Fowler, who received the Nobel Prize for explaining how heavy elements are formed in stars, and his colleague Fred Hoyle, who did not; pioneer student of the origin of life Alexander Oparin; geneticist Joshua Lederberg, who coined the word "exobiology"; physicist Charlie Townes, who invented the laser and the maser, enabling the detection of molecules in the thin gas between the stars; astrobiologist Scott Sandford of the NASA Stardust Project; pioneer exoplanet hunters Bruce Campbell (who failed) and Geoff Marcy (who succeeded); Bill Borucki and Natalie Batalha of the NASA Kepler Mission, which has discovered the first Earth-like planets; and many others. His emphasis on people and their motivations makes this book an easy read, while many of his historical insights will be fascinating even to veteran astrobiologists.

The first major theme of the book is "Born of stars." Here the author discusses the discoveries of nineteenth-century pioneers such as Bunsen and Fraunhofer who invented the techniques used by astronomers to determine stellar compositions with amazing precision.

He then traces the complex issue of the origin of the elements, especially the "heavy" elements (anything with a mass greater than helium's), which are critical to the existence of planets and life. His detailed and even-handed discussion of the research of Willy Fowler, Fred Hoyle, and their collaborators makes the complex physics of element formation in stellar interiors readily understandable.

Part 2, "The invisible universe," begins with an overview of the basic questions (many still unanswered) about the origin of life. Berkowitz then provides a broad view of modern astronomy emphasizing the essential elements for life: hydrogen, oxygen, carbon, and nitrogen. Much of this discussion focuses on the way infrared and radio detection has revealed a universe teeming with complex molecules, including organic molecules that are possible building blocks for life.

Part 3 takes the next step to a "Living cosmos." We begin with the solar system, tracing the origin of the precursors of life on our own planet. He tells how astrochemists today are following Carl Sagan's dream to understand the primordial soup and explore the possibility of life throughout the cosmos. Finally, there is an up-to-date assessment of the existence of other worlds that might be the home of life. This chapter begins with a 1908 quote from George Ellery Hale: "The province of the student of astrophysics may be said to end with an understanding of the production of a planet like the Earth." It ends with the latest results of the search by Kepler mission scientists for "Earth 2.0."

This is a splendid book, beautifully written and scientifically accurate. Its structure, using the stories of individual scientists to illuminate the quest to understand our cosmic origin, is highly successful. This book can be read with profit and pleasure by anyone from a young student beginning her interest in science to an old astronomer, like this reviewer, who has trod many of these paths for the past half century.

About the author

David Morrison is director of the Carl Sagan Center for Study of Life in the Universe at the SETI Institute, and a member of NCSE's Advisory Council.

Author's address

David Morrison
SETI Institute
189 N Bernardo Ave
Mountain View CA 94043
dmorrison@seti.org