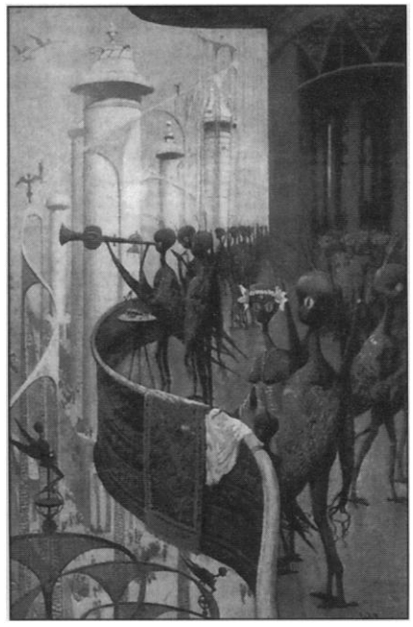
BOOK REVIEWS

Looking for Company

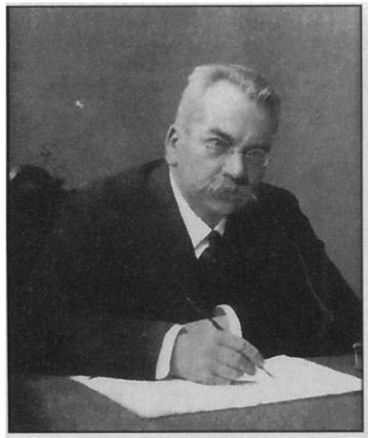
The Biological Universe. The Twentieth-Century Extraterrestrial Life Debate and the Limits of Science. STEVEN J. DICK. Cambridge University Press, New York, 1996. xvi, 578 pp., illus. $54.95 or £40. ISBN 0-521-34326-7.

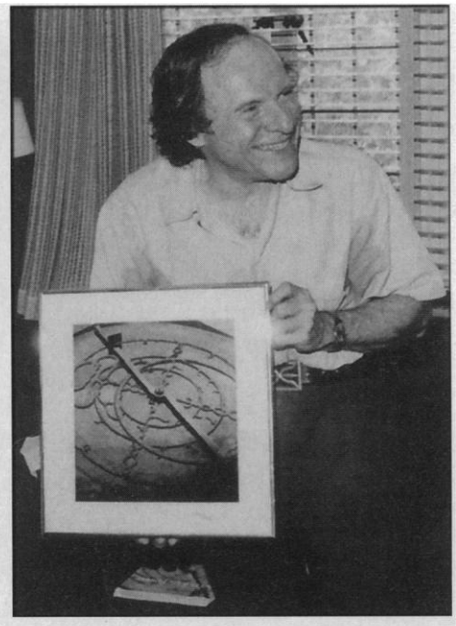


"Drawing by William R. Leigh from H. G. Wells, 'The Things That Live on Mars,' a nonfiction article that appeared in *Cosmopolitan* magazine for March 1908 at the height of the Martian canals furor." [From *The Biological Universe*]

"Everywhere around us we see the infinite diversity of life on our planet," the author writes, "but nowhere else in the vast universe has any life been found. This remarkable fact—at once a measure of our ignorance and a cry of loneliness echoing through the centuries—is decidedly not a result of indifference on the part of *Homo sapiens*." Indeed, in this important new book historian and astronomer Steven J. Dick presents eloquently the vast range and complexity of this lack of indifference. As in his earlier work on the subject, *Plurality of Worlds: The Origins of the Extraterrestrial Life Debate from Democritus to Kant* (Cambridge University Press, 1982), Dick works firmly in the history-of-ideas tradition. He traces the history of the idea of extraterrestrial life in our century through a myriad of contexts, including the physical, biological, and social sciences, literature and the arts, religion, popular culture, and government policy. He analyzes the attempts to establish a credible new scientific discipline, "exobiology," the controversial search for extraterrestrial intelligence (SETI) by radio and other means, and even the extraterrestrial hypothesis in the phenomenon of Unidentified Flying Objects (UFOs). He examines how this idea (whether hypothesis, conviction, or otherwise) has provoked scientific programs, public clamor, and intense debate in all sectors of society. His book provides a literate, reliable, and stimulating historical account of how the notion of extraterrestrial life has evolved in these various contexts, as well as a powerful and provocative hypothesis concerning its grand significance. Dick contends that the biological universe, in which life is a common and usual development, is only the latest demotion of humankind from uniqueness, culminating a movement that began with Copernicus and that has played out in numerous other contexts since.

The existence of life beyond our home world has, as Dick contends, been seen as a notion testable by contemporary scientific practice, but just beyond the ability of science to demonstrate definitively. Yet, this notion has had scientific and social consequences of a magnitude "disproportionate to any truly verified claims." Two recent episodes are particularly instructive: in 1976 the Viking landers relayed data that seemed to suggest biological activity in the Martian soil, and just last summer researchers put forth a suite of circumstantial evidence that one or more Martian meteorites recovered from the Antarctic contained remnants of fossil bacteria. In both cases, initially tantalizing results were soon challenged by alternative hypotheses, leading to an ambiguous answer. Critics have blamed the planetary exploration doldrums of the 1980s on the Viking disappointment, and although the meteorite case has only just begun to play out, Mars exploration programs are even now being revised in its wake. This is a timely book.





Left. Kurd Lasswitz, "considered "the father of German science fiction." Lasswitz's highly successful novel *Auf Zwei Planeten* (1897), about a visit of highly advanced humanoid Martians to earth, reflected his "strongly felt ideas about society in the important role of science and technology in it." *Right.* "Philip Morrison, who opened the modern era of SETI with his paper co-authored by Cocconi. Morrison is seen here in 1975 at about the time of the SETI workshops that he chaired." [From *The Biological Universe*]

There is nothing significant to complain about in this work, although many readers will yearn for more on various topics. The book is well documented and offers a wealth of leads to a variety of literature, much of it otherwise difficult to find. The bibliographic essay gives the reader a succinct and helpful entrée to the core literature. Its Western orientation is entirely defensible, particularly in light of our intellectual heritage. An Aristotelian cosmology of a single universe with a hierarchy of beings (humans at the top, of course) early fused with a monotheistic religion wherein a benevolent god took a personal

interest in making a suitable home for his finest creation, and this view continued to influence the debate even long after Copernicus and his successors. On this point, it would be fascinating to explore the issue in other cultures, particularly those that have different metaphysics and epistemologies, and where humans have not traditionally occupied so central a place in the universe.

With this volume, Dick has completed the reconnaissance of this topic, together with Karl S. Guthke's *The Last Frontier: Imagining Other Worlds from the Copernican Revolution to Modern Science Fiction* (Cornell University Press, 1990) and Michael J. Crowe's *The Extraterrestrial Life Debate, 1750–1900: The Idea of a Plurality of Worlds from Kant to Lowell* (Cambridge University Press, 1986). Few other areas of science have such fine, reliable, convenient, and literate accounts of their history.

Joseph N. Tatarewicz
3782 Folly Quarter Road,
Ellicott City, MD 21042–1412, USA

Vignettes: Biodynamics

At first I liked [the] nineteenth-century image of gears, pinions, levers, and rods clanging away inside the cell. But as I obsessed longer about cancer cells, I found a more modern metaphor even more appropriate: The machinery seemed to function like a mini-computer that operated inside cells and programmed their growth. Those who would one day cure cancer would think more like electronics technicians and less like grease monkeys.

—*Robert A. Weinberg,* in *Racing to the Beginning of the Road: The Search for the Origin of Cancer* (Harmony)

Biotechnology in general and the Human Genome Project in particular aim high. No wonder the Human Genome Project's apologists have called it biology's equivalent to putting a man on the moon. Where else could he go with all that thrust?

—*Donna J. Haraway,* in *Modest_Witness@Second_Millennium. FemaleMan ©_Meets_OncoMouse™* (Routledge)

Interacting Electrons

Electron Correlation in Molecules and Condensed Phases. N. H. MARCH. Plenum, New York, 1996. xvi, 395 pp., illus. $115. ISBN 0-306-44844-0. Physics of Solids and Liquids.

A typical condensed system, an ordinary piece of household copper wiring for example, contains an enormous number (~Avogadro's number) of electrons interacting strongly with each other through the Coulomb interaction. Coulomb interaction is singular at short distances and, more important, falls off slowly at long distances. It therefore seems to be a daunting task to try to calculate the quantum mechanical consequences of such strong electron-electron interactions in condensed systems. The same is true for molecules where the number of electrons involved may be of the order of a hundred. Quantum aspects of electron-electron interaction effects in condensed systems are often referred to as "electron correlation" effects because the strong interaction among the electrons tends to correlate their dynamics and the simple independent electron approximation, where all the electrons are assumed to be moving independent of each other, no longer applies. The study of electron correlations is one of the most important subjects in condensed matter physics and chemistry, and, not surprisingly, a large number of books exist dealing with this topic at various levels of sophistication. The present book by March takes a courageous broad approach to the topic, with the explicit aim of introducing the modern theoretical concepts to "experimental physicists, materials scientists and physical and inorganic chemists."

The book is vast in scope, as it deals with many different aspects of electron correlations, including several different theoretical techniques such as the density functional technique, the numerical quantum Monte Carlo method, many-body perturbative diagrammatic theory, and nonperturbative model calculations. Each of these theoretical topics can (and does) have books dedicated just to itself. A prospective reader who wants to develop specialized expertise in a topic must therefore look elsewhere. But this book serves the purpose of introducing the reader to the variety of advanced techniques available to study electron correlations in condensed systems.

Electron correlation is the cause of many phenomena in condensed systems—magnetism and certain types of metal-insulator transitions (called Mott transitions) are, for example, direct consequences of electron-electron interaction. The phenomenon of the fractional quantum Hall effect, which occurs in two-dimensional semiconductor systems at very high magnetic fields and low temperatures, is caused by electron correlations that drive the system into an exotic incompressible quantum fluid. The superfluidity in helium-3, associated with the most recent Nobel Prize in physics, is a spectacular and subtle consequence of interaction effects. The high-temperature superconductivity is thought by most practitioners to be caused by electron correlations. Of these topics March treats magnetism and Mott transitions in some detail. Several advanced topics, including the fractional quantum Hall effect and Luttinger liquids, are mentioned in the appendixes. Each chapter is usefully divided into many sections, and these sections often have informative titles including this wonderful title for section 7.7 (p. 165): "Can molecules exist in metallic phases?" (The answer is "maybe.") The book is not always easy to read because of its vast scope and because of the complexity of the subject matter. It could, however, be quite useful to a diligent reader who is interested in some perspectives on modern concepts and techniques in electron correlations.

Sankar Das Sarma
Department of Physics,
University of Maryland,
College Park, MD 20742-4111, USA

Browsings

Encyclopedia of Pinball. Vol. 1, Whiffle to Rocket, 1930-1933. Richard M. Bueschel. Silverball Amusements, New York, 1996 (distributor, Pinball Resource, LaGrangeville, NY). viii, 253 pp., illus. $49.95. ISBN 1-889933-01-5.

A detailed, illustrated history of the Depression-era beginnings of the "Golden Age" of pinball, America's contribution to the world of coin-operated public amusements, with an overview of its development from the 18th-century French court game bagatelle, as well as profiles of 100 collectible vintage pinball games from the modern era.