Who is out there?

Search for Life/Astrobiology
by Monica Grady
Natural History Museum/Smithsonian Institution: 2001. 96 pp. £9.95/$14.95 (pbk)

Don Brownlee

Living in the thin but luxuriant biosphere of Earth, it stretches the mind to think that life would be difficult to find elsewhere. Only a century ago it was possible to imagine that creatures similar to humans might live on our neighbouring planets, but a century of investigation has yielded no totally convincing evidence for extraterrestrial life. It surely exists, but it has not been easy to find. The search is complicated by the probability that environments as favourable as Earth's are not common in the Universe, and it is likely that life elsewhere will not be nearly as obvious as it is in our fecund biosphere. Instead of looking for people, Klingons or Wookies, the search will probably have to concentrate on detecting bacterium-like organisms similar to those that have dominated more than 80% of the history of life on Earth.

The fascinating and richly interdisciplinary story of the search for extraterrestrial life is admirably summarized by Monica Grady. The search reached a watershed, almost its Waterloo, in 1976, when the two Viking missions travelled to Mars to search for life there. Although the two landers and orbiters were huge successes, they found no evidence of life, and the data they sent back were widely interpreted as evidence that life, or even organic compounds, could not exist on the martian surface. Mars, the most Earth-like planet in the Solar System, was in some ways more hostile to life than the surface of the Moon, dashing decades of hopes of a breakthrough.

Those decades before Viking had seen the birth of the science of exobiology, the instigation of searches for radio signals from other intelligent life, the formulation of the Drake equation (a means of estimating the number of civilizations in the Galaxy), the discovery of interstellar organic molecules, the abiological synthesis of amino acids and the discovery of extraterrestrial amino acids in the Murchison meteorite. Enthusiasts hoped that exobiology might soon give us exciting news of the nature and abundance of life on other planets. Nay-sayers complained that exobiology was not a science and never would be, because it had no data and never would have any. Detractors simply restated Fermi's paradox about the existence of extraterrestrial life: "So? Where is everybody?"

A quarter of a century after Viking, exobiology has found a new incarnation as astrobiology — a field that has expanded to cover almost all aspects of the origin and evolution of life on Earth, and the search for suitable habitats and life elsewhere. Although alien life has remained, and may always remain, elusive, a wealth of recent discoveries has given vigour and optimism to the field. The discoveries of life in deep-ocean thermal vents, in rocks many kilometres below Earth's surface, in fluid inclusions in ice and in dry Antarctic valleys has extended our idea of the environmental conditions in which it can occur on Earth. Beyond Earth, an apparent ocean has been discovered on Europa, one of Jupiter's moons, and there is evidence for ancient water on Mars, along with controversial hints of microfossils in martian meteorites. Other developments include the discovery of planets beyond our Solar System as well as new understanding of the nature and evolution of terrestrial life and the causes of global extinctions.

Life at the extremes

The discovery that life can exist on Earth in conditions previously thought impossible has raised hopes that it could exist elsewhere in the Universe. Above, the Minerva Terrace hot springs in Yellowstone National Park, from *Life Beyond Earth* by Timothy Ferris (Simon & Schuster, $40).

Astrobiology is a rich intersection of many fields of science that include microbiologists, geologists, atmospheric scientists, astronomers, oceanographers, glaciologists and chemists, who frequently meet to discuss the nature of life in the cosmos. Whether or not we ever find alien life, astrobiology has landed and established a permanent beachhead in academia. *Search for Life* is an excellent introductory overview of its current status, covering the origin of known life and its nature and the search for it elsewhere. The book is not intended to cover the field in depth, but is a well-illustrated, whirlwind tour of most of the significant areas. Nevertheless, I imagine that even the most experienced astrobiologist will learn something from it. The broad expertise involved in astrobiology is always a challenge, and even 'experts' will benefit from such an informative overview. ■

Don Brownlee is in the Department of Astronomy, University of Washington, Seattle, Washington 98195, USA.

More astrobiology

Life Everywhere: The Maverick Science of Astrobiology
by David Darling
Basic Books, $26

The view from Japan

Primate Origins of Human Cognition and Behavior
edited by Tetsuro Matsuzawa
Springer: 2001. 587 pp. $119

Marc Bekoff and Jane Goodall

The past decade has seen enormous growth in the study of animal cognition. Anecdotal reports and detailed observational experiments abound for many species and for diverse cognitive skills. But much of the research on primate cognition has been done in Japan, and valuable information, not published in English, has been poorly circulated. Now, for the first time, detailed accounts of Japanese research on primate cognition have been compiled in this excellent volume. Tetsuro Matsuzawa summarizes and synthesizes previously published data as well as presenting new information.

The book is refreshing for the way in which it shows that detailed, single-subject case studies — for example, early vocal development in a chimpanzee infant — and anecdotal accounts are very important for advances in cognition and for informing subsequent experiments. In addition, it proposes new techniques for studying old problems; such methods hold much promise for future comparative research.

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Another thinker? Whether primates other than humans have a notion of 'self' is an intriguing question.

'Animal cognition' refers to the many ways in which individuals sense and interact with the world. In seven sections and 28 chapters, *Primate Origins* considers some 90 species, including humans. Topics are discussed from evolutionary, comparative and ecological perspectives. They include perception and cognition, speech and language, learning and memory, recognition of self and others, imitation, tool use, social behaviour and social organization, and culture.

We are told that the human ability to handle many social relationships and different 'levels' simultaneously is related to our massive cortex. 'Levels' range from situations in which objects are dealt with singly to those in which there are several different possible relationships between them, for example a nut to be cracked, an anvil and a stone tool. The ability of early humans to perceive the world in terms of the relationships between three things (self, other members of the species and objects) underpins the advanced technology and spoken language that characterizes *Homo sapiens*.

To identify how cognition varies between species, we must understand the historical and adaptational factors that have influenced the evolution of information processing. For instance, rhesus monkeys, chimpanzees and chickens (but not pigeons) perceive a figure as a single entity even if it is hidden by an object and later emerges. It is not the size of an animal's brain, but rather the nature of its food, that appears to be responsible for the evolution of this ability. Some species need to be able to track moving food, whereas others do not.

Chimpanzees process information about light and shade differently from humans, and this seems to be related to their tropical-forest habitats. Ecological variables can also dictate species differences in vocal communication and spatial memory. Furthermore, animals of many species need to be able to estimate the number of individuals in a group or the amount of food available in a certain locale. Studies show that many primates are very adept at such 'counting', estimating and object-categorizing.

A major question in primate cognition