

## Book Review

**Intelligent Life in the Universe: From Common Origins to the Future of Humanity**, by Peter Ulmschneider. Springer, Berlin, 2003, 251 pp., ISBN: 3540439889.

AS ASTROBIOLOGY MAKES ITS WAY into the mainstream, astrobiology texts (Kutter, 1987; Goldsmith and Owen, 2002; Bennett *et al.*, 2003; Gilmore and Septho, 2004; Lunine, 2004) compete for our attention. By penning the majority of these texts, physical scientists are displacing biology “memes” and putting a deterministic imprimatur on our understanding of what astrobiology is. Peter Ulmschneider, an astrophysicist at the University of Heidelberg specializing in acoustic waves in the solar chromosphere, continues this pattern with his new book on this popular topic. I enjoyed reading it. The book is a well-illustrated review of the basics of astrobiology. An amazing amount of important information is clearly summarized between its well-bound covers. The trick in cooking up such a comprehensive synthesis is to marinate the spiciest ingredients from disparate fields into a narrative, without concocting a dog’s breakfast of diversions and caveats. In this respect, Ulmschneider has succeeded.

The book has three sections: “Planets,” “Life,” and “Intelligence.” “Planets” is an authoritative review of what we know about stellar evolution, planet formation, and circumstellar habitable zones. Ulmschneider knows stars well and is on familiar ground here. I recommend this section highly, even to astrophysicists. In the “Life” section, Ulmschneider does an admirable job reviewing basic information about amino acids, DNA, and various ideas about the origin of life. However, toward the middle of his chapter on evolution, the book gets into trouble as his strong ideas about the directedness of evolution begin to pop up (more on this later). The third section, “Intelligence,” is interesting because Ulmschneider is an enthusiast for space engineering and mankind’s future in space. He ignores the role of artificial intelligence and unmanned missions

and seems to think that an increasing number of genes in our organic descendants will be the key to the future of intelligence—not laptops and Google. We’ll see.

Although I enjoyed reading the book, it has some flaws. First, I will quibble about the small ones, and then I will discuss a large one at length. Although numerous figures enliven the text, many of the captions are no more than figure titles—too short to explain the main point carefully or link the figure to the text. Readers with high expectations will notice the reliance on articles in *New Scientist*, *National Geographic*, and *Scientific American* rather than the primary literature, and the frequent use of references from the 1970s won’t be reassuring.

Biologists will also be disturbed by the author’s ideological assumptions. For example, Ulmschneider repeatedly uses the terms “higher life,” “advanced life,” and “complex life.” It made me wince to read about more evolved and less evolved species: “The subsequent evolution toward the higher animals and man proceeded. . . .” And what in the world is an “advanced amphibian” (p. 121)? One that acts like a mammal?

The book can be read and enjoyed for its more objective information content, and, with some effort, we can ignore its soft anthropocentric underbelly. It is impossible, however, to ignore assumptions when they are at the heart of what the book is about. This book is entitled *Intelligent Life in the Universe* so the issue of what intelligence is and how to assess the likelihood of intelligent life elsewhere in the universe is *the* issue. The issue of whether intelligence is a convergent feature of evolution is possibly the single most important issue in astrobiology—more important to most people than even the issue of whether extraterrestrial life exists. I believe this is because intelligence has to do with our self-image and self-respect. We use it to define ourselves (“*Homo sapiens*”), and with unabated pre-Darwinian fervor we use it to separate ourselves from other animals and from the other apes.

However, intelligence is notoriously hard to define. Very intelligent people disagree about what it is. The answer to our question “Are we alone?” depends on who “we” is and on our definition of intelligence. Usually, when people ask the question “Are we alone?” they are assuming that we are alone on Earth. That is, they are assuming a definition of intelligence that excludes all our terrestrial relatives, and postulates an imaginary general group of non-terrestrial organisms who are, in Carl Sagan’s words “the functional equivalent of humans” (Sagan, 1995).

Most biologists refuse to take the idea of such an imaginary group seriously. In studying the variety of life on this planet, they see that general groups with only one species in them are self-contradictions that do not exist. Without such a group, the question “Are we alone?” means “Are we (*H. sapiens*) the only ‘homo sapiens’ in the universe?” For a biologist, the answer to that question is an obvious yes, we are alone—once extinct, species don’t come back even on this most Earth-like of earth-like planets. The dodo bird will not evolve a second time, and neither will *H. sapiens*.

In the search for “intelligent” life in the universe, we have two camps. In one corner we have the non-convergentists (mostly biologists) who, after studying the biological record and evolution insist that the series of events that led to human-like intelligence is not a trend, but a quirky result of events that will never repeat themselves anywhere in the universe. Gould has been a spokesman for this group: “*Homo sapiens* is an entity, not a tendency” (Gould, 1989). The non-convergentists include Simpson (1964), Olson (1985), Diamond (1990a), Mayr (1994, 1995), Tipler (1980, 1981), Pine (2005), and myself (this review).

In the other corner are the convergentists (mostly physical scientists): Sagan (1995), Goldsmith and Owen (2002), Bennett *et al.* (2004), and several christian biologists, including deDuve (2002) and Conway-Morris (2003). Ulmschneider is definitely in this intelligence-is-a-convergent-trait-of-evolution corner. He is probably the strongest advocate of this position I’ve seen in print, and this strong stance makes this book both interesting and, from my point of view, severely flawed. He tries to reach further and make bigger claims than his more conservative co-conspirators. His approach adds much to the debate because, though the writers of the astrobiology texts mentioned above are in his corner, they muster only a few pages on the same issue. Ulmschneider sticks his neck out further. He argues that accumulating information equips organisms for survival (p. 115) and that the existence of universal laws of nature will result in intelligent organisms on other Earth-like planets (p. 206): “. . . [T]here are good reasons,” he says, “why evolution should culminate in intelligent beings” (p. 105).

According to Ulmschneider, if we replayed the tape of life again, starting 65 million years ago, “[t]he high demand on mental capacity required for survival in the angiosperm rain forest may well have triggered the appearance of primate-like intelligent tree-dwelling dinosaurs” (p. 144). For Ulmschneider, the evolutionary selection pressure for large human-like brains is so strong that if the dinosaurs had not become extinct, they would have evolved into the functional equivalent of humans.

Ulmschneider and the convergentists subscribe to what I call the “Planet of the Apes Hypothesis.” The movie *Planet of the Apes* (1968) is set in a future in which humans, by having a nuclear war, have forfeited their assumed supremacy over the “beasts.” They lose the ability to speak and have to fight and forage in the fields. Three species of apes—chimps, gorillas and orangutan—take advantage of this recently emptied “intelligence niche.” The apes learn how to speak English, ride horses, farm corn, shoot rifles, and in general represent a hirsute Hollywood version of Sagan’s postulated group of “functionally equivalent humans.” The basic idea is that human intelligence is so useful that any species worth its salt is waiting in the wings for humans to trip up. When humans trip, the new species rushes in. This convergentist idea is widespread, but it is not good science.

The convergentist “Planet of the Apes Hypothesis” is an appealing idea, but it has failed a series of exhaustive tests. It disagrees with the best data we have. A series of long-duration, independent, and thorough experiments in evolution were set up and left to run. The most straightforward interpretation of the results is that human-like intelligence is not a convergent feature of evolution. There is no “intelligence niche” toward which animal species have a penchant to approach. In the absence of humans, other species do not converge on human-like intelligence as a generic solution, or even a specific solution to life’s challenges. These tests have been almost universally ignored.

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The names of these tests are South America, Australia, North America, Madagascar, and India. About 180 million years ago, Pangaea broke up into Laurasia and Gondwana. About 140 million years ago Gondwana broke up into Africa/South America and Antarctica/Australia/India/Madagascar. About 125 million years ago India and Madagascar split from Australia/Antarctica. Africa and South America split about 100 million years ago—and New Zealand has been floating off by itself for about 100 million years. For landlocked species, these continents that drifted independently of each other for between 50 and 200 million years were crucial experiments in evolution (*e.g.*, Hedges, 2002).

The time scale for tripling the size of the human brain in Africa was about 2–3 million years, while the time scale of the experiments was 50–200 million years. Thus, the experimenters were conservative and ran the tests 10–100 times longer than was necessary.

New Zealand is as close as we will get to the opportunity to study life on another planet (Diamond, 1990b). So it is important to examine what happened there during the last 100 million years of independent experimentation. Which species are we to imagine is the one that evolved toward human-like intelligence? The kiwi? The tuatara? Obviously neither. Human-like intelligence did not evolve in New Zealand. Similarly, as South America drifted independently of Africa for 90 million years with lots of monkeys for much or all of that time, primates continued to evolve. Which of South America's species are we to imagine evolved toward human-like intelligence? Are howler monkeys or squirrel monkeys the species that evolved toward the "intelligence niche"? Consider Australia. Is the koala or the red kangaroo or the platypus the species in Australia that has been moving toward human-like intelligence?

Five continents and millions of species evolving over tens or hundreds of millions of years are yelling at us upwind against our vanity: "There is no evidence for the 'Planet of the Apes Hypothesis.' Human intelligence is not a convergent feature of evolution." Rather it is a species-specific trait—like the beautiful yellow crest of a sulfur-crested cockatoo.

Although the results from these experiments are compelling, it is important to consider any contrary evidence. What scientific information does Ulmschneider bring to bear on this issue?

One of his arguments for the inevitability of human intelligence evolving elsewhere in the universe is based on Table 5.4 and Fig. 9.1, which indicate that, out of all the creatures on Earth, humans have the largest number of genes. Ulmschneider writes, ". . . intelligent behavior . . . can be seen to rise persistently with time from fish to man. The perpetual increase in the number of genes in the eukaryotic cell line leading to man can be taken as another plausible example for long-range directedness based on Darwin's theory, the growth of information, the know-how to survive, with time" (p. 147).

In other words, he bases his argument that intelligence is a convergent trait on the idea that more intelligent creatures have more genes. However, in October 2004 (too late for publication in this book), the International Human Genome Sequencing Consortium (2004) published the new estimate for the number of human genes: 20,000–25,000. So according to Table 5.4 and the updated version of Ulmschneider's argument, lungfish, mice, and stink lilies have more genetic information in them than we do and are, therefore, smarter or better or something.

Ulmschneider's argument is based on a progressive theory of the evolution of intelligence: ". . . it is clear that in the evolution from fish to amphibians, from reptiles to primates and man, one sees a progressive increase in intelligence: predatory dinosaurs are believed to have been more intelligent than amphibians or fish, the primates more so than reptiles and other mammals, the great apes more so than monkeys, and humans more intelligent than them all" (p. 144).

This progressivist analysis (*e.g.*, Jerison, 1991) is flawed for the following reason: Every species has some unique feature to it—a feature that makes it different from its closest living relatives and from its ancestors. For example, elephants have longer noses than their living relatives. So when we focus on this unique feature and plot the sizes of the noses of its living relatives and of their evolutionary ancestors, we find of course that in the series of progressively earlier ancestors, noses get progressively shorter. This is a selection effect that has nothing to do with a general tendency that can be extrapolated to the rest of the universe. Increasing nose size is not a general feature of evolution. It is something that occurred in the line that led to elephants. The apparent trend is a result of choosing to focus on a feature that is most extreme in an extant life form

and then examining the evolution of that extremity.

Similarly, when we examine the fossil record of the lineages that led to *H. sapiens*, we find a gradual increase of brain size over time. A similar analysis of the evolution of our tiny olfactory lobes would lead to the conclusion that the shrinkage of olfactory lobes is a trend. These results are selection effects, not evidence for general trends. If we found a trend in skull thickness or body size or tooth sharpness or any of a thousand characteristics that were not specifically chosen for study because humans were an extreme example of it, then the discovery of a trend would be of more general interest. But that is not what has been done.

In some sense astrobiology is the search for trends and universals in the pile of quirkiness called life on Earth. The fossil record and the living results of five large-scale, long-term experiments suggest that there is no convergence toward human-like intelligence. These multiple, long-term experiments, which show a non-convergence on human-like intelligence, need to be taken much more seriously since these experiments are probably the best data set we have to address in a scientific way the question of "intelligent" life in the universe.

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—Charley Lineweaver  
Planetary Science Institute  
Research School of Astronomy and Astrophysics  
and the Research School of Earth Sciences  
Australian National University  
Canberra, ACT 0200, Australia

E-mail: [charley@mso.anu.edu.au](mailto:charley@mso.anu.edu.au)