Intelligent Life in the Universe

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Peter Ulmschneider

Intelligent Life in the Universe

Principles and Requirements Behind Its Emergence

Second Edition

With 156 Figures and 24 Tables
Including 37 Color Figures

Springer

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Preface to the Second Edition

In the first edition of this book it was argued that the uniqueness of human intelligence is the consequence of a very large brain and man's outstanding specializations in communication and tool use. No other life form on Earth is able to communicate in such a detailed manner by both vision and language and is able to handle so many diverse objects and tools. Yet apes, monkeys, dogs, elephants, seals, dolphins and even corvids all show highly intelligent behavior, which in recent years has become increasingly understood and appreciated. Palaeanthropologists argue that exceptional human intelligence arose from keen vision acquired in the rainforest, an upright walk together with a complete freeing of the hands for tool use adopted after our ancestors entered the open savannahs, and from our intimate social interactions in group living. Since our technological intelligence is based on the development of hands it is intimately connected with life on land. This is seen, for instance, by the modification of arms into fins or flippers when vertebrate land animals evolved back to life in the oceans. The development of our type of intelligence therefore is a consequence of the conquest of the land by animals and plants, which by a mutualistic relationship makes animal life on land possible.

For this reason a whole new Chap. 3 "The Earth" on geology has been added, in which the phenomena of plate tectonics and continent formation are discussed. This has resulted in a renumbering of the remaining chapters. In addition, sections on the conquest of the land by plants and animals are greatly expanded to show the enormous difficulties that life encountered before it finally mastered the land 470 million years ago, over 3.5 billion years after it first appeared in the Earth's oceans. The planetological history of the early Earth is discussed in greater detail to give more insight into how Earth-like planets form and how the chemical composition favorable for life arose. Finally, the rapid advances over the last four years in all fields, from the search for planets to the search for the Last Universal Common Ancestor of all life, has been brought up to date.

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Heidelberg, January 2006 *Peter Ulmschneider*

Preface to the First Edition

One of the most exciting questions for mankind is whether we are alone in the universe. That intelligent nonhuman beings exist was commonly believed in prehistoric times as well as in antiquity. Creatures such as giants, centaurs, angels, and fairies were essential and universally accepted parts of Greek, Jewish, and Germanic mythologies. Although no fossil traces of such beings have ever been found, most of us firmly believe that nonhuman intelligent beings do indeed exist. This conviction is derived from the staggering size of the universe with roughly 100 billion times 100 billion (10^{22}) stars, which makes it inconceivable that we could be the only intelligent society in the universe. Indeed, modern science has shown that since the Copernican revolution all attempts to define our position as an exceptional one in the universe have failed dismally.

But if other intelligent civilizations do exist, how can we find them? Why is there no terrestrial or astronomical trace of them, despite great technological advances in recent centuries and especially in modern times? Why have we never found artifacts discarded by visiting aliens, which would convincingly prove the existence of nonhuman intelligent beings? Is the number of planets on which life is able to evolve too small, or is the formation of life – and particularly intelligent life – an extremely rare event? Could these intelligent societies face insurmountable difficulties in traveling over large galactic distances, or do they no longer exist?

Recent advances in search techniques for planets, in the theory of planet formation, and particularly in biochemistry, molecular, and cell biology are about to give answers to these questions: how life appeared and how many planets can be expected in the universe on which life, and eventually intelligent life, developed. New in this book is the argument that, by thinking carefully about the future development of mankind, one can gain insight into the nature of extraterrestrial civilizations.

The book consists of three parts: planets, life, and intelligence. In *Part I*, Chaps. 1–3 discuss stars, galaxies, and the origin of chemical elements, our recent planet formation theories, the search methods for extrasolar planets and what has been found so far. Chapter 4, "Planets suitable for life", describes what constitutes an Earth-like planet and how many of them can be expected in the universe. In *Part II*, Chaps. 5 and 6 outline life and its origin on Earth, how it evolved, and how intelligent life developed. Chap-

ter 7 discusses the search for extraterrestrial life and intelligent societies. In *Part III*, Chap. 8, "The future of mankind", gives possible insights into what can be expected about the nature of extraterrestrials. Finally, Chap. 9, on extraterrestrial intelligent life, constructs a likely picture of these beings and attempts to answer the question of why they don't interact with us.

Heidelberg, June 2002 *Peter Ulmschneider*

Table of Contents

Part III Intelligence