Cellular Origin, Life in Extreme Habitats and Astrobiology 23

Liz Swan
Richard Gordon
Joseph Seckbach *Editors*

Origin(s) of Design in Nature

A Fresh, Interdisciplinary Look at How Design Emerges in Complex Systems, Especially Life

Springer

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Volume 23

Series Editor:

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ISSN 1566-0400
ISBN 978-94-007-4155-3 ISBN 978-94-007-4156-0 (eBook)
DOI 10.1007/978-94-007-4156-0
Springer Dordrecht Heidelberg New York London

Library of Congress Control Number: 2012941365

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

DEDICATION

For my husband, Eric Swan, and for the little piece of nature we gave origin to, Freeman Jack Swan.

–Liz Swan

Dedicated to my wife Fern, our children, and grandchildren in the Seckbach clan. And in addition, to the late botanical professor, Yaakov Leshem (Bar Ilan University, Ramat Gan, Israel), who guided me on the publication path.

–Joseph Seckbach

For Diana Gordon, artist, on the occasion of her 90th birthday, and her great grandson Luke Hunstad, of as yet undesigned aspirations, on the occasion of his first.

–Richard Gordon

INTRODUCTION TO ORIGIN(S) OF DESIGN IN NATURE [ODIN]

The origin of life is still a mystery, but the results of design are visible on Earth and in the universe. Design, including the emergence of many evolutionary lines and diverse ecosystems, is familiar to all of us. We recognize design everywhere; interior decorating, garden landscaping, urban planning, and industrial uses are only a few examples. There is also design in social sciences, intelligence, and other manifestations of life.

In this volume, we deal with the *Origin of Design in Nature* (ODIN), with its 42 authors discussing various aspects of this topic. The aim of the authors is to determine whether all phenomena in nature originated spontaneously or under intelligent guidance and creation. One might visualize the wonderful internal structure of atoms, molecules, cells, organs, organisms, and the universe itself and its galaxies and ask, "How did all this come about?" or ask, as stated in the Bible, "Who created all of those?" (Isaiah 40:26). The articles in this book range from a purely scientific approach to the traditional act of creation as seen by religions wherein there is a biblical account for the emergence of life (in the first chapters of Genesis). These statements need not necessarily contradict the scientific approach. Indeed, natural designs can be seen all over, but their origin has led to lively and constructive discussions, as the present book demonstrates. This volume (number 23 of *COLE*) provides an interdisciplinary look at how design emerges in complex systems.

The target audience of this volume is graduate-level students and professional humanists and scientists in philosophy of science, astrobiology, evolution, dynamics, and complex systems.

We acknowledge all the contributors for their chapters and among them the patient "early birds." Special thanks are due to Professor Julian Chela-Flores (ICTP, Trieste, IT) who is always our "right hand" within the new volumes of COLE books and to Fern Seckbach for her constant linguistic and style assistance. Appreciations are due to the reviewers, to external referees who read all the chapters and gave their comments. Last but not least, thanks to Maryse Walsh and Melanie vanOverbeek—the Springer team.

Joseph Seckbach The Hebrew University of Jerusalem, Jerusalem, Israel

FOREWORD

The main theme of *Origin(s) of Design in Nature: A Fresh, Interdisciplinary Look at How Design Emerges in Complex Systems, Especially Life* is especially relevant for the development of the life sciences. Charles Darwin's two theories of evolution remain the cornerstones of our discussion (Mayr, 1991): evolution by natural selection and the common descent of all life on Earth. Indeed, life on Earth is an example of life that can be understood in terms of evolution by means of natural selection. Darwin's second theory is intimately related to the search for the origin of life on this planet.

We should take a closer look several issues that have been discussed for a considerable time in the context of the wider problem: design in nature (Chela-Flores, 2011). This topic has a long history going back to ancient Greece. However, in modern times, we may begin with the work of William Paley (1743–1805), who was an Archdeacon and Doctor of Divinity at Cambridge University. His writings were highly respected in the Anglican order. His *Horae Paulinae* was written in 1790 specifically to prove the historicity of the New Testament. Another famous book was *View of the Evidences of Christianity* (1794), a text that was standard reading among undergraduates during Charles Darwin early university education. However, his best-remembered book is *Natural Theology,* which played an important role in the early stages of the establishment of Darwin's arguments.

Paley presented some observations from nature intending to prove not only the existence of a grand design, but more importantly also, in his book, Paley attempted to prove the existence of an intelligent designer. The famous quotation that follows is at the beginning of his book:

> *Suppose I found a watch upon the ground, and it should be enquired how the watch happened to be in that place…When we come to inspect the watch, we perceive that its several parts are framed and put together for a purpose…the inference, we think, is inevitable, that the watch must have had a maker…*

This argument can be traced back to classical times, but Paley's defense of it in modern times was influential in the nineteenth century dialogue between science, philosophy, and theology. One of the fundamental steps in the ascent on man toward an understanding of his position in the universe has been the realization that natural selection is indeed a creative process that can account for the appearance of genuine novelty within science frontiers, independent of a single act of creation, but more as a gradual accumulation of small successes in the evolution of living organisms. This is a point that has been defended by many of the founders of Darwinism, most recently by others, who refer to an analogy with

artistic creation. The creative power of natural selection arises, according to Jacques Monod, as an interaction between chance and necessity (a phrase that became familiar thanks to his very popular book *Chance and Necessity*).

With Francisco Ayala, for instance, we may consider a painter who mixes and distributes pigments over a canvas (Ayala, 1998). The artist does not create the canvas and pigments, but the painting is the creation of the artist. A random mixture of pigments could not have created Leonardo's *Mona Lisa*, or at least the probability is infinitesimally small. This underlines the fact that natural selection is like the painter—it is not a random process. The scientific approach to rationalizing the complexity of the human eye, for instance, has shown us that it is the result of a nonrandom process, namely, natural selection. It is somewhat surprising, however, that what has just been described, Darwin's straightforward (but brilliant) thinking, has led to so much controversy at the frontier of science and the humanities. In the future, unfortunate controversies will gradually disappear, due to recent work, and I am convinced, also, due to many of the chapters that make up the present book.

I would like to end this brief Foreword with some thoughts that may help to turn bitter debates into constructive dialogues helping our culture on both sides of the humanities/science frontier. Two terms from the humanities are relevant for our considerations. Firstly, exegesis is a critical explanation of any text, but more often it is restricted to a critical interpretation of a religious text to discover its intended meaning.

On the other hand, hermeneutics refers to an approach arising from the method of interpretation. When we apply it to religious texts, it is precisely exegesis, but when we apply it elsewhere, it coincides with other approaches to interpretation. For example, when we apply it to literary texts, the interpretative method is known as philology, whereas when it is applied to legal texts, it is known as jurisprudence (Changeux and Ricoeur, 2000). The objective of hermeneutics is not to reach some ultimate truth, but to get deeper insights into thoughts and symbols, to reach within our limitations the best and most exact position possible.

Hermeneutics is in principle relevant to all forms of communication and expression: written, verbal, artistic, physiological, and sociological. But the physical, Earth and life sciences have not been included in this range of disciplines. For a good reason, we may add since science within its frontiers—defined by Galileo—has to be judged by its close adherence to the results of repeatable experiments, or by careful repeatable observations. As scientists, we are not qualified to cross over into the domain of the humanities, as its various branches are, unlike scientific disciplines, not based on theories supported by experimental data or supported by observations shared by a large number of independent scientists. And very often, when the frontier is crossed in the opposite direction, lamentable misinterpretations occur. In general, frontier crossing without the necessary background and respect for the special characteristics of science, as well as for the special characteristics of the humanities, lie at the root of most of the misinterpretation

of Charles Darwin's monumental contribution to science, which is the basis for understanding design in the life sciences.

Humanists have an advantage on scientists, in the sense that with the long traditions of exegesis and hermeneutics, going back to the emergence of Western civilization, only misinformed interpretation of the Holy Books of the Abrahamic religions lead to unnecessary defense by the pious in view of a presumed contradictions raised by rational thinking. More damaging still is the vision of a (fortunately) small group of highly prolific scientists—extraordinarily competent in their own special scientific field of expertise—but without a thorough mastering, or even with complete lack of respect for the specific merits and methods of the humanities. Without hesitation, or meditation, sometimes, the scientific frontier has been crossed into areas of the humanities that are best left to the specialists of philosophy and theology, where the scientific method is well beyond its range of validity. Fortunately, excellent clarifications of these extrapolations have appeared in competently written literature by well-qualified humanists (Cornwell, 2007).

With its many chapters by our distinguished authors, the present book is making a genuine attempt to provide arguments related to design in complex systems, including life. We are convinced that these pages will define more sharply the all-important frontier of science and the humanities. This volume is intended to serve as a stepping-stone to fully appreciate, and to interpret correctly, the humanistic implications of one, if not the most, transcendental contribution to science: Darwin's publication in 1859 of his seminal book *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life.*

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PREFACE: ODIN

Design as evidenced by the presence of ordered complexity fills nature. Most especially, but not exclusively, this is manifest in the biosphere. The conundrum we confront in this book is from where did and does this complexity, this functionally effective design, arise, and how does it maintain itself? Does the emergence of design demand that there be a designer? From the finely tuned structure of an atom, through the eloquent molecular biology of a microbe, to the intricacy of a brain with the surprise emergence of consciousness, design is obvious. Just as it is with William Paley's proverbial watch found on a path. But unlike a watch which has no ability to remake and refine itself, nature seems imbued with a drive, a force that pushes it to ever-increasing complexity. This upward direction is so obvious and ubiquitous that we, being one of the products of this drive, may fail to internalize the implications. Nature has a direction.

Though the universe, as it expands outward, races toward its own heart death, in specific, favored locations where abundant sources of energy remain, complexity abounds. The forces of nature cannot defeat increasing entropy on the scale of the universe. This is one of the unyielding laws of nature. But locally, those same forces can out maneuver the drive toward chaos, concentrate the energy, and ultimately give rise to life and brain and mind.

"I don't know who discovered water, but I'm pretty sure it wasn't a fish." So wrote Marshall McLuhan in The Medium is the Massage. Why would not a fish be the first to discover water? Simply because it is their total milieu. We are not so different. We live so totally in a world of complexity and consciousness that only by intellectual effort do we question its origins. Let us do that.

The first step toward sentient life is the creation of existence, the universe. We might ask why there is existence, but of course if there were nothing, we would not be here to ask. So, let the need for existence be a given. An eternal universe (i.e., no creation) presents technical problems such as accounting for the residual useful energy currently present in an infinitely old universe. If the universe is not eternal, then we need a force to produce it. The current best estimate is that a quantum fluctuation in a virtual vacuum brought the universe into being.

Our concept of time begins with the universe. Therefore, the laws of nature, of which quantum phenomena are a part, must predate time, be timeless at least in the human conception of time. This has extraordinary implications. As Ed Tryon, who first proposed this idea almost 40 years ago, recently observed, "If matter and energy are the result of a spontaneous creation [i.e., a quantum fluctuation], then matter and energy are not fundamental. They are manifestations

of underlying the laws of nature. Ultimate reality would then be the laws of nature." The world we discover is the product of ethereal eternal forces of creation.

The laws of nature as they act within this world which they created have a plethora of complexity enhancing and ultimately life-enabling traits. To name just two, we have the following: the Pauli Exclusion Principle and de Broglie's revelation of the wave characteristics of matter. Remove these from our milieu and chemistry ceases, stable molecules never form. Together, along with the twist of nature that produced protons and electrons with identical but opposite electrical charges even though the proton has a mass 1,837 times that of an electron, it allowed chemistry to proceed. The fundamental requirements for life were present, not only at the creation, but if Ed Tryon's hypothesis is correct, the needs for eventual life were present even prior to the creation, couched within the laws of nature.

Fourteen billion years had to pass before the expanding universe became amenable to life as we know it. But once the life-friendly platform we call Earth emerged, the right-sized planet located in the narrow habitable zone around the right-size and right-age star, our sun, in the life-friendly region of a spiral galaxy, the Milky Way, life burst forth. On Earth, the oldest rocks that can bear fossils of life have them. And noting that the size and shapes of these primordial fossilized microbes are spot-on matches of their modern descendents, it is likely that their genetic engineering was similar to that found throughout today's biosphere.

DNA, the universal (or at least earthly)-coded blueprint of life seems to have been ubiquitous from the very beginning of life. Now that is surprising because DNA is a totally digitally coded system. Just as dot dot dot dash is meaningless to anyone not familiar with the Morse code (It signifies the letter "v.") and just as dot dot dot dash holds absolutely no similarity to the letter for which it stands, so the four-digit code of DNA, the four nucleotides, bear no physical relationship to any one of the 20 amino acids for which they code by varying their arrangement on the DNA helix. All life is a variation on this theme. And life appears to have gone digital from its inception. With that majestic innovation, the potential for variation became vast.

Darwin was correct when he wrote in the closing lines of The Origin of Species, "… from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved."

But how did it happen? Is all this the work merely of the laws of nature, as Professor Tryon wrote, or is there a more cosmic force at work nudging those laws to facilitate the emergence of forms "most beautiful and most wonderful?"

For this, we might turn to the complete quote of the closing sentence of Darwin's "Origin," as it appears in every edition except the first (including the second edition which appeared a mere 5 weeks after the first edition). "There is a grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and whilst this planet has gone cycling

on according to the fixed laws of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved."

Has Darwin correctly identified the ultimate origin of design in nature? Would that not be a surprise!

End

Gerald L. Schroeder College of Jewish Studies, Jerusalem, Israel

ACKNOWLEDGMENTS

The editors would like to extend thanks to Melanie van Overbeek and Maryse Walsh of Springer who have been encouraging and attentive overseers of the *Origin(s) of Design in Nature: A Fresh, Interdisciplinary Look at How Design Emerges in Complex Systems, Especially Life* project since its origin.

Thanks also to Glen Mendels for donating all of the nature photos in the book with the exception of the fan palm, which was taken in Utuado, Puerto Rico, and donated by Liz Swan, and the zebra photo which was acquired from the Internet.

We would also like to acknowledge the hard work of all the reviewers who gave helpful feedback on the chapters in ODIN. We apologize in advance for accidentally omitting any names. Our thanks go to: Dave Abel, Pieter Adriaens, Tom Barbalet, Tom Buke, Richard Carrier, Vladimir G. Cherdantsev, Stephen Cook, Michael Dickson, Mark Faller, Hillel Furstenberg, Natan Gadoth, Dan Galili, Zann Gill, Louis Goldberg, Steve Grand, Attila Grandpierre, Oren Harman, Joshua Howard, Morton Isaacs, Arie Issar, Subhask Kak, Yury Kamenir, Nicholas Kazanas, Sergey Kovardakov, Charley Lineweaver, Victor Margolin, Steve McGrew, Curtis Metcalfe, Ely Merzbach, Esta Miran, Michael Miran, Massimo Negrotti, Stuart Newman, Diane Rodgers, Jana Roskers, Israel Rozenson, Larry Sawers, Sarah Schoonmaker, Eileen Stillwaggon, Josef Svoboda, Tim Taylor, Mark Tschaepe, Scott Turner, Andrew Winters, Joel Yisraeli, Roye Zak

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PART I:
ORIGIN OF DESIGN

Lineweaver
Egan
Grandpierre
McGrew

Nature and Man – cooperation in design. This photo of a bush shaped like an elephant was taken by Joseph Seckbach at the Utopia Park at Kibbutz Bachan near the city of Netanya (Israel). All rights reserved by the photographer.