

Book Review: Signs of Science - Linguistics meets Biology

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Abstract: „Biosemiotics“ is an integrative and interdisciplinary research effort that investigates living systems with concepts borrowed from linguistics and the communication sciences. Life is seen as an entanglement of communicative processes relating entities with each other by defined rules. Those “rules” are the very heart of (bio)semiotic analysis. A hallmark of life is the existence of rules that are very different from natural laws. We can find such rules embedded in the genetic code, for example, where a transfer RNA relates a codon in mRNA to an amino acid. Nevertheless, it could have evolved in another way as well as genetic code engineering shows. Apparently arbitrary relationships are inherent to all levels of biological organization: from cells to organisms. Parts are connected in ways that can hardly be inferred from physical (thermodynamic) principles and still await reconciliation in a reasonable manner.

Essential Readings in Biosemiotics
Anthology and Commentary
Series: Biosemiotics, Vol. 3
Favareau, Donald (editor)
1st Edition., 2010, 880 p., 219,94 €, Hardcover
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Considering human communication, “codes” are at work facilitating verbal and abstract interaction between subjects. For example, we communicate by using symbols to represent items in our environment thus allocating meaning to things. We may ask if forms of symbolization also work on a cellular level. Marcello Barbieri addresses this issue in his chapter “Biosemiotics: A New Understanding of Life” providing insights into cellular aspects that are quite different from classical biochemical approaches. It turns out that in biology we are dealing with meaning rather than with common sense “information”. “Information” has been a buzzword ever since the discovery of DNA and this topic is issued in several of the chapters presented within this anthology. The quote “A difference which makes a difference” (Gregory Bateson, author of Chapter 16) reveals that information is not enough to explain living systems. For an animal, a difference in whatever we might think of becomes only meaningful within a specific context, and not due to the existence of an entropy difference yielding a possible content of “information”. Barbieri applies ideas and concepts from the American philosopher Charles Sanders Peirce (chapter 3) to cells. Accordingly, this is leading to the conclusion that cells indeed are structured in a distinct way, namely there are symbols that are interpreted by cellular systems. The genetic code is just representing one of a plethora of codes that make up cellular relationships. Following up this thought, light is shed on the origin of life problem, as this framework allows a clear distinction between living cells and chemical replicators. The difference of living vs. non-living ontologically equals rule-based vs. law-based. The evolution of (organic) codes is succeeded by the rise of the first cell(s)...

But topics covered in the Biosemiotic Anthology are not only the molecular ones. The most prominent past and current authors relevant to Biosemiotics are given space to present their ideas to spread. Chronologically arranged, the development of (bio)semiotic thought is outlined by excerpts from major works of the field. These deal with the science of meaning (Jakob von Uexküll

“The Theory of Meaning), signs (Charles Sanders Peirce “The logic of Signs), behavior (Charles Morris “Signs, Language and Behavior”), and culture (Juri Lotman “Universe of the Mind: A Semiotic Theory of Culture”). The experience and ideas of those scientists built the foundation for or at least inspired current authors working on biosemiotics. Their voices are heard in Part II, III and IV of the anthology and cover most but not all areas of (bio)semiotic research. The evolution of language, thought and behavior are central to communication and authors like Thomas A. Sebeok (“Biosemiotics: It’s roots, Proliferation and Prospects”), Heini Hediger (“The Clever Hans Phenomenon from an Animal Psychologist’s Point of View”), Giorgio Prodi (“Signs and Codes in Immunology”), and René Thom (“From animal to Man: Thought and Language”) represent part of this biosemiotic journey. It is a tour from language evolution to communication at the organismal level.

A fascinating insight into the co-evolution of language, sign systems and the brain is given by a chapter taken from Terrence Deacon’s book “The symbolic species”. The author investigates the development of brain and language in evolutionary and behavioral contexts. He sets himself apart from many other authors in his field in that he is also integrating thermodynamic and information-theoretic considerations into his work. The evolution of language and symbols is treated like an egg-and-hen problem with respect to anatomical brain development. This anthropological excursion to neuroscience and cognition is really an adventure of its own.

Part IV of the book covers current discussions on molecular and information-theoretic topics in biosemiotics. It starts with Jesper Hoffmeyer’s (and Claus Emmeches) concept of Code-Duality that deals with living systems as being self-representational (“The semiotics of Nature: Code-Duality”). But what is required to maintain biological subjects? Living systems reproduce themselves and are self-referential. This form of organization according to Hoffmeyer relies on the existence of two information processing systems, one being digital (memory) the second analog (action). The existence of these interdepending worlds is discussed in detail and helps clarifying the concept of genetic information and is also worth to consider with respect to epigenetics.

The concept of genetic information is covered by Emmeche, Queiros, and El-Hani (“Information and Semiosis in Living Systems: A Semiotic Approach”) who describe the genetic system in terms of semiotics, i.e. as signs (indices, icons, and symbols). They consider the hierarchy of genetic information processing and built an ontological framework based on Charles Sanders Peirce’s ideas (chapter 3) covering all steps of genetic information flow. The distinction DNA/genes vs. program is outlined from the biosemiotic perspective. Actually they are developing a new definition of the “gene” concept.

Furthermore, Søren Brier deals with concepts of information in a communicative setting (“The Cybersemiotic Model of Communication: An Evolutionary View on the Threshold between Semiosis and Informational Exchange”). His “cybersemiotic” research deals with unification of cybernetic theory (i.e. self-regulatory systems, autopoiesis) and classical information theory (e.g. Wiener, Shannon) with sign-based communication (e.g. Charles Sanders Peirce). He is evaluating meaning from different perspectives and describes the border between cybernetics and semiotics (sign-usage) as well as different levels of causality (physical, informational, semiotic). It is a philosophical discourse from molecules to cognition with integration of social communication theories (Niklas Luhmann).

Anton Markoš in his chapter “Readers of the book of life” discusses different philosophical approaches to the evolution of organisms. His point of view is top-down rather than genocentric. To put into one sentence, it is the organism that reads the DNA and makes the best out of it, so to speak. Markoš reminds us that hardcore darwinism and ideas like those of Richard Dawkins are far from reflecting reality. Nevertheless the gene-centered perspective is widespread in biology and complementing ideas can rarely be found. Interestingly, the (re)emerging field of evo-devo covers topics related to points made by Markoš from a molecular perspective. Thus readers of the Biosemiotic Anthology may gain deeper insights into the meaning of evo-devo and epigenetics rather than with the underlying molecular substrates.

At a first glance, it may appear obscure to mix molecular biology, language sciences, immunology, physics, psychology, information, culture, and behavior into one volume. Nevertheless, the

approach of this book is to show that we can find unifying principles throughout all levels of organization in biology. Don Favareau has compiled articles that allow us to draw attention again to the phenomena of life and to the historic question “What is life?” that has been substituted by “What does life consist of?”. It is a journey from parts to principles in the very sense. Students of either field interested in biology can gain insight to what the riddle of life really is about. In many universities biology is broken down to “molecular” and “organismic” branches but biosemiotics is uniting rather than dividing. The book shows that it is possible to develop a coherent bottom up approach that couples molecules to minds within one and the same theoretical framework.

Libraries should provide this book to students and researchers as it is a unique resource of articles and book excerpts to which only few universities have access to. Especially interesting for those who are familiar with some of the thesis offered in the book are the chapter introductions giving insights to autobiographic information on the respective authors. Everyone who wants to know more about biosemiotics should have a look at this compilation. Also, the very extensive referencing provides even more interesting literature on the subject.

About the Author

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He is a biologist who worked on targeted drug delivery of DNA/RNA using polymer-based delivery systems and on molecular targeting of cellular microRNAs using chemically modified RNA (e.g. LNA). Furthermore, he investigated the regulation of PIM-1 kinase and miR-17-92 cluster in human leukemia cells. Current interests are: biosemiotics, evolution, and animal behavior. He received his Diploma (2006) and PhD (2010) degrees at the Philipps University of Marburg, Germany.