Introduction: Biosemiotics and Evolution

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Abstracts One of the most exciting endeavours and opportunities presented to a researcher lies in the possibility of being at the hinges of historical change, especially if the historical turn guides to a more positive outcome and we have reflective control over our participation in such quest. The present book is such precious opportunity, and the editors, Richard Simanke Theisen and Elena Pagni, have bravely positioned themselves at the crossroads of development and consolidation of a new discipline, or, shall we say, a new paradigm of biology: Biosemiotics. In exploring the natural foundations of meaning and symbolism, Biosemiotics must effect a turn to be an even more open inter-disciplinary and trans-disciplinary discussion; this discussion encounters the most prominent explanation of living systems on earth: evolution. The resources for our dialogue come from semiotics, the rigorous science of signs, but are not limited to it. In this volume, the foundations of symbolism, as the title of the present book alludes, can span beyond into a phenomenological, technological, philosophical, psychological discussion that will enrich our knowledge of those foundations and establish an engaging exchange with all synthesis of evolution. In this introduction we will position the reader to a short reminder of what the subject of Biosemiotics is about, and through that start preparing ourselves to the depth of the discussions to come. After this, I will offer a very short comment on what discussions are going to be present throughout the book and how these discussions are articulated with the project of the present volume, highlighting its unity and the outstanding work of the editors.

Keywords Biosemiotics · Evolution · Semiotics · Symbolism · Naturalism · Evolution theory

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Kalevi Kull has expressed that Biosemiotics is "the science of signs in living systems" (Kull 1999, 386). Biosemiotics is a surrogated discipline of the rigorous science of signs *qua* signs, i.e., of semiotics. Semiotics acquired the status of a rigorous logical science when Charles Sanders Peirce described the triadic logic of relations. Semiotics renders understanding of the functioning of signs, thus, "the sign is a medium of information that professes to represent its object in some aspect so as to produce an effect, which is its interpretant" (Romanini and Fernández 2014, 2). Once we understand the appropriate structure of sign-relations we are apt to inquire into living systems, the origins of life, the diversification, evolution and functioning of these systems, as well as their interaction with their environment.

Donald Favareau (2009) has done a wonderful job recapitulating the prehistory, the history, and the trends of Biosemiotics, in his wonderful review he truly delves deeply within the history of philosophy and biology. He brings the help of John Deely's and Alastair McIntyre amongst others to convey an understanding as to how the sign was at the very beginning of inquiry into living systems. He starts with Plato and Aristotle, and how, however concomitantly, the medieval thought on sign *qua* sign came to a pinnacle in the work of John Poinsot (1589–1644) and his *Tractatus de signis* (1632). He also makes a very compelling case of how the Cartesian divide of body/mind escalated to become the prejudice of separating meaning and interpretation from signs, constituting a paradigm of separation between materiality and cognition. Descartes, however, was not the only one to endorse such divide, it is ubiquitous in much rationalist and empiricist philosophy, and particularly poignantly taken for granted in the development of physics from Galileo and Newton onwards.

Barbiery (2008) recalls that contemporary biology is indeed affected by the above-mentioned Cartesian division that not only prejudices philosophy, but scientific practice: a first dichotomy of particular concern is the duality genotype/phenotype conceived as a sort of software/hardware divide, that leaves meaning out of the picture, along with a satisfactory explanation of how living systems function in sustaining themselves. Secondly, there is the always lurking problem of a physicalist metaphysics that reduces all realities to materialism of objects and their quantifiable properties, leaving aside everything that is not of such kind (including the laws of nature themselves!). Physicalism is a kind of obsessive reductionism, and for biology is disastrous, since downplays the best explanations of living systems reducing them to their material properties that are present in the sciences below them, for instance, to the chemistry and physics of part of their material molecular conformation. Finally, the belief that every biological novelty has been brought to existence by natural selection also constitutes one of the reductionisms of contemporary biology, presenting an incomplete and insufficient story of evolutionary development that leaves the code to understand it comprehensibly outside the narrative of biological explanation.

The achievement of having a field of study consolidated was no easy accomplishment, it is the result of an active strive for dialogue that owes much to Thomas A. Sebeok. Sebeok plays a very important part in recalling the stages of Biosemiotics in its conformation as a new paradigm for biology; let us have a quick review of the importance of his work:

Thomas A Sebeok started his career as a linguist, but soon enough his explorations of languages took him to the task of joining sign science with life science. Sebeok was initially aware of how a rigorous science of signs can and ought to be applied to the animal world first and then extending the world of meaning to all living systems. Sebeok's spirit was a free one, and even though he lived through the times of a divide in the academic world between the western world and the eastern communist world, this was no impediment for him to establish significant connections and develop a community of eastern and western researchers during the Cold War.

While Sebeok needed a rigorous science of signs, he soon enough realised that this could not be found in the structuralist tradition of Ferdinand de Saussure, but in the triadic conception of the sign proper to the semiotic created by Charles Sanders Peirce. Sebeok's synthesis of Charles Sanders Peirce's semiotics accounted not only of his semiotic ideas, but the architectonic system of his thought, including his triadic system of categories. The attention he lent to Peirce's seminal brilliance was very fertile, and this had a liberating effect in Sebeok's openness to new ideas. This openness also led Sebeok to the thought of Jakob von Uexküll and his idea of the *Umwelt*. Sebeok's synthesis of Jakob von Uexküll's *Umwelt* with Peirce's thought became the axis of a lasting contribution to biosemiotics: the discovery of the primacy of signs and meaning in living systems. But Sebeok not only contributed to establish the discipline in a theoretical way, he actively campaigned to break the disciplinary borders of science and to create a project of mass cross-fertilisation that Biosemiotics was called to be. Sebeok's legacy and the continuation of the biosemiotic project were free of the initial defence mechanisms of the circle of established academics and open a fruitful niche.

In the same wise we have to acknowledge the parallel work and efforts that came to biosemiotics from the biological research, which is the case of Jesper Hoffmeyer and the Danish School. Sebeok brought the semiotical thought to biology, and Hoffmeyer and his colleagues came to semiotical thought by the effect of finding an answer to the most important conundrums of biology and scientific inquiry. The convergence and consolidation of the two projects into a common programme shows that fruitfulness that Peirce wished for a community of inquiry. It is as though diverse ecosystems of researchers, prompted by an unrestricted desire to understand and overcome the limited regionalisms and borders of a discipline, came to flourish. Part of this conformation was definitely given by the International Gathering in Biosemiotics that rendered opportunities for that genuine exchange. Thus, scholars, researchers, and minds from different backgrounds found in Biosemiotics the opportunity to contribute to the brand new science. Just to mention outstanding examples we ought to remember how the Copenhagen–Tartu connection of scholars was consolidated, how the hermeneutical way of understanding Biosemiotics came to the picture with the work of Cvrcková and Markoš with their 'Readers of the book of life' (2002). Physicists joined the liberating effect of biosemiotics and we can briefly mention Edwina Taborsky (1998), Peter Voetmann Christensen (2000) and started taking seriously Peirce's categories and semiotic in the field of physical cosmology and its corresponding research. Howard Pattee (1965) is an important biologist that

understood the need of semiotics to understand nature appropriately with the categories of semantic closure and epistemic cut. Biosemiotics is also an appropriate environment for concepts pertaining Maturana and Varela's 'autopoiesis' (1973); Ilya Prigogine's 'dissipative structure' (1969), and many more, that steadily called for an overcoming of reductionism, physicalism, and eliminativism not only in biology but in science at large. Of course, the discipline will have developments and challenges unforeseeable to us, but from the 2000s to the date (2021), we can confidently witness a consolidation of the field. Two important examples are the official conformation of the International Society for Biosemiotic Study and the foundation of the *Journal of Biosemiotics* in 2005.

Since 1981, Marcello Barbieri came across the semiotic importance of the organic code for the study of Biosemiotics, according to Barbiery (2008, 1),

> Biosemiotics is the idea that life is based on semiosis, i.e., on signs and codes. This idea has been strongly suggested by the discovery of the genetic code, but so far it has made little impact in the scientific world and is largely regarded as a philosophy rather than a science. (2008, 1)

Barbieri has a very clear conscience of the need to improve the paradigm of evolutionary theory, and in this way explains that evolution cannot be fully understood only considering the role of natural selection, but the idea of natural convention is needed to explain the continuities and discontinuities in the processes of macroevolution. For Barbieri, Biosemiotics has to focus its efforts in the paradigm of the organic code, perhaps entering its final stage of conformation. Elena Pagni (2016) has stressed that a common approach to Biosemiotics suggests that semiosis is embedded in evolution and because of that requires meaningful processes. Though Barbieri is hugely enthusiastic about the importance of the code, Biosemiotics ought not to be reduce to it, as the evidence of the presence of meaning is everywhere to be found in biological research, and not only in genetics.

After our quick log of recapitulation of the evolution of Biosemiotics one naturally would ask about the future of Biosemiotics. A natural response is that the evolution of a new scientific paradigm is under way and that some clear trends guarantee us, in virtue of the evidence of its integrated origins, that Biosemiotics will continue to be a necessarily inter- and trans-disciplinary study. However, there seem to be no need of establishing limits on the breadth and depth of this study. Of course, biology and semiotics will always define the principles of the programme, but this book is a token of evidence that the explorations into new discussions are unlimited and will become the seeds of more breakthroughs for the discipline and for the understanding of meaning by and large. However, it is this book the first one that endeavours exploring the relationship between Biosemiotics and Evolution: for the first time we not only have a presentation of different approaches to living systems as living signs and codes, but as evolving signs and evolving codes. Indeed, understanding living systems from Biosemiotics opens a very important door of understanding those living systems as dynamical systems, and the most important dynamism at play is evolution. The reader, of course, will ask what account of evolution might be brought to the dialogue: in short, we can answer that an open

dialogue between Biosemiotics and Evolution requires the most comprehensive and experimentally open account of evolution, and here the modern synthesis falls short. In my opinion, we need a powerful and open account, one such as Extended Evolutionary Synthesis, which is a set of theoretical concepts argued to be more comprehensive and successful in integrating evolutionary developmental biology, the role of configurations, genomic structures, dimensionality of fitness landscapes, multilevel selection, epigenetic inheritance, developmental plasticity, phenotypic novelty, punctuated equilibrium, and a host of phenomena successfully developed: Biosemiotics and Extended Evolutionary Synthesis (as defended for example, by Pigliucci and Müller 2010 and Jablonka and Lamb 2005, 2014), allows a predictive and experimental status that can also be a semiosis of living systems, as some of the chapters of this book allow us to see.

This collection goes beyond much of what has been produced before in the field of Biosemiotics, as we will appreciate below, many of the contributions of this volume put Biosemiotics in new and novel spaces of dialogue, particularly accounting for evolutionary transformations, creating a series of roads for future contributions. As D. Favareau (2009) and Barbiery (2008) optimistically point out, Biosemiotics is a science in the making, and at this early stage we cannot predict what future outcomes and scientific breakthroughs will be made in the way. However, we are certain that this book represents a definite way forward that the discipline is taking: we have here a consistent and open dialogue with other disciplines and paradigms that opens more and more the possibilities of the discipline. Our authors have not only generated a dialogue with the consolidated sciences, but even with the frontier research of contemporary scientific inquiry as well as philosophical research.

The book is divided in three parts: the first one, 'Life, meaning, and information' includes contributions that establish the terminology of our dialogue that spans across Biosemiotics to Evolution.

The second chapter of our book is a great exploration on the philosophical and scientific foundation of meaning entitled 'Exploring the Philosophical Background and Scientific Foundations of Naturalist Approaches to Meaning and Symbolism' tailored by our editors Elena Pagni and Richard Simanke Theisen. The chapter delineates a historical, philosophical, and scientific framework that is needed to understand the fascinating connections between biological sciences, phenomenology, and Biosemiotics, and thus, these are a handy as well as important clarification of the framework of the whole volume. Perhaps there are little works as good as this to emphasise how the biosemiotic paradigm is apt to generate an epistemological pluralism that helps overcome unjustified impasses in the history of thought and pushes science and philosophy forward.

Franco Giorgi contributes with a hugely interesting work: "Life Sciences and the Natural History of Signs" that is subtitled with the question 'Can the Origin of Life Processes Coincide with the Emergence of Semiosis?' In this work Giorgi explores the concept of life as expressed in evolution and a dynamical interaction to the environment (*Umwelt*), and shows us that the role played by signs in the emergence

of forms and functions is the best way of channelling and understanding the unity and establishment of evolutionary trends.

Alin Olteanu's contributed chapter has the title: 'A Proposal for a Biosemiotic Approach to Digitalization: Literacy as Modelling Competence', and constitutes a bold exploration from Biosemiotics to the representational possibilities of the digital systems. The proposal is a potential merging of communicational networks that can revolutionise the way we approach digital systems: he focuses in multimodality as opposed to Glottocenticism and simultaneous participativity as opposed to the feedback processes of current digital systems. The result of such a proposed transformation is a more natural interaction between users and digital systems that will significantly improve the possibilities of digital communication as a more effective process of human semiosis.

The research on the foundations of meaning for the living systems keeps deepening in the work of Arthur Araujo: 'Threshold, Meaning and Life'. In his chapter he argues that meaning is an activity that distinguishes life systems from lifeless ones. Furthermore, that meaning and life are overlapping processes that hold continuity, this continuity has no strict boundaries, it is a process without a discreet tipping point. The author uses Peirce's anti-Cartesian view of cognition to explain that the threshold is not a specific moment in time, but a continuity that makes meaning and life convertible.

As we entered the depth of this volume, it is turn to Vinicius Romanini to offer us the work: 'How Information Gets Its Meaning'. The aim of the chapter is to clarify, using Peirce's semiotics and Peirce's pragmatist philosophy, the concept of information in the appropriate dynamism through communication. Romanini demonstrates that Peirce's clarification on the universal semiosis is well needed in biological explanations. Information then, should be embodied in icons, expressed by indices and communicated by symbols.

The second part of the book takes us to the dialogue of Semiosis and Evolution proper. Such dialogue shows the different models from the modern synthesis to the extended one, and from models of evolution to the applied evolutionary epistemology that deals with then. The contributions of this part open the Biosemiotic interpretation of evolution by approaching the fine grained theories.

In chapter seven, Philippe Huneman enriches the span of the discussion with a work entitled: 'Inclusive Fitness Teleology and Darwinian Explanatory Pluralism: A Theoretical Sketch and Application to Current Controversies'. In this text Huneman considered the uses of a view of evolutionary theory based on Formal Darwinism, but he re-activates the Aristotelian quadripartite teleological and etiological causality so as to show their potential fruitfulness in expanding explanatory practices in evolutionary biology.

We move onto: 'The Origins and Evolution of Design: A Stage-based Model', the authors Juan Mendoza-Collazos, Jordan Zlatev, and Göran Sonesson offer us a model that suggest the harmonious integration of continuities and relative discontinuities in the evolution of design, in such project they take on account human bio-cultural evolution and Biosemiotics of living systems, and use Donald's theory of the evolution of the mind to account for the resources of design.

Nathalie Gontier and Marta Facoetti's chapter 'Biosemiotics and Applied Evolutionary Epistemology: A Comparison' present us a wonderful systematic comparison between Biosemiotics and the results of the programme of Applied evolutionary epistemology. In their exploration, they find the important complementarity present in research programmes as well as the convergence in their interest, they also venture to establish the connection altogether explicit by touching the issues of adaptation and finality as well as the evolutionary nature of knowledge, cognition, and meaning.

The following chapter is presented to us by Jonathan Luís H. Ferreira: "Extended Synthesis and Jablonka and Lamb's Four-Dimensional View of Evolution: Some Remarks". Ferreira explores the four-dimensional view of evolution given by the paradigm of Extended Evolutionary Synthesis as articulated by Jablonka and Lamb (Jablonka and Lamb 2005, 2014). The author believes that the extended view helps liberate the constrains of what he calls 'reproductionism' and then helps us, along with the enriched conceptions of the extended view. In short, a phenomenological attitude with biosemiotics helps us to articulate a richer view of sexual behaviour that is open as an expression of meanings.

From this point we enter the third part of our volume: Physics, medicine, and bioenergetics. In this final section we can appreciate the impressive potential of application of our dialogue between Biosemiotics and Evolution by concrete applications in different experimental approaches.

'Physical Intentionality. The Phenomenological Roots of Biosemiotics' is a contribution by Roberta Lanfredini, in this chapter she shows us the important phenomenological roots that are modelled in Biosemiotics. She uses the notion of 'physical intentionality' to express the need of properties to be equivalent to meaning, then producing a freeing effect that liberates from physicalism and helps us to come across a phenomenology of the living.

Chapter twelve is a contribution by Rogério Estevam Farias called 'Cancer and Cell Death: A Biosemiotic Perspective' which is a splendid proof of the superiority of Biosemiotics as a paradigm of explanations. In this case the understanding of Cancer and carcinogenic cells is on point: the author explains us that the two systems by means of which the cell is indicated to die away and thus sustain the stability of a multicellular system: the processes are apoptosis and necrosis. The first one is given within the cell by its own singling resources that are transferred by code signalling. Farias explains us that an increase of disorder in the signalling processes of apoptosis called biosemiotic entropy inhibits the coding interpretation of the cell systems, producing a tumoural-like cell that has lost communication with the system. Though this is a short contribution, one cannot stop stressing the importance of this contribution, that offers the best explanation available of Cancer research based in its genomic evidence.

In our final contribution, Giulia Degl'innocenti contributes with the chapter 'Biosemiotics and Bioenergetics: Two Perspectives Compared'. The contributor explores an important common direction that emerges from both research programmes. On the one hand, according to Biosemiotics, the biological body is a place of signification as is generated, structured, and evolves. On the other hand,

bioenergetic analysis shows that the body is inscribed in relational and affective experiences and fully characterised by meaning. Two different sources of inquiry into the living body lead, then, to a common conclusion with regard to the living body.

The above richness of fields in the explorations on the foundations of meaning and symbolism of living systems as evolving living signs and codes testifies to the importance of this volume, as well as reflects the characteristic spirit of collaboration proper of the community of inquirers that Biosemiotics is. Notwithstanding this book also shows the breadth and depth of the collaboration by its international and multidisciplinary character, that adds new layers of future bonds of thought and fertile discussion. We are certain that this is a hugely valuable step on the direction for a fruitful and rigorous dialogue between Biosemiotics and Evolution.

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