Edited by **Ľudmila Lacková**
Claudio J. Rodríguez H.
Kalevi Kull

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Preface

"You do not remember everything you do the first time. But the First Gatherings concluded with a shared and pretty living feeling that a rich field of research, germinating in distant areas of the world, has now progressed to a state where its further maturing implies a continuing and critical interaction by a diverse community of inquirers; and I look forward to the coming Gatherings with the innocent hope that they will be just as intellectually joyful as the first." These were the words by Claus Emmeche[1] after the very first International Gatherings in Biosemiotics, which took place in Copenhagen twenty years ago this May 2001.

We have met for now every year during the two decades since, to discuss the research on biosemiotic processes and to endeavor to develop together a biosemiotic theory of life – and the intellectual joy in doing so remains as strong today as at our very first Gatherings.

In that time, too, we have lost the company of some dear friends and important voices along the way. Our long-time leading light, Jesper Hoffmeyer, passed away in 2019. So too, have we lost in the last few years such central contributors as John Collier (1950–2018), John Deely (1942–2017), Eliseo Fernández (1935–2017) and Wendy Wheeler (1949–2020). This year, also, we commemorate the 100th anniversary of the birth of Thomas A. Sebeok (1920–2001). As is the way of life, new voices with new ideas have appeared during these last 20 years, as well. Indeed, the 20th Annual International Gatherings in Biosemiotics has itself been organised by biosemioticians of the next generation.

And throughout all of this change and develoment, our view that biosemiotics is a necessary approach for biology (and also for semiotics) has become even stronger, while we understand that the building grows step by step. While the objects of our study are biological, the knowledge and support that biosemiotics continues to receive from the humanities is both instructive[2] and encouraging,[3] and one will always find scholars from both sides of what is elsewhere a "disciplinary divide" exchanging insights freely and productively at every Gatherings.

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1 Emmeche, Claus 2001. The emergence of signs of living feeling: Reverberations from the first Gatherings in Biosemiotics. *Sign Systems Studies* 29(1): 369–376; p. 376.

2 Cobley, Paul 2016. *Cultural Implications of Biosemiotics*. (Biosemiotics 15.) Berlin: Springer.

3 E.g., Livytska, Inna 2020. Turning back to nature: Perspectives of biosemiotics in a post-pandemic humanity. *Postmodern Openings* 11(1, supl. 2): 7–11.

For this reason and many others, we feel even more strongly today that a truly semiotized biology has the potential for bridging and overcoming the contemporary, but misleading, "divide" between the natural sciences and the humanities. Immanuel Kant reminds us that there are two kinds of systematicity that we need to understand in order to understand our being: the systematicity of *nature* and the systematicity of *freedom*[4] (which we may also think of as the systematicity of *things* and the systematicity of *knowledge*).

Biology, on the one hand, has an important and impressive history of studying the systematicity of *nature*, as it is exhibited in the details of the physiological and morphogenetic processes of living systems. Yet biology, at the same time, is certainly also the study of the systematicity of *freedom*, in as much as it is interested in the phenomenon of life itself. And so biology, understood as biosemiotics, studies life's capacity for aboutness, for establishing mediated and arbitrary relationships that result in the creation of novelty, for making choices, and for the ongoing exploration of possibility – of which the establishment of the biosemiotic project and community itself, is just one close-to-hand example.

To provide an historical record of that ongoing project, first twelve Gatherings were reviewed in a volume published for the 2012 Gatherings in Tartu, Estonia.[5] For the Twentieth Anniversary of the Gatherings this year in Olomouc, Czechia, this second review volume attempts to capture some of our collaborative attempts to further develop biosemiotics since that time. For so long as nature and freedom will always be with us, let us continue our investigations into their mysteries and subtleties together, and may there be many, many, many such volumes of investigation to come!

Kalevi Kull, President
Donald Favareau, Vice-President
International Society for Biosemiotic Studies
October 25, 2020

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4 "Es sind aber nur zweyerley Begriffe, welche eben so viel verschiedene Principien der Möglichkeit ihrer Gegenstände zulassen, nämlich die *Naturbegriffe* und der *Freyheitsbegrif*" (Kant, Immanuel 1790. *Critik der Urtheilskraft*. Berlin und Libau: Lagarde und Friederich, xi).

5 Rattasepp, Silver; Bennett, Tyler (eds.) 2012. *Gatherings in Biosemiotics*. (Tartu Semiotics Library 11.) Tartu: University of Tartu Press.
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Contents

Introduction: Twenty

Ľudmila Lacková,[1] **Claudio J. Rodríguez H.**[2]

Nature and Explosion

Nature grows everywhere we look, causing both gradual and explosive change, rippling through what lives and making it always new. The Gatherings in Biosemiotics become instantiated by the people who meet and the places they meet at, and the fateful 20th year of conferences comes to us in the middle of Europe, at a crossroads between places, cultures and ways of knowing, and at quite an important moment for society and its interaction as a whole with the COVID-19 pandemic. Biosemiotics, as remarkable a discipline as it is, can only subsist through our common efforts in seeking the meaningfulness of meaning itself for biological systems, and the Gatherings have been nothing short of essential in keeping the discussion alive – and evolving, despite the weirdly oppressing circumstances brought about by the virus affecting the whole world.

Joined together beyond scientific denominations, the project of biosemiotics is composed of various philosophical, biological and even technical approaches fusing, clashing and changing. The 20th Gatherings in Biosemiotics brings forth a new opportunity to explore questions about what exactly counts as *meaningful* in biology, whether this can be quantified and how, the degree to which doing so would be philosophically sound, and ways to understand our sign models in light of our current knowledge of biology, to name some of our present concerns. Continuing with these sometimes very abstract questions even under the present conditions is more important than ever, as the pressing issues of biosemiotics become more ingrained in the problems society faces: dealing with the pandemic, its social and biological ramifications from the perspective of meaning-making, presents us with a novel field of study, ready for daring biosemioticians.

The passing of Jesper Hoffmeyer, an unparalleled figure for biosemiotics, reminds us that the nature of research is always associated to the individuals that make up the research community. Yet, his work lives on ever so bright in the constant development of biosemiotic theories. This year's

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Gatherings will not only honor his memory as a biosemiotician, but will also celebrate his groundbreaking work through the new ideas presented by biosemioticians of all stripes.

Twenty years of conferences, twenty years of research and twenty years of biosemiotic dialogue come to us following the tracks of theoretical biology and semiotics, a conjunctive and unpredictable explosion of meaning and its understanding from an ever-changing point of view, going strong even through adversity.

Two decades of biosemiotic research

The Gatherings in Biosemiotics have been populated by many of us interested in meaning as a biological phenomenon, and while faces and names fluctuate, the reason for being there remains strong: Working within a framework that takes semiosis seriously in all forms of organisms. The two decades of Gatherings have shown us variation in themes and approaches, and 2020 is, we hope, no different in that regard. One of the valued aspects of biosemiotics is its openness to new approaches, and the ability to critically assess views that may not seem to be directly connected to concerns within general semiotics.

Though biosemiotics is not a singular theory, but a grouping of philosophical and scientific theses interested in how semiotics brings to light new ways of thinking about biology and signification, there is an undeniable connection between its different offshoots. Cooperation, agreement and disagreement are all part of a functional cycle of interrelated research. In this "ecology" of biosemiotics, our different points of view may remain isolated or in communion – either discussed and confronted or left to grow on their own –, but the project as a whole continues moving towards a better understanding of what makes nature semiotic.

It is our hope that both this year's Gatherings and this book are a positive addition to our ever-growing area of research and a representative display of the variety in biosemiotic thought.

Olomouc, a history in the world of biosemiotics

The tradition of biosemiotic thinking in the Czech Republic goes back to Zdeněk Neubauer, biologist and philosopher, the founder of the Department of Philosophy and History of Science at Charles University in Prague. The main merits of the Czech biosemiotic tradition, both as an international research as well as a part of the International Society for Biosemiotic Studies, are connected with Anton Markoš, Neubauer's disciple. Markoš contributed actively at the very beginnings of the establishing of biosemiotics as a discipline. He was also present at the creation of the journal *Biosemiotics*, an essential piece of Biosemiotics as a current discipline. The Gatherings in Biosemiotics have been held in the Czech Republic three times already, in 2004, 2009 and 2016, every time at the Charles University in Prague. This year's Gatherings in Biosemiotics will be held in Olomouc for the first time, a medieval ecclesiastical city situated only 200 km from Prague, lying at the center of Moravia.

Why Olomouc? Olomouc is a university city located by the Morava river in the eastern area of Czech Republic, making it part of the Morava region. Teaching, research and projects in biosemiotics are quite active at the Department of General Linguistic of the Faculty of Arts of Palacký University in Olomouc. The Olomoucean tradition of biosemiotics is rather young and we are grateful for its establishment to Anton Markoš. It was Anton Markoš himself who introduced scholars from Olomouc to biosemiotics, resulting in a very fruitful cooperation. In collaboration with the Department of Philosophy and History of Science at Charles University in Prague, linguists from Olomouc organized workshops, joint projects and university courses related to Biosemiotics. A crucial name for biosemiotics in Olomouc is Dan Faltýnek, a linguist interested in the linguistic metaphors of life and the applications of linguistic methods to genetic strings. His biosemiotic approach was spurred by his curiosity as a linguist into the analogies between natural language and the structure of DNA. Inspired by Roman Jakobson, Faltýnek investigated "semiotic primitives" present both in natural language and in the genetic code in his doctoral thesis. What were likely the very first results of the cooperation between Prague and Olomouc appeared in form of publications in 2010: first, with the publication of a monograph with Dan Faltýnek as one of the authors (Markoš *et al.* 2010); then, with a paper in *Biosemiotics* by Markoš and Faltýnek (2011). In the past 10 years Faltýnek has vigorously tried to create a research group of linguists, philosophers and biologists, from Olomouc and abroad, to develop an Olomoucean biosemiotic tradition. At the current state of art, the Olomouc research group consists of professors, scholars and PhD students, including Lukáš Zámečník, the actual head of the Department of General Linguistics and a philosopher of science interested in biosemiotics, Claudio Rodríguez Higuera, a postdoctoral researcher with a PhD in Semiotics from the University of Tartu, Ľudmila Lacková, a former PhD student of

Dan Faltýnek in joint degree with Bologna university, Hana Owsianková, a current PhD student, and Alexander Bolshoy from Haifa Unviersity, former student of Edward Trifonov and an expert in DNA linguistics.

The overall distinctiveness of the Olomouc biosemiotic group is based on its linguistic approach, yet it is not limited to a mere metaphorical conception of similarity in natural language and genetic scripts. We believe that linguistic methods may help understanding the semiotic nature of the life as such which, in our understanding, is a real and crucial component of the living.

The Gatherings and the pandemic

The sanitary emergency that the world is facing at the moment of the 20th Gatherings is unprecedented in the history of institutional biosemiotics. The decision to move forward with the organization without skipping the year was not an easy one in that the proposition is risky, and far too many outside factors contribute to the uncertainty of what can actually be done. Still, we strongly believe that, despite the situation, the Gatherings must continue in one form or another, and in this case, it will be the first Gatherings in Biosemiotics to be held completely online. Olomouc, at the heart of the Czech Republic, abundant in historical buildings and beautiful parks, is also home to a Faculty of Arts that teaches courses on semiotics, biosemiotics and cognitive semiotics, with a strong research group that focuses on quantitative linguistics, Peircean biosemiotics and philosophy of science. The Department of General Linguistics, in charge of the organization of the 20th Gatherings, has tried its best to put together a conference worthy of the 20 years of Gatherings given the pandemic, offering to go ahead with an online conference for presenters and attendants. The Gatherings are no newcomers to online presentations, with multiple researchers unable to travel giving them through online streaming services, but the 20th Gatherings will be quite special in this regard, offering unprecedented access to the conference both to the biosemiotics community and the world at large. While nothing can replace the feeling of being in the location, seeing the gorgeous old town of Olomouc, visiting the Bouzov castle and simply trying what the city has to offer, a remote 20th Gatherings will still be a warm encounter of researchers and attendants, all together in the perusal of understanding meaning-making through biosemiotics. Let this also be an open invitation to visit Olomouc soon, enjoy the sights and flavors of the city and meet the local biosemioticians. No matter how far you are from here, it is our hope the Gatherings serve as a bridge to become closer in our shared interest for semiotics.

Contents of the book

In commemorating the 20 years of Gatherings, we have tried putting together a book that represents its history as well as the location chosen for it. The first part of the book, from parts I to III, comprises a number of original contributions to biosemiotics scholarship, both in commemoration of the 20 years of Gatherings as well as its most recent organization in Olomouc. Part I, *Approaches*, begins with a number of special contributions from Czech biosemioticians. Here, **Vít Gvoždiak** explains how cybernetics became a source of theory for Czech semiotics in the 1960s in what counts both as a historical excursion into the creation of a more general perspective on semiotics in the Czech Republic and as a way that is sometimes set aside for framing general semiotic questions. After that, **Anton Markoš** and **Jana Švorcová** provide us with a work on Peircean semiotics with the idea of expanding John Deely's framework towards all forms of life through an exploration of different perspectives developed in biology and biosemiotics. This is followed by **Dan Faltýnek**, **Lukáš Zámečník** and **Ľudmila Lacková**, who expose some of the recent work done by the Olomouc biosemiotics research group, where they talk about novel approaches to quantitative research in biosemiotics, showcasing exciting theoretical possibilities for the future of biosemiotics. In the first non-Czech contribution, **Yogi H. Hendlin** frames biosemiotic development as a clear awareness of human logocentrism, capable of acknowledging meaningfulness beyond language, and grounding humans as part of the natural world biosemiotics aims to describe. Next is **Marcello Barbieri**'s contribution to the book, an overview of the developments in Code Biology in the past few years. While Code Biology has developed independently from Biosemiotics in its current form, Barbieri's contributions to the field are innumerable and valuable, and we hope his paper will expand the dialogue between interested biosemioticians and code biologists. This is followed by **Adolfo M. García**, **Daniel Franco-O'Byrne** and **Agustín Ibáñez**, who present some novel work on neurosemiotics, an underexploited field within biosemiotics that has much to offer given its proximity with neuroscience, cognitive science and experimental psychology. Closing the first part of the book is **Kalevi Kull** with a survey on the developments in biosemiotics during the last two decades, answering a number of questions that were first posed in

1987 about the scientific results of semiotics and what lies ahead for the discipline.

The second part of the book, *Past*, briefly reviews some important aspects of the history of biosemiotics, starting with **Donald Favareau** – who has established himself as one of the main historians of biosemiotics – narrating the developments of the Gatherings from its beginnings to the present conference, walking us through the cities and names that have left their mark on the organization of Gatherings across the years. Remembering the life of **Jesper Hoffmeyer**, **Claudio J. Rodríguez H.** brings out an interview with Hoffmeyer from 2014 after the presentation of the Estonian translation of *Biosemiotics* (2014), a snapshot of Hoffmeyer's wit on the state of Biosemiotics. Closing the section, **Howard H. Pattee** and **Kalevi Kull** discuss some thoughts on Bertalanffy and Rosen in a modern epistolary exchange that touches on the properties of interpreting agents as well Pattee's involvement with Theoretical Biology in a vivid picture of two of the most influential figures in current biosemiotics.

The third part of the book, *Future*, briefly surveys different responses to the question of the state of biosemiotics in 2050, with a cross-generational set of responses from new and established voices alike in the field of biosemiotics.

The fourth part of the book contains the programs of the last seven Gatherings in Biosemiotics, continuing the work started with the 2012 book published on the occasion of the Gatherings in Biosemiotics held in Tartu in the same year (Rattasepp, Bennett 2012). Each of the Gatherings also contains a brief overview from their organizers, with **Kalevi Kull**, **Silver Rattasepp** and **Timo Maran** and (Tartu, 2012), **Franco Giorgi** (Castiglioncello, 2013), **Paul Cobley** (London, 2014), **Luis Emilio Bruni** (Copenhagen, 2015), **Jana Švorcová** and **Karel Kleisner** (Prague, 2016), **Ekaterina Velmezova** (Lausanne, 2017), **Yogi Hale Hendlin** (Berkeley, 2018) and **Alexei Sharov** (Moscow, 2019) sharing their personal recollections of the Gatherings as their hosts.

After the selection of articles and programs from previous Gatherings, we have included the abstracts that were accepted for presentation and posters for the 20th Gatherings in Biosemiotics. Despite the uncertainty about the global conditions, we believe that this selection of abstracts represents some of the state-of-the-art research in biosemiotics and hope that it serves as both an archive and source of inspiration for future biosemioticians.[3]

[3] The organization would like to thank Barbora Anna Janečková for her invaluable contribution with the edition of this book, Pavel Baránek for his excellent work on materials for distribution and Jana Buzková for her tireless assistance in tasks related to the conference. We also thank Don Favareau for his kind help.

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I Approaches

Cybernetics as a source of Czech semiotics

Vít Gvoždiak[1]

It is clear that biosemiotics should not be limited to the obvious relationship between biology and semiotics but rather acknowledge and explore the fact that cybernetics is also one of its relevant sources (Cannizzaro 2013). The benefits of collaboration between biosemiotics and cybernetics have been demonstrated several times (cf. Brier 2008, Sharov 2010). This paper focuses on one small and local chapter from the history of relations between cybernetics and (bio)semiotics during the formation of Czech semiotics (elsewhere I call it the Czech theory, see Gvoždiak 2016, see also the English review by Velmezova 2016) and especially *Kybernetické modelování* [*Cybernetic Modeling*] by Jiří Klír and Miroslav Valach (Klír, Valach 1965). Of course, given that more than fifty years have passed since its Czech edition, *Cybernetic Modeling* cannot be expected to bring a significant contribution to current questions in biosemiotics, and the Czechoslovak cybernetics of the 1960s itself can hardly be considered a direct and explicit source of current (Czech) biosemiotics. *Cybernetic Modeling* can nevertheless be seen as a way – albeit imperfect – of framing biosemiotic questions, and in the case of the Czech theory it may even play a constitutive role.

Semiotics and cybernetics in Czechoslovakia

On global scale, the most significant Czech / Czechoslovak contribution to semiotic thinking can be found in the works of the Prague school in linguistics, literary theory and aesthetics, especially the oeuvres of Jan Mukařovský, Roman Jakobson and other members of the Prague linguistic circle. After the Second World War, however, the power and scope of this tradition in Czechoslovakia petered out to almost nothing, until it once again – albeit only for a short time – could enter public debate in the mid-1960s; it only returned in full strength after 1989. The suppression of the Prague functional structuralism in Czechoslovakia led to a certain intellectual vacuum which, apart from the role of Marxism-Leninism, was – at the methodological and epistemological level – not easy to fill.

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In the constellation of the suppressed structuralist tradition at home and the merely non-existent (but slowly emerging) semiotics abroad, cybernetics proved to be a salvaging alternative. In the 1960s, cybernetics in Czechoslovakia was a promising direction, with several political and methodological advantages. Since the end of the 1950s, cybernetics had a relatively strong institutional support in the Institute of Information Theory and Automation of the Czechoslovak Academy of Sciences and also the so-called Cybernetic Commission. In the mid-sixties, the Commission was transformed into the Czechoslovak Society for Cybernetics (which remains active as the Czech Society for Cybernetics and Informatics), and at about the same time, the journal *Cybernetics* launched, further strengthening the position of cybernetics on the domestic intellectual scene. The "Organizační řád Československé kybernetické společnosti při ČSAV [Organizational Rules of the Czechoslovak Society for Cybernetic CAS]" (1966), published in this journal, formulated the main objectives and interests of cybernetics as a scientific rather than philosophical endeavor (cf. Barbieri 2009: 241).

Cybernetic modeling

In Czechoslovakia, cybernetics penetrated different scientific areas, from mathematics, physics, linguistics and literary science to the theory of arts and mass culture. Despite various contributions that appeared in the 1960s under the auspices of cybernetics, one of them is of particular interest for the Czech theory and Czechoslovak semiotics, namely the book by Jiří Klír and Miroslav Valach *Cybernetic Modeling* (Klír, Valach 1965). On the one hand, it offered a methodological framework based on the general concepts of information and model without having to assign to linguistic sign or linguistic structure any constitutive terminological role. On the other hand, it explicitly addressed the issues of biological systems and posed an essentially biosemiotic question of the relationship between life and non-life.

Cybernetics in Czechoslovakia was not methodologically tied to the previous linguistic tradition, especially the tradition of the Prague linguistic circle. The *Cybernetic Modeling* relied on purely cybernetic and mathematical resources, and although Klír and Valach addressed genuine linguistic problems, such as sentence analysis and semantic relations within sentence, these were merely examples of analysis of one particular system, not a methodological pattern that should be followed in general. In fact, the authors also dealt with questions of living (or biological) systems, including the question of the origin of life. Thus, *Cybernetic Modeling* can be considered semiotic, but not linguocentric or semiological. In principle, therefore, Czechoslovak cybernetics did not in any way coincide with the structuralist paradigm, which even today does not appear to be of special methodological relevance for the biosemiotic research (Brier, Joslyn 2013: 2).

The main strength and (bio)semiotic relevance of the *Cybernetic Modelling* lies in its overall terminological and conceptual setting, which, while not explicitly using the concept of sign, nevertheless offered a robust alternative in the form of model and modeling. Already at the level of elementary cybernetic concepts, signal and information, it is apparent that authors treated (i) the signal as a material condition of information that cannot be identified with information in the strict sense, and therefore (ii) information can be viewed as – not only quantitative – degree of order in a system. Of course, *Cybernetic Modeling* cannot be assumed to offer a precise, biosemiotically up-to-date and relevant definition of information (Cannizzaro 2013; Cárdenas-García, Ireland 2019), or to take into account its biosemiotic diversity (Fernández 2010), but the general account offered by *Cybernetic Modeling,* not strictly formal in this respect, admits discussion about the difference between the biosemiotic interest in life and the cybernetic interest in non-life (Sharov 2010).

In *Cybernetic Modelling*, the life – non-life dichotomy was framed by the question "Can an inanimate system live?" and the answer lied above all in the rejection of the strict contradictory nature of this dichotomy by pointing to the variability of the conditions under which the system is assessed. The life – non-life dichotomy itself is not absolute, but necessarily context-sensitive and therefore it can be said that *Cybernetic Modeling* subscribed to some sort of functional (or pragmatic) understanding of semiosis, i.e. understanding of key differences cannot be based solely on the mechanistic idea of the materiality of sub-semiosical signals. Although implicitly, Klír and Valach identified in this dichotomy an important component of – what is now called (cf. Rodríguez Higuera, Kull 2017) – a semiotic threshold. In their view, it is tightly linked to the methodological decision whether the system will be assessed and studied in terms of its behavior or in terms of its structure. Inadequacy of external observation of system behavior as a criterion of (non-)life is intuitively obvious, Klír and Valach rejected it, and considered the only reasonable way to be an analysis of (internal) structure of the system. From this point of view, living organisms are characterized by material and energetic efficiency, while non-life has a major advantage in the speed of transmission and processing of information. Other important differences include the fact that in living organisms the purpose of processing information is mainly to predict changes in the environment, self-organization and self-reproduction. None of the three characteristics, however, are considered to be exclusive to living organisms and authors speculated on the potential for convergence of life and non-life but de facto leave it without a clear answer. In spite of its synthetic optimism, the very ending of *Cybernetic Modeling* sounds undoubtedly biosemiotic: nature – also through human endeavors – continues in a project that started without people and can proceed further in the same manner.

Cybernetics as a source of two types of models of life

In Czechoslovakia, *Cybernetic Modeling* did not meet with any massive scientific, philosophical, or semiotic response. Even the English translation, which was published two years after the Czech edition (Klír, Valach 1967), did not raise any particular enthusiasm, with the exception of brief reviews, some of which were cautiously commending (Zorkoczy 1967), others rather mocking (Doran 1968). Yet *Cybernetic Modeling* plays an irreplaceable role in the history of Czech / Czechoslovak semiotics, thanks to Ivo Osolsobě, who (Osolsobě 1993) not only considered this book an original contribution to the fundamental questions of semiotics, despite the fact that the authors mentioned semiotics only in one small remark (Klír, Valach 1965: 60), but above all Osolsobě himself used the concept of model – as defined in the *Cybernetic Modeling* – in his own critical attempt at the concept of sign (Osolsobě 1969), and in a way also founded his thinking about ostension (Osolsobě 1967, 1986; see also Gramigna 2016), and especially about theater and semiotics of theater on it. Osolsobě (1970) emphasized that the (cybernetic-inspired) modeling is not exhausted by representation of dualistic semantic relations (cf. Brier, Joslyn 2013: 2 for the inadequacy of dualistic semiotics for biosemiotics), but necessarily relies on a certain type of pragmatics and that theater in particular takes advantage of the so-called maximum semiosical opportunity, which Osolsobě – with some terminological freedom, but not frivolity – calls the modeling of life. Thus, the cybernetic line of the Czech theory did not lead directly to biosemiotics, but had a crucial influence on another, no less interesting type of semiotic endeavor, the semiotics of theatre. Of course, the theatrical modeling of life Osolsobě speaks about cannot be simply identified with the modeling of life that biosemiotics seeks. From the point of view of the history of semiotics, however, it is worth noting that from the standpoint of the Czech theory both approaches draw from the same, cybernetic source.

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Cutting down the Porphyrian tree: Objective reality as created by the innerness of living beings

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> [S]igns are not a particular kind of object; signs are presupposed to object existing – to objects being objects – in the first place. Without signs there would be no objects. And without objects there could be no understanding of things. So what is most fundamental is the last thing to be discovered. It becomes possible, after Poinsot, to introduce a new definition of sign: not simply the minimalist 'one thing standing for another', but now further *that which all objects presuppose.*
>
> J. Deely 2009b: 179–180

> Biology is, after all, a kind of applied chemistry, and chemistry is a kind of applied physics. So isn't everything, including us and other living creatures, just physics when you really get down to the fundamentals?
>
> J. Al-Khalili & J. McFadden 2014: 20

The concept of hierarchy has been shown to be extremely useful in many areas of human knowledge, and parsing the world into higher and lower, more or less complex, developed, or intelligent units is a heuristic tool we commonly use in order to understand the world around us. A *scala naturae* extending from rocks to humans to angels to God, or nowadays from elementary particles to humans to galaxies, is integrated into the fabric of our worldview. The concept is especially useful in biology, where it features either in its static form in biological systematics (Linneaus), or in the historical, evolutionary dimension such as we find in the works of Darwin and Haeckel, but also in cladistics and other fields. Markoš and Das (2016) argue that the term "domain" would be more appropriate for classification of living beings because it does not assume a hierarchy. When considering communicational processes within biological systems, a heterarchical concept indeed seems more appropriate (Švorcová 2016; Bruni, Giorgi 2015).

A natural implication of the very definition of biosemiotics is that *all* life ought to be viewed as a semiotic category (e.g. Markoš, Švorcová 2019; Švorcová *et al.* 2017). To do that, however, we must first of all find a

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common level where all life is equal with respect to its semiotic equipment. Thanks to their common origins in the primordial biosphere, all lineages bear a common semiotic heritage, all are capable of interpreting their world and organizing their umwelt accordingly. We believe that even the earliest cells were capable of meaning attribution and negotiation. Švorcová and Kleisner (2018) proposed that such variation in meaning attribution should be viewed as an additional and universal source of evolutionary changes. In such a system, humans do not occupy a position more special or privileged than the position of any other life form. At the same time, though, we must further specify our definition by adding that "Life is the *only* category in the universe that is semiotic."

Our attention focuses on Peircean semiotics in the interpretation by John Deely (2010, 2009a, 2009b, 2008). Where Peirce seems to express even pansemiotic views, Deely preferred limiting himself to speaking only about the "human animal", and only grudgingly – perhaps under the influence of Thomas Sebeok – broadening his scope to encompass also the "brute animals". The aim of this paper is to further broaden Deely's explanation framework and to apply it to all life. To do that, though, we should start with hierarchy and see how the notion is treated by three theoretical biologists, Marcello Barbieri, Adolf Portmann, and Jakob von Uexküll, who each have their own goals and treat the subject from a different point of view.

Humans are always the winners

Marcello Barbieri (e.g. 2009a) readily accepts that living beings are semiotic but promptly adds that there are three levels of semiosis, namely a manufacturing, signaling, and interpretative one, whereby the last is exclusive to humans and perhaps some higher animals. In his view, the "lower" life forms are firmly locked in the realm of codes. They blindly follow instructions how to build structures or perform activities, all this according to "code tables" that emerged in the process of evolution. These instructions cannot be inferred from chemistry and physics alone and they also do not lend themselves to interpretative explanations and/or interpretations on the part of the living beings involved. This offers an advantage because it enables the establishment of biosemiotics as a *science*: since the codes are here, they can be analyzed and described *to the last detail* by the selfsame chemical and physical laws that can be applied to any other artefacts, be it computers or space ships. Interpretation, as we "already know", Barbieri notes (2009a: 12), cannot be applied on the level of a cell: "Only animals [...] build internal representations of the world and only these representations allow them to perceive and to feel. But perceptions and feelings are precisely what we call subjective experiences, so it is only animals that have what we call 'subjectivity'" (Barbieri 2009a: 26). In short, despite of the heated polemics between the Barbieri and Deely regarding the "lower" levels of semiosis (Barbieri 2009b; Champagne 2009; Deely 2009c), their views may in fact be rather similar.

The abovementioned polemic concerned the question of whether the science of biology can integrate the semiotic aspects of life, or whether the term "semiotics" belongs exclusively to the cenoscopic realm. In the end, the whole issue culminated when partisans of the "scientific biosemiotics" broke away from the biosemiotic community, which was unwilling to accept the concept of semiosis without interpretation. They founded a *Society of Code Biology*, which was much more palatable to the rest of biological sciences. A disagreement between the two groups persists regarding the question of whether "interpretative biosemiotics" (an obvious pleonasm) might one day be accepted as a branch of biology. Our opinion is that it cannot: biology is an ideoscopic science.

Our second example of hierarchical approach is Adolf Portmann (1897–1982), the founder of "biological esthetics". He argued that the main attribute of living beings is their *innerness*. Living beings manifest their innerness, their inner self, by external patterns (*Selbstdarstellungen*), by signs (*eigentliche Erscheinungen*) that are addressed "to nobody" and arise simply as a byproduct of life's potency (Portmann 1967, 1964). This would look highly congenial to our intents and purposes were it not for the fact that Portmann also believed that only humans are capable of appreciating the manifold of such creativity. In other words, he claimed that other forms of life cannot *reflect* their innerness. This is where hierarchy came into play again. Moreover, after giving a plethora of examples from the realm of plants, snails, etc., Portmann rather surprisingly introduced a "cephalic index", which is supposed to show that the perfection of self-presentations depends on the size of the brain. In other words, while not doubting that the beauty of expressions in the *lower* forms of life (plants, mollusks, etc.) *does* refer to their wellbeing and is an outward expression of creative potential, their *innerness* is as if *unintended*. They can be compared to the beauty of perfect crystals or the "creative" outbursts of fractal projections on a computer screen. The symmetry of a crystal and of a flower somehow belong to the same category of symmetry-seeking, hypothetical laws of nature.

Our third example is Jakob von Uexküll (e.g. 2010, 1992, 1985) who is often considered a proto-biosemiotician, but even his concept of *Umwelt* could be interpreted as referring to just a hardwired scheme that prevents any interpretative moves on the part of an animal (Uexküll was not interested in other forms of life). An animal is locked in its umwelt and interpretation is limited to a world-scheme (perfect, well-tuned, etc.) that is somehow given *in advance*. Again, only humans have an *Innenwelt.* Only they have the ability to puncture the bubble of their umwelt, only they have access to all facets of the surrounding world. In fact, Uexküll inspired Heidegger to formulate a similar scheme (see Heidegger 1995). John Deely had adopted Uexküllian notions of umwelt and *Innenwelt* as a distinction between animals and humans, as we will see below.

To summarize the views of Barbieri, Portmann, and Uexküll: all three strongly oppose the idea that living beings are mere machines. They all, and each in his own way, emphasize the uniqueness of living creatures, but they also stress that inhabitants of the biosphere are *not equal* in their access to the world. In the view of all three, humans tower over the rest of life. This is, on one side, a trivial statement but on the other hand, one could object that by doing so, it is as if they assumed that non-human living beings are not-so-fully living. In short, a hierarchy or *scala naturae* is present at the core of their thoughts. Genuine, i.e. living, trees, snails, or bacteria occupy a very rung on this *scala*. In the following, our goal is to show that biosphere is organized rather as a hedge, or even better a lawn, a rhizome, an encyclopedia of interconnected meanings (see also Markoš, Švorcová 2019).

Things, objects, signs

John Deely, medievalist, philosopher and semiotician, made a lifelong effort to explain the "way of signs" (i.e. semiotics) as a contemporary ("postmodern")[3] alternative to modernity's leitmotif, the "way of ideas". In his *Medieval Philosophy Redefined* (2010), he traces the history of the Latin Age from late antiquity until the seventeenth century. With surgical precision, he unpicks from voluminous medieval tractates devoted mostly to theology the golden strand of proto-semiotic development, in other words, the "way of signs", all the way until the end of the Latin age in the

3 Postmodern in a sense of "replacing modernity" (in the sense of the age that started with Descartes and Galileo), not as in the postmodern movement in philosophy from late twentieth century, which is, according to Deely, but a continuation of modernity in the former sense. In our view, "non-modern" would better express his point.

seventeenth century. At that point, the thread broke and was forgotten with the arrival of the Modern Era, only to be picked up again by C. S. Peirce. Below, we list three examples of Deely's conceptual scheme, within which the concept of *object* plays a central role.

(1) The first definition, albeit anthropocentric, is the most comprehensive: "Anything, to be an object, must exist in awareness. To be known and to be an object: the two are the same" (Deely in the Praeludium to his *Purely Objective Reality*, 2009b: 8). Let us analyze some examples: the center of mass, Napoleon, horse, entropy, and words designating such objects. Obviously, such objects are constructs. They can represent things that exist in the external environment independently of our consciousness as *entia realia* (horse, Sun), but also things which are assumed to exist only in our consciousness as *entia rationis* (witches, quarks). An object reflects *some* properties of thing's subjectivity as interpreted by our perceptions[4] and integrates an added value grounded in words, in our memory, and our experience, of memory and in experience as cultivated in our culture, and in the way as we express such experience by words. In other words, in canonical or new contexts, in argot, or in poetry (e.g. Barfield 1973). Things, however, may also exist only in our awareness (e.g. entropy, the center of mass, or Dasein). As such, they represent the work of our mind and are expressions of such work. In either case, our awareness, or more generally, innerness, *must* be at work to construct an object that can be communicated, learned, and shared by other members of a community. *Ens rationis* is comprised of memory and experience (individual, communal, historical) which enable it to "leap into the future," to construct ways of living that permit further survival. We add: our task, as biosemioticians, should be to replace the *ens rationis* with a broader concept of memory and experience applicable to all life, a concept that could function as a general property of *being alive.*

(2) A similar definition can also be found in Deely's *Descartes & Poinsot* (2008: 98) where in addition to "object," the term *sign* enters the stage: "To say 'object' may or may not be to say 'thing'; but to say 'object' and to say 'object signified' is a matter of redundancy. There is no object other than one signified. Every object in principle is a significate, whether or not it is also a thing existing in the order of *ens reale.* So, a sign strictly speaking is a triadic relation suprasubjectively uniting three terms: a sign-vehicle or

[4] Perceptions as context-dependent *always* assume interpretation, not only trans-coding.

representamen, and object-signified or significate, and an interpretant or one to or for which the representamen functions as other-representation."

The spiral of signification must stop at the object to make it at least temporarily sharable and recognized in a given community, i.e. to make it possible for members of a community to understand an object in more or less similar way. In other words, a community constructs its image of the world, i.e. umwelt, as an *objective reality* that can be communicated and is accessible to all its members. Note that this definition is applicable to any living being (even if Deely did not mean for it to work this way).

(3) The third quotation (2009b: 11) takes a leap from humans to other animals but with a strange disclaimer: "[The] subjective constitution of material and physical things extends into our own bodies as well: it is the 'essence' of all bodies that they have a constitution that makes them what and as they are, and it is the 'essence' of human understanding to be able to objectify that subjectivity and made it known – an ability not given to other animals simply because within their umwelt the objects are considered only in relation to *the animals themselves*, with no opening further to consider the constitution of objects in relation to *the objects themselves*; because this requires a semiotic ability, the ability to consider relations as distinct from (even if not independent of) the objects that are related."

The framework of the animal *umwelt* thus directs animal "awareness" towards objects but without making animals *aware* of the fact that they *are* objects, i.e. constructs. Animals have no way of distinguishing things from objects. What they perceive is always a mere object. Animals are marooned in a cage of their species-specific *umwelt* which filters external sensations into percepts comprehensive to an animal and there is no genuine innerness admitted even for animals endowed with brains. There is thus a gaping chasm between animals and "human animals" (the term Deely uses for humans), an abyss between animals and the rest of the biosphere. This is, once again, a hierarchy of the living.

In what follows, we try to consider the concepts of codes, innerness, and umwelt without the hierarchical tree and from a perspective of a "hedge" or "rhizome" that encompasses all life. This move requires us to start from what all living creatures have in common as a prerequisite for lineage- or species-specific achievements that enable them to understand the world. Only in that way can we make life a semiotic category.

What we have in common

In the following, we present a brief outline of argumentation developed in our recent book (Markoš, Švorcová 2019), where we discuss some principles that underpin semiotic processes in the biosphere. In short, all denizens of the biosphere recognize the basic processes of communication and construction of the objective world while performing in their particular lineages a free play of innovations, while coming up with new ways of living. Yes, they share structures and codes as presupposed by Barbieri, but they do not behave blindly as if hardwired.

All life is cellular life and all life is bound to communities of cells, such as multicellular bodies, microbial consortia, biomes, or even the biosphere. These two facets of life, namely individuals (cells or multicellular assemblages) in the context of a community, are elaborated upon in a theoretical model developed by Kauffman (2000). In this model, *autonomous agents* (here, living beings) live in a heterogenous *biosphere*, make their living in it, and *negotiate* its further evolution. Reverting to our own terminology, *all* living beings are capable of acting on their own behalf and they all also influence their surroundings, both physical, communal, and living. Organisms, as well as lineages, assemblages, etc., evolve not in isolation but in constant interaction with other forms of life in a historically established being-together (Markoš 2016). That organisms represent a major evolutionary "force" that operates on other organisms is a fact that recently started to be recognized (Matthews *et al.* 2014; Odling-Smee *et al.* 2003).

To be capable of its tasks, all life shares properties inherited from first life that emerged some four billion years ago. What we mean here are properties that are not merely the result of some prebiotic chemical (metabolic) evolution. Below, we offer a partial list of some shared features that are the *sine qua non* of being alive both on cellular and supracellular level and on the level of communities.

Closure

The internal settings (milieu) of a cell, i.e. its composition, structure, metabolic and genetic processes, as well as behavior, differ in almost all parameters from conditions that prevail in its abiotic surroundings. Maintenance of this asymmetry is essential for cell's survival or, to be more poetic, it guarantees its innerness. Cells never emerge *de novo*. They all are (modified) descendants of the primordial biosphere, which is why their internal milieu reflects – in one way or another and naturally with modifications in particular lineages – this primordial state. As a consequence, cells in contemporary biosphere are in this respect significantly similar. Variations in their patterns and their heterogeneity are evidence of memory and experience of the ages, differently modified and interpreted in the particular lineages of life.

At the same time, the closure, i.e. the interface between cell's innards and its surroundings, is not absolute and the interface, that is, the plasma membrane, is a location of selective bidirectional flow of nutrients, wastes, metabolites, energy, and information. Yet since a large part of surroundings does not consist of abiotic space but of other inhabitants of the biosphere, such flows are often directly *aimed* at them and they are taken up into the incessant web of biospheric exchanges of matter, energy, information and signs. They become the representamina for cells capable of taking up such cues, of recognizing them as objects. Such penetrability thus enables selective meaning attribution followed by the formation of internal representations rooted in a different patterning of memory and experience. Sensory inputs are thus modified into objects by cellular structures (genetic, epigenetic, metabolic, etc.) and their relations (hardwired, or achieved by trial and error).

Such internal representations of agents of the different lineages also vary, although to scientist's eye they may represent the same physical cue (a molecule, an impulse, or a sequence of behavioral events). That is how new morphological traits evolve: through cooption and modification of preexisting developmental cues and pathways (Kassahn *et al.* 2009; Teichmann, Madan Babu 2004), when the same molecule (for instance, a hormone or a product of the *Hox* gene) can play different roles depending on the specific context of tissue expression (Zhang *et al.* 2013; Chi, Epstein 2002) and thereby represent a well-established convention (as emphasized in Švorcová, Kleisner 2018; Švorcová 2012). Such reinterpretation is further evolutionarily integrated thanks to organic memory.

Memory and experience

Memory is a record of whatever can serve some living being as a cue for reconstruction, interpretation, or a new reading of reality. A dinosaur fossil is a record of something but only if recognized by a paleontologist does it also become a memory, a record that can have an impact on the world, for instance via a new interpretation by a scientist or a philosopher, of evolutionary events. Experience is then an interpretation of such memory traces in the light of contemporary understanding of a particular topic.

Memory is also a store of internal information about how to reproduce, differentiate, develop, or change cellular architecture, behavior, cooperation within a community, etc. Proteins – linear aperiodic polymers of hundreds of amino acids (from a repertoire of 20) – are the main tool for providing all these functions. A key step in evolution came with the invention of how to store *genetic information*, how to accomplish repeated and reliable protein synthesis in a medium that is not a protein. The carrier of genetic information (DNA and RNA) can be easily copied and when needed, it can be translated into a protein according to a recipe called the *genetic code*. The code is a historical (contingent) product that cannot be inferred from chemistry. It is a genuine product of evolution and it enables a recording of the memory store onto a set of protein molecules.

But the invention of the script – usually a one-dimensional non-repetitive sequence composed of a small set of discrete characters – was perhaps crucial from another point: such strings, albeit conservative and meticulously copied, open the way to new worlds, new interpretations of areas already known, because their meanings can substantially change over the course of generations, in different contexts and environmental settings, in different ways of "pronunciation" and "diacritics" (e. g. Markoš, Švorcová 2009). Hermeneutics entered the stage: an analogy between DNA and the human language and its scripts is highly fitting.

As in the abovementioned case of fossils, the store of information becomes a memory only for *actual* cellular structures[5] which decide what information, when, and in what context should be retrieved from the DNA store. This is the first of many other possible examples of interpretation processes on a cellular level.

Interactions

Cells-to-cell communication, but also concurrent interactions between multicellular assemblages of various types, can be carried out in a plethora of ways which are, however, all in principle based on the same four principles: (i) cell-to-cell contact (by recognizing cell-surface patterns or structure of an extracellular matrix, such as cell walls); (ii) signal vesicles (as in a synaptic transfer but occurring generally); (iii) horizontal gene transfer (the sending and receiving of strings of genetic material); and (iv) chemical or physical messengers (hormones, pheromones, light, sounds, and the like).

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[5] Nowadays, of course, the recipients include molecular biologists who can set up translation also under artificial, non-cellular conditions.

Such communication requires established protocols to achieve high quality of messages, transfer and amplifying pathways, but also for instance receptors and effectors. Without such protocols, highly homologous in all life forms, mutual understanding would not be possible. It follows then that all forms of life share at least part of communication protocols that had been established in the primordial biosphere. Of course, they may have become, over the ages, adjusted, twisted, differently hardwired, chemically modified,[6] and/or supplemented by new inventions, such as language in humans or sexual displays in animals. At least some elements of the network did, however, remain mutually understandable, even if only vaguely or perhaps imprecisely. For example, thanks to such intertwined "hairball", an animal and its gut microbiome maintains a meaningful bidirectional communication (the gut-brain axis). Stress processed in our brain influences – via parasympathetic (the vagus nerve) and sympathetic (prevertebral ganglia) nervous system and using neurotransmitters such as acetylcholine, dopamine, or serotonine – the digestive activity of our gut and thus also the composition of gut bacteria. The gut bacteria, in their turn, produce various neurotransmitters, such as acetylcholine, adrenaline, GABA, or serotonin (Yano *et al.* 2015; Barrett *et al.* 2012), which have a major impact on our brain (Markoš, Švorcová 2019). We can observe similar relationships everywhere in nature, an all-pervasive symbiosis taking the form of intracellular symbiosis, fungus-plant, or fungus-alga symbiosis and many other cases of animal-bacterium symbiosis. All of these relationships rely on abovementioned communication protocols shared by the entire biosphere.

"[I]n the swampy region between Firstness, Secondness, and Thirdness" (Eco 1999: 113) from which objective reality emerges, the quality, intensity, and timing of circulating signals and signs allow for the world of objects and their mutual relations. The region is swampy because of the endless movement on the part of perceptions (*entia realia*) as well as innerness (structure, memory, and experience) of individuals, their lineages, and their communities which often involve all life.

The umwelt

In Švorcová *et al.* (2017), we suggest that the Uexküllian concept of umwelt ought to be broadened to encompass also the historical (evolutionary) dimension of life, which naturally goes hand in hand with the accumulated

6 For more on the role of such chemical "punctuation marks" in the cell chromatin, see e.g. Markoš, Švorcová (2009, 2019).

store of memory, experience, and ways of living of individuals and/or their communities. The umwelt functions as a capacitor of all this, whereby the elements which form the Uexküllian umwelt form but a small subset of this more encompassing concept. It follows then that any concrete realization of what we interpret as an umwelt of a particular animal or group is historically conditional and dependent on the life history of the lineage as well as on environmental cues. Models in biology, however tend to be constructed on the basis of conservative organisms that follow stable traits in genetics (Mendelian peas), molecular biology (bacterial operon), development (*Drosophila*), or umwelt (ticks). Models are a useful tool of conceptual understanding but we must not forget that they are not easily recognized in the buzz of the biosphere that is the semiosphere (Markoš 2016, 2014; Lotman 2001; Hoffmeyer 1996). In sum, the historical aspect of innerness, continuously reinterpreted, is what distinguishes living beings from non-life and what constitutes their umwelt-that-is-innenwelt (i.e. culture). Human innenwelt is but one “sport” restricted to the lineage of *Homo sapiens*.

Conclusion

In Al-Khalili and McFadden’s book (2014: 103), we read: “No serious scientist today doubts that life can be accounted for within the sphere of science; but there remains a question mark over which of the sciences can best provide that account”. The authors undoubtedly have the sphere of natural (ideoscopic) sciences in mind but we believe that the task cannot be met without the aid of cenoscopic sciences, especially (bio)semiotics. The task is made harder by the strange, idiosyncratic turn of contemporary English which uses the same word for a science and its subject, so that for instance “biology” designates both an ideoscopic natural science and the real world of life (see Markoš 2009). Consider an example from the abovementioned book (Al-Khalili, McFadden 2014: 50, italics added): “In the 1920s, life was still a mystery. Although nineteenth-century biochemists had made great advances in constructing a mechanistic understanding of the chemistry of life, many scientists continued to cling to the vitalist principle that *biology* could not be reduced to chemistry and physics but required its own set of laws.”

Indeed, biology as an ideoscopic science can and should be reducible in such a way. After all, it was established and developed as such. But if we mean “life”, it certainly requires its own set of rules.[7]

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Quality and quantity in biosemiotics: Explanatory power of quantitative approach

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Introduction: Semiotics, linguistics and quantitative methods

Semiotics and biosemiotics as fields of study are undoubtedly linked above all with a qualitative view of the matter. If we look at the basic works of semiotics – e.g. Ch. S. Peirce or Ferdinand de Saussure – it is obvious at first glance that semiotics is a theoretical discipline that seeks to integrate the description of the different ways of representation, categorize the types of relationships between objects and means of representation, and model their position in the system of representations. In a much simpler way, semiotics systematically describes the signs, codes, and usage of both. For these tasks, there seems to be no way to involve quantitative methods.

Linguistics is posted in an analogous situation in terms of qualitative and quantitative methodology. This position of linguistics remains the same whether we regard linguistics as subordinate to semiotics, in the way de Saussure says that human language is only one example of all existing sign systems; or if we understand it as superior to semiotics (Barthes 1968 [1964]), because the use of all sign systems is based on "translation" from or into natural language. The use of quantitative aspects in linguistics can be found in its history, for example in the field of experimental phonetics, where statistics is applied by necessity (Hayward 2013). In this way, the quantitative aspect has been reflected in some of the initial formulations of structuralism – for example, in the concept of flexible stability of V. Mathesius (1932; see Vachek 2003: 103), where *parole* represents a statistical fluctuation of language variables used in the utterance, and *langue* is an abstract system of values in the sense of phonological oppositions etc. A quantitative view has been adapted in linguistics in authorship attribution (Yule 1938, 1944), e.g. in the traditional issue of attribution of authorship to a particular literary work (Shakespeare, later Federalist, see Mosteller, Wallace 1964). Quantitative metrics such as average sentence and word length, vocabulary richness, distribution of functional words, etc. became

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authorial characteristics – these characteristics of the text cannot be expressed other than quantitatively. Diachronic discipline *glottochronology* is based on the use of quantitative analysis. Glottochronology solves the problem of linguistic affinity based on statistical analysis of vocabulary, especially borrowing-resistant words – vocabulary core analysis gives an estimate of the "half-life" of the language into separate dialects and distinct languages (Swadesh 1955; Haspelmath, Tadmor 2009).

The question is, is the way these quantitative engagements affect the discipline itself of crucial importance to linguistics? We have here (A) a statistical view of *parole* against abstract *langue*, (B) a statistical description of author's characteristics and (C) a statistical evaluation of similarity of the core of vocabulary. All of these three examples can be said to stand a little – or rather very – aside in traditional linguistics. (A) In the case of structuralism, quantity is completely out of sight – questions of the frequency of use of an element of opposition (e.g. phoneme, morpheme in word-formation) do not explain the nature of the system and can only supplement explanation of systemic change by textual description (we are talking about e.g. phonetic or word-form changes). (B) In diachronic linguistics, quantity cannot substitute for historical and comparative analysis, which has fine tools to describe the relationship of linguistic variables at certain periods; a quantitative view cannot express the sequence of linguistic changes or their reversibility, and does not explain the change in terms of system adaptation. (C) Authorship attribution is completely out of linguistics and is a peculiar interdiscipline with its own methodology (Holmes *et al.* 2001; Baayen *et al.* 2002; Juola 2006). A, B and C can be said to represent only a complementary way of studying the subject of research in linguistics.

Given the authorship attribution (representing A, B and C), we can say with a slight exaggeration that the death of the author (Barthes 1967) is applicable to most traditional humanities. In this case, the author's death can be reformulated as a lack of interest in uniqueness. The main interest of humanities is to generalize – whether it be linguistic, cultural or artistic phenomena. This is possible only on the basis of generalization in the form of abstract quantities – in the case of linguistics in terms of language units such as phoneme, morpheme, word, etc. In this generalization, the author or the unique use of the unit cannot speak. It follows from the above: if a quantitative aspect is used in humanities, then with respect to a particular phenomenon. Quantitative point of view means working with individuals – quality is the basis of the theoretical framework of the discipline. Quantities in this comparison look less attractive and, as can be seen, not the main interest of a discipline such as linguistics. This also applies to semiotics and biosemiotics, as their main focus of interest requires an abstract point of view that deteriorates the author or a particular organism – uniqueness – from their point of view.

Returning to semiotic disciplines and using quantitative methods, most of the approaches that are profiled in this way are focused on commercial use, especially on big data analysis. The semiotic task here is to prepare analyzed topics for machine learning methods, natural language processing etc., and to interpret the results of such analysis. In other words, semiotics serves as a discipline mediating linguistic, visual and other content (Compagno 2018). However, the use of semiotic theory is limited here, for example, semiotic theory is not interested in reflecting such an application by reforming its concepts. In analogy to linguistics, we see here that a quantitative view of the matter is associated with the analysis of specific phenomena and also to application in advertising, marketing, etc.

Another example of the usage of quantitative methods in semiotics is experimental semiotics, which deals with the evolution of sign systems or the use of new technically mediated means of communication (Steels 1997, 2003; Galantucci, Garrod 2011). Quantitative methods come into play here in the form of computer modeling of communication behavior and the development of semiotic means in a particular communication situation. Experimental semiotic approach is closer to the theoretical core of the discipline than quantitative semiotics is. This is due to the fact that modeling specific conditions of communication draws general conclusions regarding the used abstract sign system and its development. This brings us back to the qualitative core of the discipline and to the fact that the quantitative approach serves as a means of expressing a theoretical basis from the specific conditions of use. So it seems that even for semiotics, the opposition of quantity versus quality corresponds largely to the opposition of particular versus general. Let us now consider that, as in the case of experimental semiotics, biosemiotics also has an overlap where quantitative methods are used in relation to basic theoretical concepts.

Quantitative potential in biosemiotics and linguistics

Let us now focus on biosemiotics, which is based on the theoretical framework of semiotics and uses it to describe biological phenomena. Biosemiotics and semiotics share the dominant choice of qualitative approaches. Although it deals with phenomena described by biology and many other hard sciences, its role lies in explaining these phenomena in terms of the sign composition and structure of the sign systems. Quantitative approach has been applied to biosemiotics, even if very rarely. We can mention work by Ulanowicz (2002) who considers ecosystem as complex systems and proposed a mathematical way of explaining biological phenomena in selected ecosystems (ecosystem of the Chesapeake Bay). Quantitave approach has been common in many biological fields, for instance the relation between increase in body size and evolution (fitness) was mathematized by Cope (see Stanley 1973), Lotka–Volterra equations were proposed to are used to express quantitatively the relation between predators and preys in ecosystems (Lotka 1920) or in genetics Hardy–Weinberg law formulates the frequency of a given genotype within a population (see Edwards 1977). Mathematisation of non stable complex ecosystems recalls the famous book by Kauffman (2000), *Investigations*.

We have seen with the above examples that the mathematization in biology is rather commun. Therefore the aim of this paper is not to discover a possibility of qunatification of life, but to discover a possible quantifiacation of the *semiotic aspects* of life. When dealing with genetic information and its expression in the living organisms, surely the quantitative approach is used in connection to the information theory. Several studies were conducted to quantify and measure the amount of information or the probability of information to be expressed by means of Shannonian information theory (Jablonka 2002). For a biosemiotic purposes, this approach is not fully valid, since it treats information in a non-semantic way. In biosemiotics, the *meaning* of the genetic message is crucial, not only the mathematical amout of information (see more on this topic in Emmeche *et al*. 2010; Brier 2017). In relation to aforementioned quantitative linguistics, however, there is one more area in which the quantitative-linguistic methodology and an object of study of biological sciences are approached. That is a research in quantitative linguistic laws and research aimed at using linguistic analysis of a text in texts representing biological phenomena such as DNA or protein strings (see Bolshoy 2003).

We will try to refer briefly to the research of linguistic laws in the field of biological phenomena and subsequently evaluate the importance of such research for biosemiotics. When we speak of quantitative linguistic laws, we mean above all Zipf's Law (Zipf 1949) and Menzerath-Altmann's Law (Menzerath 1928, 1954; Altmann 1980; Hřebíček 2002 shows that Zipf's Law is a variant of the Menzerath-Altmann Law). Zipf's law formulates a proportional relationship between the order of the quantity in the frequency rank and the frequency of the quantity – the frequency drop of less frequent units of text is linear in the logarithmic representation. Menzerath-Altmann's law formulates the relationship between the length of the higher language unit and the length of the unit it consists of, in inverse proportion – the longer the sentence, the shorter the words in the number of syllables, etc.). The research of both laws of natural language texts has a rich tradition and developed methodology (Grzybek, Stadlober 2007; Grzybek *et al.* 2008; Benešová *et al.* 2015) and addresses not only the methods of testing but also the explanation of why naturally produced text manifests these laws, mostly as a reason of various economization aspects (Piantadosi 2014; Locksmith 2014).

Explanatory aspect of quantitative linguistics

On the explanatory level, the interpretation of quantitative linguistic laws was characterized by a shift from the traditional structuralist and systemic description (Köhler 2012: 3–5) towards functional models of explanation. This functionality, originally interpreted through Hempel's approach (Hempel 1965: 297–330), which assimilated a teleological explanation by functional analysis (see Garson 2008; Benešová *et al.* 2018 for a history of this), is interpreted in system-theoretical linguistics in relation to the limitations of the language system. These limits are physical, biological and cognitive constraints of the speaker (Altmann 1978; Köhler 1986, 2012).

These laws then play a major role in the position of explicating the principle of the deductive-nomological model of explanation. Menzerath-Altmann's law is most often used in this position. Its interpretation differs from Köhler, who interprets it as a structural principle (defined by the register hypothesis, Köhler 2012: 84–86), and from Altmann, who uses it purely as a template for statistical description of data (see unified approach, Altmann, Wimmer 2005: 792)

It is Köhler's approach that remains true to the qualitative foundations of theory (Köhler also recognizes the importance of the semiotic description of language – Köhler 2012: 171). In the like manner, Grzybek (2006) and Zámečník (2014) commented on the qualitative level of linguistic research with the need to define basic linguistic concepts (similarly to Meyer 2002). Köhler shows that the definition of linguistic theory requires some input qualitative steps: the identification of quantities, their definition, which is not exhausted by operationalization itself, distinguishing the explanatory principle, and drafting the law as a structure that is binding on data are all clear qualitative input conditions.

Köhler's approach contrasts with Altmann's inductive unified approach (Altmann, Wimmer 2005). In Altmann, we actually meet a strict quantitative approach, but with two problems: this approach lacks a theoretical dimension – the mathematical means of statistics serve only as a template for data fitting (in software form, the heart of this approach is contained in the Altmann fitter concept, which allows to find a distribution function for the linguistic data that fits best); also, this approach reduces the content of linguistic variables (historically, this evokes the approach of Herdan, who sought to express the basic properties of the texts by means of a *K* coefficient (so-called Characteristic, Herdan 1966: 101–102), referring to what Strevens (2018) refers to as "good practice of statistics by scientific disciplines" (*ibid*).

Quantitative laws in biology

In addition to the natural language text, Zipf's law was tested on genetic text. The reason for using this law for testing genetic material was based upon an important question: can we recognize whether certain sections of the genetic text carry information that is useful to the organism (in this sense we could talk about semantics, not just information as a statistical quantity, see Shannon 1951)? This is related to the earlier differentiation of so-called junk DNA and coding DNA. In the texts of Havlin *et al.* (1995) and Mantegna *et al.* (1995), the function of junk DNA is predicted on the basis of linguistic analysis - or rather on the basis of linguistic law analysis. This prediction was later confirmed (see NCODE project and also Nyiogi, Berwick 1995; Tsonis *et al.* 1997). This research is subject to reassessment, particularly in view of the fact that the manifestation of Zipf's law can be expected in many structured systems, both non-linguistic and inanimate (Ferrer-i-Cancho, Elvevåg 2010).

Menzerath-Altmann's law has also been used in connection with biosemiotic issues. For instance, Ferrer-i-Cancho *et al.* (2013) studied the size and number of chromosomes in the genome (see also Baixeries *et al.* 2013; Hernández-Fernández *et al.* 2013), and exon sizes in relation to their number in the gene were studied (Li 2012; Nikolaou 2014). Other studies investigated the relationship between protein domains size and protein size (Shahzad *et al.* 2015) or DNA coding and non-coding regions (Eroglu 2014). The linguistic relationships taken from the structure of the text are therefore applied to biological phenomena and thus again the assumption that the study of both disciplines has a similar basis, which is the biosemiotic starting credo, is reinforced.

A very important application of language laws is related to the study of animal communication. The analysis of both laws interfered with the discussion of the concept of animal communication systems. This was partly removed from the center of attention by language design features due to linguistics (Hockett 1982). It is the quantitative applications that recall the semiotic aspects of animal communication. In primates, this law was studied by Fedurek, Zuberbühler and Semple (2017), followed by Gustison, Semple, Ferrer-i-Cancho and Bergman (2016). In coincidence with the quantitative research on animal communication, this topic again returns to a qualitative view of biosemiotic and biological (Augustyn 2018; Uhlíř 2018a, 2018b; Čadková 2015).

The mentioned studies of both linguistic laws are often carried out on the assumption that the manifestations of these laws are a kind of universal feature of *natural* language or, in general, structures of communication or representation. In the case of biological phenomena, application of linguistic laws is a kind of quantitative analysis that should help to determine the adequacy of the theoretical concepts used in the areas where we are not sure of the semiotic nature of the phenomenon. At this point, the qualitative and quantitative aspects of biosemiotics meet very intensively. The biosemiotic scale of exploration is full of topics of which we do not have a clear view, and we use a devolved conceptualization from humanities – including description of language and society – to describe them. Quantitative linguistic laws come from the analysis of natural language texts, whose structure we have an enormous qualitative awareness of. Therefore, we would like to transfer this knowledge to the less explored field and reveal the nature of semiotic phenomena that are difficult to grasp.

Quantitative view: a new structuralism?

If, following the example of inductivism, we remain with a strictly quantitative view, then we have only another proof of the "promiscuity" of statistical methods and we do not gain more than a statistical description, a suitable fit of mathematical functions and data. However, the pursuit of theory, possessing the conceptual autonomy that is essential for the theory formation, brings back the original dimension of semiotics and semiology (in both Saussure's and Peirce's way). These unifying views of contemporary life sciences are demonstrated in formulating structural and topological explanations of the behavior, nature, and properties of living systems (see Huneman 2018; Kostic 2020; Reutlinger, Saatsi 2018).

This new comeback of "structuralism" is present in quantitative linguistics. It is not only found in Köhler (in the register hypothesis), but is also present in Hřebíček in defense of the principle of "compositionality" (Hřebíček 2003, this view is interesting in comparison with Hjelmslev's principle of analysis). Hřebíček even speaks literally of the search for linguistic symmetry (following the symmetry found in physics, Hřebíček 2003: 2) and the principles of invariance that relate to the scale-free nature of linguistic structures, expressed in power law (MAL) and associated with the mathematical concept of fractals. In this respect, who goes further in Hřebíček's search for "beyond language", is Andres in his concept of linguistic fractal (Andres 2009).

For biosemiotics, in its striking susceptibility to Peirce's form of semiotics, a novel way of quantitative approach arises. Rather than quantitative, a formal approach might be found in Peirce's formal description of signs. Peirce's formal sign theory yields for a triadic formalisation of a sign relations, the very basic triadic relation to be seen between object, sign and interpretant. A great work has been done in this direction by Emmeche *et al.* (2010) to describe genetic information with aid of a Peircean formalisation of sign relations. Peirce's Logic of Relatives (mainly linked to Beta Graphs) is another concept potentially usefull in a formal description of (bio)semiosis. By means of topological graph theory (which Peirce was one of the predecessors of, see Hudry 2004; Shin 2002; Lacková, Zámečník 2020) a topological graphical explanations can be provided to deal with the living, starting from the genetic information. This could bring the desired formal dimension to biosemiotics, which still lacks some form of qualitative research. It is not enough to talk about the irreducible nature of the living, which is demonstrated in its sign nature and semiosis, but it is necessary to come up with a formalization that converts important impressions into a conceptual form. This is where we see the challenge of a new form of structuralism that begins to permeate quantitative linguistics and its extension in life sciences.

Discussion

Can we use quantity to explore phenomena such as life in a semiotic way? Just as the quantitative description of a natural language text (like poem, essay or dialogue) may seem to be reductive, the essential characteristics of life do not seem to be treated by numbers. We wanted to show that if quantitative analysis and qualitative (theoretical) approach are engaged in dialogue, quantity can be an interesting research guide. At first, a quantitative view of life or text gives us the opportunity to formalize their grasping – like in the case of Peirce's Logic of Relatives or semiotic levels analyzed by linguistic laws like Zipf's Law and Menzerath-Altmann's Law. Although we find ourselves in a methodologically problematic position because these laws are not verified but axiomatized, their use for analysis has a clarifying role and leads us to understanding of the qualitative properties of studied phenomena – such as biopolymers strings understood as text. What is the structure of these biological texts and what codes do they represent? The above studies analyze chromosomes as sign planes, but also introns, triplets, etc. Quantitative analysis of these strings as texts and its comparison lead us to decide which of these phenomena is of a sign nature. It means that based on quantity, we can proceed from known to unknown using the universal principles, and we can build theory in the form of quality judgments, categorizations and descriptions as well. This can be the circle of quality and quantity in the study of language and life.

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The human turn in biosemiotics

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Language is meaningless *per se*. The meaning of language or more widely, semiotics, comes through the interrelation between agents that form and constructively constrain each other. No semiosis occurs in a vacuum; instead it occurs in histories with geographic and temporal links. *Which* language or form of semiosis we use to convey and converge upon meaning is unimportant in communication. Crucial however, is that we come to an understanding with our surrounding co-actants as deeply as possible, to minimize the resources misspent on misunderstanding. Equally, this applies to the gap between the real and the rational; the larger the disconnect between objects and how they are perceived, the more precarious and potentially undermining the relation becomes. Coming to understandings with others is accomplished sometimes effortlessly, other times violently.

This description could reflect the communicative theory of action of Jürgen Habermas and Karl-Otto Apel, various strands of hermeneutics, the complex systems theory of Gunderson and Holling, subfields of cognitive science, or cognitive ethology. Simultaneously, it is deeply biosemiotic.

As biosemiotics has matured as an interdiscipline, it has become apparent that biosemiotics and its cognate disciplines (such as ethology) bear significant insights not just for the more-than-human world, but for the human species as well (Bargh, Chartrand 1999; Barrett 2010; Byrne 2012; Gardner 2011; Hendlin 2019; Henrich *et al*. 2010; Kessler 2010; Waal 2010). Intersectional sciences such as those relating to the Environmental Evolutionary Synthesis, cognitive sciences, and neurobiology allow us to critically examine some of the great reductionist deviations of the 20th century that plunged the examination of human behavior into a morass of formalistic models on the one hand, and bottomless pits of interiority, on the other. From Freud's diagnosis of the human brooding unconscious and fundamental irrationality, to the predictable (and controllable) *homo economicus* stochastically responsive to algorithms, both of these psychological models have in most cases hindered rather than helped humanity understand and reflect on our actions and patterns as animals (either due to

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popular misinterpretations or their failure to neutrally integrate biological and evolutionary properties and processes). As animals caught in a web of ratcheting symbolic meanings, our bodies are ill-equipped to constructively handle the detached symbols characteristic of our current era (Bennett 2015; Deacon 1997, 2012). The widening disjunct between models and reality have perpetrated various violences, from the colonial structures of capitalism to the one-size-fits-all of communism and the psychographic canalizing of big data marketing. The gap between the rational and the real has led to a degradation of our umwelt (Serres 1995, 2010), through the abnegation of physical reality through relentless exclusion of the world beyond detached symbols,[2] which ultimately denies or ignores (and thus further leads to) the actual degradation of living ecosemiosis (Anderson 2008; Hendlin 2019; Kull 2011; Maran, Kull 2014; Nöth 1998; Tønnessen *et al.* 2015, 2015).

Enter biosemiotics. Rather than the narcissistic recursion of obsessing over the individual, as filmmaker Adam Curtis (2002) trenchantly examines in *The Century of the Self*, biosemiotics focuses on the contrapunctal semiosis between the organism and its environment, with the two concepts inextricably intertwined. More than just organisms constructing niches, as niches construct organisms, the environment (umwelt) forms the excluded middle of individualism. For example, corporations downplaying their active role in generating the necessary social license and norms to legitimate selling harmful products point to biopsychosocial models of disease and addition, but deliberately omit their own multifaceted manipulation of user's environment (through advertising, lobbying, product placement, etc.) (Elias *et al.* 2018). Public health, which from its origins and development along with epidemiology, for this reason has tenaciously focused on collective exposures and stochastic harms rather than retreating into the more lucrative if less effective compartmentalization of individual health. Attention to environmental factors and their construction now impels public health to place the "commercial determinants of health" front and center as public health enemy number one (Collin, Hill 2016; Lacy-Vawdon, Livingstone 2020; Dorfman *et al.* 2012; Hastings 2012; Kickbusch *et al.* 2016; McKee, Stuckler 2018). Rather than genetic determinism, or force of will, it is our umwelt – or in design parlance – our "user experience" (UX) that predominantly determines our behaviors. In the situational philosophy of Kwame Anthony Appiah (2010), amongst others, we also see a return from virtue

[2] As Yuk Hui (2016: 205) has commented, "To restore the foundation of knowledge, knowledge cannot be conceived in purely abstract forms, such as represented by detached symbols, but must be founded in humans' 'kinestheses', that is, the movements of the living body".

ethics to socially situated responses. This creates an ethics contingent on rather than invincible to the matter of context (Hendlin 2015; Tønnessen *et al.* 2015). Biologists such as (neurobiologist) Robert Sapolsky and (mathematical biologist) Evelyn Fox-Keller have reintroduced into mainstream discourse the ways in which our bodies respond to our biological environments despite our symbol dominated built environment (Fox-Keller 1995; Keller 1984; Sapolsky 2017).

Taking a look at UX IRL (user experiences in real life, which in my interpretation positions virtual interfaces inextricably as a subset of a larger, material, ecological human umwelt) is one of the social design applications to which biosemiotics can contribute. A biosemiotic deconstruction of the different levels of simultaneous semiosis (Hendlin 2016), how they interact and supervene on one another, and the resulting distortions when any aspect of semiosis is recurrently suppressed or ignored, has ranging applications in contributing to medicine, public health, philosophy of science, and the current political-economic crisis driving planetary ecocide.

While biosemiotics always is about the human insofar as humans are performing the biosemiotic analysis, and science is codified by humans (Hoffmeyer 2014; Hoffmeyer, Stjernfelt 2016; Shapin 2010), the founders of biosemiotics aimed to "provide the human sciences with a context for reconceptualizing foundations" based in rather than ignoring biological factors (Anderson *et al.* 1984: 8). Thus, I'll suggest that biosemiotics by its compound founding in biology and semiotics is already diatopic,[3] triangulating from different science studies to observe the resulting diffraction pattern. In this essay, I focus on two different strands of the human turn in biosemiotics, arguing that these could usefully be brought together into a more cohesive biosemiotic framework: (1) the linguistic-semiotic approach that starts with human symbol use and attempts to connect this to a more generalized theory of biosemiotics (represented by Deacon's *Symbolic Species*), (2) and the nonreductive communicative-based approach of the biosciences (represented by ethology) working up (as it were) from the different laws of physics, chemistry, biology, sociality, psychology, and semiotics. These "top

[3] The term "diatopic," which arose in the context of diatopical hermeneutics, goes beyond the temporal (diachronic) dimensions of hermeneutics and address the topological (*topoi*) differences of cultural (and species) modes of understanding. As Raimon Panikkar (1979: 9) writes, "Diatopical hermeneutics stands for the thematic consideration of understanding the other without assuming that the other has the same basic self-understanding. The ultimate human horizon, and not only differing contexts, is at stake here." Thus to stress the diatopic elements of biosemiotics – here disciplinary, cultural, but also special – is to see it always as a comparative scholarly enterprise.

down" and "bottom up" approaches to biosemiotics have only rarely been brought into fruitful conversation; and thus a unified version of the human in biosemiotics remains incomplete, beckoning a more rigorous and purposeful research program.

Claiming that we need to turn our field's attention to a more comprehensive understanding of humans as biosemiotic creatures – to address all sorts of gaps between the real and the rational that have precipitated from the simulacra of symbolic reference eclipsing the biological signals in other organisms and our own bodies, as well as the ecological signals in our planet – recognizes the hierarchic nested logic behind current dominant framings of the human being. We observe that the human is not some alien with a biological *differencia specifica*, as our symbolic capacities have recruited a remarkable in result but typical in function mammal brain. Rather, we are wrestling with the blessings and curses of a semiotic *differencia specifica*, the human ability to enjoy and get lost in the labyrinth of symbols.

Allied fields

Biosemiotics' founders discussed the unfulfilled promise of integrating "the three E's of ethology, ecology, and evolution" (Anderson *et al.* 1984). Since this time, these three fields have continued to develop according to biosemiotic perspectives, with cognitive ethology, niche construction views of ecology, and ecological evolutionary developmental biology ("eco-evo-devo") providing much of the scientific foundation and substantiating biosemiotic insights. Contemporary maturity in the field of cognitive science has also brought us embodied, embedded, extended, enactive, ecological, and affective (5EA) cognitive science, providing semiosis with much needed ancillary theories, while Extended Evolutionary Synthesis paradigms of science and philosophy of mind as well as biology/ecology in the twenty-first century have created a strong scientific foundation for biosemiotic hypothesis testing (Ahmed 2014; Bitbol 2002; Böll 2008; Laland *et al.* 2015; Noble 2008; Panksepp 2004; Pigliucci, Müller 2010). These interdisciplines sympathetic with biosemiotic insights have overturned many of the deterministic silos instituted by the Modern Synthesis and the Cartesian mind-body split (ie, "gene determinism" and the myth of the individual). These advances have not yet been seamlessly integrated with the prevailing disciplines, let alone have their implications sufficiently suffused into the social and humanistic sciences. Yet, as these discoveries are slowly seeping through the social sciences (from the ground up, according to Jeremy Sherman's "sequi-disciplinary" model of the sciences), they are likely to precipitate earth-shifting reorientations for concepts of responsibility, action theory, social engineering (and its discontents), and other central unavoidably political questions in the classical sense.

In Myrdene Anderson and her colleagues' original 1984 manifesto, "A Semiotic Perspective on the Sciences: Steps Toward a New Paradigm," the clear strivings towards biosemiotics becoming the limit semiotic category, or umbrella term, under which other semiotic subfields (what they called "hyphenated semiotics") such as cultural semiotics, or semiotics of architecture or medicine, was already present. This vision of unity in semiotics, by reaching across the aisle of academia binding the hermeneutic and scientific paradigms, is crucial to understanding the human turn in biosemiotics, as biosemiotics too often has collapsed largely into the bifurcation of zoosemiotics for alloanimals and the study of symbolic semiosis for human animals. Instead of these separate and parallel "bottom-up" and "top down" biosemiotic approaches, biosemiotics as a discipline might benefit from a continuous and integrated mode of semiotic mapping. Even as Anderson *et al.* (1984: 9) denounce as "[i]nexcusable… the glottocentric, or any unqualified logocentric, bias" in semiotics, unintentionally the keying of human semiotics to symbols has worked to preclude more integrated bottom up approaches (Schilhab *et al.* 2012).

The appeal for a human turn in biosemiotics is simultaneously a plea for more transdisciplinary teamwork on large research questions in biosemiotics, combining philosophers and semioticians with ethologists, cognitive scientists, microbiologists, biochemists, and ecologists (to name a few). Creating major research questions in biosemiotics, that can be empirically examined, with other likeminded fields such as cognitive ethology, paradigms such as the Extended Evolutionary Synthesis (EES), and research into how the built environment interacts with human sensory, nervous and endocrine systems, and sociality. Biosemiotic methodologies could fruitfully be applied to investigations in terror management theory, for example. By attending to how differential symbol use percolates through human organisms (supervenience) as well as how exposure to chemicals and biomolecules impact our perceptions and cognition (up- or down-regulating), biosemiotic interpretations of these phenomena can support the larger scientific and ethical project of reflecting on how human activity enables or constrains human actions.

By applying biosemiotics to human activity, on the individual (organismic), group (cultural), and collective (species) levels, these insights into the agency and automaticity of life can help us calibrate between extreme anthropological philosophies as well as turn our attention to design principles and systems thinking. Biosemiotics, for example, is well situated as an interdiscipline to offer policy recommendations stemming from the Extended Evolutionary Synthesis (EES), including the topics of land management, urban planning, diet, the circular economy, pollution and contamination prevention and management, and reintegrating other species and ecosystem elements into human milieus in non-tokenistic holobiont-conducive ways. Such recommendations necessarily would elude universal prescriptivism, because they take into account simultaneously the organism and its environment. With health and medicine, for example, biosemiotics has the capacity to aid inquiries into population health, attending to environmental factors that often are omitted from such analyses.

Because of my own dual profession as an environmental philosopher and public health scientist, I see biosemiotics everywhere in the health professions, and also understand that much of the fitness that biosemioticians and EES discuss is also much larger than the individual organism. Reconfiguring anthropogenic planetary dysbiosis into a permacultural symbiosis, yoking human understanding and practice to constantly update to the realtime signs from our ecological environment, may very well be the task for the sciences in the twenty-first century and beyond. Given its unique attention to the interplay and co-constitution of individual and collective, organism and environment, foreground and background, biosemiotics has a crucial role to play in this transformation.

This transformation won from integrating top-down and bottom-up sign processes also filters through other fields of semiotics. Such an integrated biosemiotics substantiates meta-methodological critiques against individual-centered theories of action. This dovetails with the situationism of Kwame Anthony Appiah (2010), but rather than focusing on social constraints and constructions, focuses on the ecological and biological background in which humans act. By examining parasites, gut microbiota, or environmental effects (such as activating colors, scents, noises, etc), which influence – sometimes to almost the degree of determining – human desires, ideations, and actions, biosemiotics restores the deserved primacy of biological and ecological embeddedness at play with human being. Overlapping with the more sophisticated versions of cognitive science, biosemiotics decenters agency from the human without fleecing the possibility of agency through the constant engaged possibility of actively making meaning. As semiosis is neither a determined chain of reactions nor the will of a single actor, but the interplay of context and interpretation, always providing some but never all control, attending to the biological and ecological conditions of semiosis gives a more realistic picture than cultural semiotics on its own (Cobley 2016).

This is not to say that biosemiotics will absorb or metabolize cultural semiotics – that field has plenty of important and necessary contributions to make on its own. Instead, biosemiotics provides the foundation, so to say, for cultural semiotics to be at all possible. As well, biosemiotic analyses of the human predicament crucially intervene in aspects of cultural semiotics previously under-examined, and for this reason, biosemiotics provides a firmer basis from which to develop general theories of semiotics. Likewise for natural scientific disciplines, while Jesper Hoffmeyer (2011) makes the case that "biology is immature biosemiotics," in no way does biosemiotics wish to be "a colonizer of well-established academic disciplines" (Anderson *et al.* 1984: 8); we instead recognize in our zeitgeist that as disciplines themselves are blooming into interdisciplines, crossing antiquated boundaries and flourishing in the liminal zones, biosemiotics *can* begin applying (cautious) analysis to other realms of human activities and social sciences.

The biosemiotic human as Enlightenment's remainder

As climate emergencies have been declared, and the fate of earth's species increasingly lies in the hands of decolonizing human industrial culture, investigation into the global drift into dysbiosis increases. Biosemioticians have not been left behind in our attention to this quandary, and as we are equipped with an intersection of knowledge and perspectives, not only from biology and semiotics, not just from Uexküll and Peirce, but also from phenomenology, linguistics, cognitive science, ecology, conservation science, biochemistry, sociology, and ethology – to just name a sampling of the remarkable inter- and transdisciplinarity in our field. We too have tended to the imperative to support a global transition towards biomimicry, reduced ecological footprints, and mutualism amongst species large and small. A human turn in biosemiotics can aid in making sense of, but also work to shift the unsustainable practices of globalized industrialism.

Humans, like all organisms, engage in multitrophic interactions: both receiving and sending signals that have more than one species of intended target. Just as the volatile organic compounds released by a plant may be picked up and differentially interpreted by several species of surrounding plants and insects (for a *locus classicus* of such behavior, see Furstenburg, Hoven 1994), so too the biochemical signals humans receive and emit influence our environments (in ways known and beyond our current scientific understanding) which in turn create a circuit influencing how the life at all levels of our environment interact with us (Prigogine, Stengers 1984). This functional circle includes the biochemical signals that bacteria, protists, plants, and animals in our environment emit in response to their interpretations of our emissions. Ninety-nine percent of the signals that we emit in our environment interpreted by other organisms are unintentional and perhaps even unconscious, rather than conscious. Such signals nonetheless elicit real responses that in turn influence us, even if we are not conscious of our being influenced by them.

But we also change our environment intentionally and unintentionally through the side-effects of achieving our ends. Any time we have an instrumentalized aim, we push past resistance in our umwelt to achieve that aim, creating a build-up of phenomena responding to our actively and passively ignoring the limits or resistance to our activity. Kept up long enough, and with a large enough lever vis-à-vis our habitat, the consequences of our prescribing an action at the expense of other organisms' processes or ecological flows, we can create ecological and biological forcings that undermine our original projects, let alone our existence and flourishing.

While historically viewing humans as animals was a demarcation line for colonial ideologues to dehumanize certain members of the population, the advent of human ethology through the work especially of those building on Niko Tinbergen's (1951) findings, and then embodied in the 5EA cognitive science movement including biosemiotically-inclined forerunners such as Francisco Varela and Evan Thompson (Thompson 2010; Varela *et al.* 1993), biosemioticians have come to grips with the dire need to attend to the excised aspects of the human animal through scientific and interpretive ecological frameworks (Cobley 2016; Gare 2007). In some respects, many of our ecological crises stem from the reticence to attend to the ways in which our negatively-valenced "animal" sides of humanity act out in destructive ways when ignored and unattended.

In this way, biosemiotic inquiry intersects with philosophy of science, because it acknowledges that what we attend to is never predetermined: "inquiry is always selective. We look *here* rather than *there;* we have the predator's fovea (versus the indiscriminate watchfulness of prey), and the decision to focus on *this* is therefore invariably a choice to ignore *that*" (Proctor 2008: 7). Accounting for our decisions in experiments is a bottomless task; yet, precisely such self-reflexivity in food and medicine research in particular is increasingly requested (Ioannidis, Trepanowski 2018).

The Enlightenment project sought to educate out the animal in us (Toulmin 1989). The masculinist paradigm of consciousness-centrism blindered itself to so many of the aspects of consciousness that matter – by fixing attention on the rarified aspect of self-reflexive access consciousness (or *n*th-order beliefs) – forgot the mundane organs and interactions in which these acts of consciousness arise and transpire. While current cognitive science frameworks reinhabit mind in matter, more biosemiotic contributions to cognitive science grounding this work in the multiple levels of simultaneous intervening biosemiosis would benefit both fields.

Philosophical pragmatism also shares many themes of biosemiotics, only it stops short in taking up the social constitution of the self at species boundaries. In his *Theory of Communicative Action* (volume II), Habermas predicates the basis for the taken-for-granted background lifeworld (*Lebenswelt*) which he develops through Mead and Durkheim's psychological work in Uexküll's theoretical biology of species-specific sensory potentials:

> The familiar functional circuits of animal behavior serve as a foundation for these ascriptions of meaning: search for food, mating, attack and defense, care of the young, play, and so on. Meaning is a systemic property. In the language of the older ethnology: means are constituted in species-specific environments (Uexküll), they are not at the disposition of the individual exemplar as such. (Habermas 1987: 7)

Part of the biosemiotic project, in line with current biological understandings, is the notion that humans are individuals no more than any other mammal. Our environments – endosemiotic and exosemiotic – define us ontological, dialogically, contrapunctally. This pluralistic understanding comes both from the Peircean (pragmatic) as well as the Uexküllian (theoretical biology) fabrics from which biosemiotics is woven. All endeavors are communal, all results are collaborative. In creating a biosemiotic pragmatism, human agency becomes not just a matter of social milieus, but naturecultures, turning pragmatism's attention to our lived environments and biochemical exposures as much as social organization – something that so far discourse ethics has neglected.

Biosemiotically pragmatist accounts of law, politics, psychology, ethics, and other domains of human regulation might highlight aspects of outcomes partially contingent on what is now referred to as the social, environmental, and commercial determinants of health. Determinants influence without determining outcomes. For population health, for example, determinants stochastically point out likely scenarios from, say, lead exposure, against an array of other convergent or divergent protective factors and further dysergistic exposures. These are also mediated by other biological, genetic, and environmental factors. Thus, health itself is increasingly approached in ways concordant with biosemiotic perspectives. While semiotics as a science originally emerged from medicine, proto-biosemioticians such as Eugene Baer (1988) and others were merely ahead of their times. Now that public health and medicine has shifted its focus to "planetary health" and environmental risk factors (Whitmee *et al.* 2015), the time is ripe for more biosemioticians with training in medicine, and medical practitioners who train in biosemiotics, to help fill in these new scientific niches currently in construction.

UX IRL

A human turn is not just applying biosemiotics to humans, but to apply this lens to the built and degraded environments that humans – especially since industrialization – have constructed and inhabit. Thus, the UX IRL (user experience in real life) approach critically investigates anthropological and – especially for the critical project – industrial changes that certain groups of humans have enacted upon their local and eventually global environment, intentionally and unintentionally changing it, and in turn themselves. The UX IRL component of the human turn in biosemiotics applies biosemiotic tools to the myriad problems that building environments create for human health, ecological health, and other species.

An example of UX IRL is understanding how policies affect building decisions, which in turn affect human health. In *Seeing like a State*, James Scott (1999: 47) describes how the "shorthand formulas through which tax officials must apprehend reality [...] frequently have the power to transform the facts they take note of," with the example of the door-and-window tax established under the French Directorate (1795–1799) that lasted until 1917. Tax assessors reasoned that doors and windows were likely proportionate to the size of the house, and thus was a useful heuristic for assessing taxes owed without necessitating entering habitations. However, the unfortunate side-effects of this proxy measurement of value were that to reduce their taxes, many peasants opted for making their doors and windows as small as possible, which led to many (especially child) deaths from vitamin D deficiencies due to lack of sunlight. A different example of UX IRL is designing "complete streets" in cities so that cars are forced to slow down considerably through a variety of physical measures aimed at reducing noise and increasing multi-use of streets. After auto-makers coopted the public common ways for automobile use only, and stigmatized pedestrians (also coining turning the normal activity of crossing the street into the epithet "jaywalker"), smart design environmentally-minded city planners came up with methods of revoking the domination of streets by cars and turned the right of way into a partnership through introducing round-abouts, colorful pavement demarking different zones, and more trees and play structures enabling cars, bicycles, pedestrians, and children at play to cohabitate again in the connective commons (Newman, Kenworthy 1999). Streets lined with trees – even controlling for property value and many other factors – tend to exhibit lowered crime rates versus treeless streets (Troy *et al.* 2012). These interventions affect human health, and create knock-on effects from their initial purpose. Biosemiotics can aid in intentionally designing human habitats to be more prosocial, for instance. Alternatively, biosemiotic insights can also consider downstream effects of public policies, relating to lighting (or light color), sound, biodiversity, temperature, or other interventions that affect human sensory systems.

The lightning-fast replacement (on an evolutionary scale) of the natural environment with the built environment, and iconic and indexical signals with symbolic representation has far exceeded the ability of our biological developments to keep up with our cultural developments. Thus, many of our human responses to our built environments – often engineered for a small portfolio of metrics – are dysfunctional and maladaptive. Sometimes, such maladaptive loops reach the degree that global annihilation has been consistently on the menu of options since the invention of the atomic bomb. Far from exceptions, unfortunately, such irrationalities are only proliferating as the human organism's processes are becoming increasingly contorted to exist in canalized environments designed for the throughput of units and maintenance of orders contrary to the orders and requirements for the manifold diversity of life. Precisely for this reason, those humans most distal from the standard model for which built environments are made (whether streets, buildings, or ergonomics) are often the most heavily impacted by one-size-fits-all design – even if all are ultimately not served by this Vitruvian Man model of mass fabrication. Biosemiotics, in attending to the actual biological needs of biologically variant human beings, can supplement phenomenologically-informed design to focus on the contrapunctal relationship between human organisms and our environment, as well as the differential needs of different humans in contrastive environments, including a diversity of built and ecological environments.

The syllogism, 'wasp is to orchid as human is to *x*', initially puzzles us. One of the constitutive aspects of human life is our malleability, our ability, like cockroaches, to live in diverse biotopes and circumstances. From the snow landscapes of Greenland to the dry deserts of the Sahara, and crucially, our ability to survive in built environments ranging from lush palaces to concentration camps, as a species we embody the Janus-faced truth of Dostoyevsky's (1994) remark: "man, the scoundrel, can get used to anything".

So, if no other organism or ecological niche on Earth, per se, constitutes the human countrapunctal relationship, what does? The main candidate seems to be symbols. If Terrence Deacon is correct that the language program or meme has colonized our species and that in many ways we are beholden to symbolic reference at the expense of other types of reference that simultaneously are real, clamor for our attention, and if unattended to long enough create various forms of sickness (often projected and externalized), then how do we attend biosemiosically to those elements of our functional circle (*Funktionskreis*) that are habitually repressed from expression?

The trouble with symbols

The biosemiotic interrogation of symbolic signs especially since the publication of *The Symbolic Species* heralds another dimension of how the human turn in biosemiotics has accelerated. Ernst Cassirer (1929) in the 1920s already wrote about humanity as the "animal symbolicum," and along with Peirce is one of the first philosophers to hone in on our capacity for symbol-use, our *differencia specifica*. Meticulous debates over which of Peirce's different trichotomies of signs is the most stable, insightful, or true to the author, have been waged (Deacon 1997, 2012; Stjernfelt 2014). That we are the symbolic species, beholden to language in its various forms, is clear, with its wide-ranging ramifications (another version of this, forwarded by Stjernfelt rather than more widely-known Deaconian thesis, is that we are able to uniquely participate in "hypostatic abstraction"). Unfinished business remains, however, regarding if and how symbolic reference might occur in attenuated or wholly different manners for the various organisms on Earth. Indeed, this is hotly debated biosemiotic territory.

Combining the symbolic level of semiotics customary to humans with the other types of semiosis we engage in creates a tension with the symbolic order as a hierarchic structure. Deacon's notion of symbol use as scaffolding is often interpreted so that it is floating on top of the body's biosemiotic infrastructure, taking the body and material reality for granted, and in (too) many cases, largely ignored. Yet, the biosemiotic aspects of human semiosis and bodily processes can sometimes change this unidirectional process of downward (symbol → index → icon) sign distribution in the body. Although to a degree biosemiosis is always engaged in a process of gradual automation – processes lower in the hierarchy become offloaded into increasingly automated, freeing up attention for other processes – often these almost automated processes get disrupted when left to their own devices and shake us from our symbolic reverie as they demand our attention. Despite the symbolic focus of human beings, as a result of our trained desensitivity to nonsymbolic, bodily processes such as through illness, dysmorphias, and failed biochemical processes, we are called back to realizing that our existence as a symbolic species is at the good graces of other organismic properties often pushed into the background. These almost-automated biological sign processes don't become inevitable outcomes, machine-like, but rather through evolution have been (and we also consciously offload them to be) converted into *fast* semiosis, operating at levels our symbolic conscious mind can no longer keep up with. Just as the time series of plants is so slow that few humans have the ability to track its growth in realtime, many of our biological endosemiotic processes occur at such speeds, and according to such byzantine routes that they foil even the cleverest of conscious observing proprioceptive minds. These less-cognitive biosemiosis actions exist as deeply evolutionally canalized semiosis which offloads these processes from our conscious attention.

Since Terrence Deacon's 1996 *The Symbolic Species*, humans' unique use of symbols has dominated biosemiotics discourse on the human being. But increasingly, there is another strand of biosemiotics research on humans, focusing not on our ability to hypostatically abstract – as Stjernfelt (2007, 2014) interprets the main difference in abilities humans have according to his reading of Peirce –, but on the insufficiency of this aspect of us to account for the whole of who we are and why we do what we do. This second strand of inquiry indeed has often come from outside of biosemiotics, through allied disciplines' hybrid applications, such as human ethology, 5EA cognitive science, the Extended Evolutionary Synthesis, the descendants of Varela, the work of Goleman and Davidson (2017) in *Altered Traits*, biological anthropologists like Robert Sapolsky, and critical public health, critical advertising/marketing studies, as well as the history and philosophy of science. This wide tent of research, however, converges on one important finding: that the human animal is an animal, and we have neglected this fact of our embodiment and evolutionary origins to our own current collective peril. By paying more attention to our instincts, genetically primed habits, and most of all, the environment in which our epigenetics gets affected by, these scientists and theorists believe that we can begin to repair some of the massive holes in our understanding of how to create health, sustainability and symbiosis. Under the cloud of the global drift towards dysbiosis (Logan 2015), increasingly this gap between the real and the rational is finding its answer in the overlooked biological. If humans are biological creatures like the rest of life, what sorts of circumstances and conditions do we need to flourish? Especially given our extreme adaptability as a mammal, on par with perhaps only dogs and rats in filling as many diverse biotopes, the question of what we need ecologically and socially to not become distressed and create even more difficult living circumstances for us our conspecifics and interspecific symbionts is a daunting one.

In fact, to ask this question is to go against the received wisdom of all our traditional authorities – religious texts and leaders, governments and politicians, corporations and marketing, and even academics and scientists. All of these groups, in their own ways, have sought to lay a blueprint for the definition of the good life, and all purport to be working towards the creation of this good life, and yet we are evidently far from a stable, safe, equitable, and sustainable or resilient world. All indicators – mental health, chronic diseases, extreme weather events, biodiversity loss – are disturbed and showing little signs of resilience. Indeed we face biblical threats from sea level rise to unheard of locust swarms destroying the crops of tens, if not hundreds of millions, of people (Baskar 2020). Our over-attention to the symbolic world has come at a cost to the living bodies, our own and other species. In the process, we are creating pandemonium in the human world as well as across the biosphere.[4]

Much of the manipulation of humans by other humans is though accessing our instinctual psychology (via the less evolutionary recent parts of the brain such as the basal ganglia) and bodily reactions (such as the hormonal system). This manipulation occurs, however, via the symbolic level to access our animal instincts. The deceptive mimicry of evolutionarily keyed instincts distorts our biological response systems (including many autonomous processes) via commanding and controlling our symbolic references – eliciting fears and desires through abstract and imagined threats

4 For example, Andreas Weber (2019) mentions how depression is the number two cause of death, and by 2030, may well become the main cause of death in developed countries – a direct association he makes with a thanatos-centric science focused on dead objects rather than on the semiosis of living processes.

and promises (Greenberg *et al.* 1986). Like sympathetic magic (an anthropological term), the house alarm system company's advertisement evokes a fear for burglars through deploying future-thinking priming of a hypothetical situation to trigger our cortisol to make us think that there is an immediate urgency to a not-yet-present and perhaps nonexistent threat. The symbolic "what if" triggers our adrenergic fight-or-flight instincts. We take these far removed pseudo-threats to be clear and present dangers and feel we must act until we have satisfied ourselves that we have neutralized the threat (i.e., bought and installed the burglar alarm system). The association of different products with social rank and value also cues similar instinctual, biochemical systems, which produce chronic stress in the body often leading to deteriorated, non-rational but accurately responsive hormone-driven decision-making (to buy the latest fashion).

If we're a symbolic species, we're also the ideological species – and this warrants further investigation by biosemioticians. All of the evolutionary offloading we have undergone both evolutionarily and as part of learning processes, however, makes us vulnerable to biosemiotic manipulation (Hendlin 2019; 2020). These avenues of our shared animal instincts are points of entry circumventing our rational mind that can be taken advantage of or "hijacked" (Barrett 2010). The social instinct for competition, for example, once weaponized, leads to gruesome carnage. Other social instincts for cooperation and empathy, conversely are mined and manipulated by big data companies to control human behavior and purchasing habits (Zuboff 2019).

We've been drinking from the well of degenerative signs for too long, and now it's time to own up to the fact that the consequences of fearing death means that we fear life – and that the responsibility of choice – potentially in any direction with our unique semiotic abilities – can be so awesome that many of us fear our intentions will be thwarted and so attempt to defend them from any perceived attack, attacking those things we see as threatening us (whether they really imperil us or not – such is the bottomless pit of identification with our fears). When we are fearful and attacking and defending, we then think maybe others also may be out to get us, and the paranoia of degenerative signs that never reach their *Erfolgserlebnis* – that satisfaction of finality and the closing of the chapter of any given experience so that we can take the lessons and integrate them to further evolve and develop – keep us in a broken loop of tension and anxiety.

Just as factory work robbed workers of actually learning a craft, a part of a guild, amongst a community of peers eager to help and teach each other, so too via social media our joy of experiencing friendship and connection is being robbed from us, short-circuited and turning us into desperate addicts trying to achieve something we will never be able to experience through this medium. The completion of a given semiotic circle involves a forward movement that is found in *techne* plus *poiesis* but not in truncated techne by itself. Whereas the artisan learns how to create an object from beginning to end, from raw materials to vending, with the complexification and specialization of consumer goods, the factory worker focuses on merely repeating one extremely small part of the overall creation process of the object never gets to understand how to make the object, how it is composed, or the satisfaction of finishing a project.

While we approach the habits and instincts of allo-organisms from the bottom-up, that is, looking at the impacts of all sorts of sign communication and processes from the biochemical to the capacity for play, biosemiotics has mainly approached humans via our symbolic modes of constitution. Here, I suggest the distortions in our biosphere and our bodies (including our minds) deriving from our over-dependence on the symbolic sphere must be studied by also looking at what trade-offs are made in the human body when symbolic reference reigns dominant in order to better understand and model the consistency throughout the whole biospheric-semiotic structure. Our symbols are never our own percepts and our concepts, but emerge out of our public culture deserving of examination in its own right. Public value, political discourse, advertising, and the hegemony of certain signs over others, ought to be inspected by biosemiotics more thoroughly and fundamentally in our endeavor as an interpretive science, in order to understand impact of this on human beings and how things work differently in other times and places.

Long identified in linguistics and Saussurean semiotics is the disjunct between symbolic thinking reifying and projecting abstract models onto *materia* and *phenomena* with the distinction between the scientific modelling of *langue* and the lived experience of *parole*. To reclaim a non-humanistic view of semiotics by extending the concept of human communication to identify how other organisms make and take meaning in their environment and with other organisms, also suggests that we focus on the feedback loops between the symbolic, indexical, and iconic forms of semiosis in and among human bodies. As we recognize that our linguistic/symbolic capacities have recruited a brain that is fairly typical as a mammal brain, we can reexamine the hierarchic nested logic of symbols to see both supervenience of symbols on biological regulatory processes, *as well as* of iconic and indexical biosemiotic processes – endosemiotic and exosemiotic – on our symbolic motifs.

Through doing so, we can recognize that recursion is not the *cause* but the *outcome* of representation. Semiosis confines how we can combine them with other signs because they refer back to objects. But in a purely symbolic reference system, symbols can be (in theory) infinitely reprocesses and remixed (as memes), and there are no signs which cannot be paired with other signs.

Trail marker trees have been bent by Native Americans for thousands of years to indicate paths and help bands retrace their steps, even many generations from their group originally passing a spot (Houser *et al.* 2016; Kawa *et al.* 2015). By making trees purposefully crooked, tying down saplings so that they grew in an S-shape rather than straight, these road markers created enduring and coded symbols. By transforming a tree's engineered growth into a trail marker, this subtle mark of human intervention, often only recognizable by the people who used this as a path marker, enlivened the environment without metabolizing it (attested by their classification as *vivifacts*, a portmanteau of *vivus* and *artifact*). Such symbol use was resonant with the surrounding ecology, and did not undermine others from using other paths. It was a symbol without unnecessary canalization. And thus its ecological footprint was nil, as there was no gap between the material and the abstract. Andreas Weber (2019: 6) has commented that this is precisely the endeavor of the perspectival shift in biology towards "enlivenment," understanding the "entanglement of matter with symbolic meaning" to complicate the siloing of either.

Conclusion

The human turn in biosemiotics is the very opposite of the linguistic turn in philosophy at the turn of the twentieth century when first Russell, then (early) Wittgenstein, and finally (early) Derrida converted and reduced epistemological and coordination issues into analytic propositional statements to be solved through proper language use. The human turn in biosemiotics, yes, wishes us to become more aware of our logocentrism and glottocentrism by reflecting on the fact of the ineradicable remainder in our own meaning making that exists beyond language. But it also honors us as human animals, not *just* linguistic creatures – organisms with many other needs, processes, and feedback loops that have little to nothing to do with the fact that we have been recruited/hijacked by language and symbols. The human turn in biosemiotics especially has to do with the ways in which language and symbolic semiosis often utterly fail to attend to all of our human needs, and in the process, have become the tail that wags the dog.

Of course, despite the forward title of this contribution (biosemiotics is constantly "turning" along many various glucose gradients), the arguments here merely are footnotes to the work of Paul Cobley, Kalevi Kull, Jesper Hoffmeyer, Søren Brier, Terry Deacon, Myrdene Anderson, Wendy Wheeler, Don Favareau, and other contemporary biosemioticians. As Cobley (2016: xiii) emphasizes in spelling out the cultural implications of biosemiotics: "While the study of culture continues under the impression that the natural world and the sciences devoted to studying it are geared to completely different realities from culture, then that study may be doomed to an eternal loop. Biosemiotics promises a means to interrupt that loop". By getting into the business of attending to especially nonsymbolic biosemiosis applied to human psychology and culture, our discipline can provide a much needed bridge between findings in the natural sciences and policy implications based on how these effect human functioning and behavior. Neither self-authored organisms nor fully socially nor ecologically determined, we can anchor our research in working out how ethics is environmentally, ecologically, and socially conditioned.

Arran Gare (2007) has suggested that biosemiotics is part of the Schellingian tradition, based on Peirce's self-description to that effect. When Friedrich Schelling wrote that "[e]ach organism is itself nothing other than the collective expression for a multiplicity of actants, which mutually limit themselves to a determinate sphere" (Schelling 2004: 51), surely he also included humans in that catalogue. Being more aware of our biological constraints, and our epistemic humility vis-à-vis the known and unknown constraints we experience, is urgently needed in these times. Learning and communicating the ways in which humans are beholden to our bodies, the bodies of others, and the ecological body of the biosphere within which we live, is arguably more pressing than researching the wonders of any other organism. Until we learn to unravel the secrets and symptoms of the human organism in all its varieties and fury, biological research of other organisms will amount to little more than collecting factoids for natural history museums.

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Code biology: A bird's-eye view

Marcello Barbieri[1]

Biosemiotics is the synthesis of biology and semiotics and its founder, Thomas Sebeok, was a student and a strong supporter of Charles Peirce, which explains why biosemiotics has been, since the beginning, a field firmly based on Peircean semiotics and Peircean philosophy.

In the history of biosemiotics, however, there has been a brief period – between 2004 and 2012 – when a serious attempt was made to build an '*extended biosemiotics*', one that was not confined into the straitjacket of the Peircean approach. Eventually, however, that attempt was officially rejected by the majority of the biosemioticians, and the result was that in 2012 a small group of people broke away from biosemiotics and founded the new research field of code biology.

The motivations of that break have been described in an article entitled "From biosemiotics to code biology" (Barbieri 2014) and will not be repeated here. The validity of that break, on the other hand, has been contested by Federico Vega in an article entitled "A critique of Barbieri's code biology through Rosen's relational biology: Reconciling Barbieri's biosemiotics with Peircean biosemiotics" (Vega 2018). This critique has already been discussed (Barbieri 2018) and will not be repeated here.

After this brief account of the beginning of code biology, this article will try to give an overall view of that field and will do so by summarizing the results obtained in the study of three problems: the first is the origin of the genetic code; the second is the origin of the other organic codes that exist in living systems; the third is the idea that there has been a universal neural code at the origin of mind as there has been a universal genetic code at the origin of life.

Code biology has proposed novel solutions in all three cases and the present article is dedicated to illustrating them, so it is ideally divided into three parts.

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1. The genetic code

1.1. Two explanations for the genetic code

In *Chance and Necessity* (1971) Jacques Monod wrote that there are two alternative explanations for the genetic code. The first is chemical, or more precisely stereochemical: "… if a certain codon was 'chosen' to represent a certain amino acid it is because there existed a certain stereochemical affinity between them". The second is that "…The code's structure is chemically arbitrary: the code as we know it today is the result of random choices which gradually enriched it" (Monod 1971: 135).

Monod declared that the first hypothesis is far more appealing but added that "the numerous attempts to verify this hypothesis have up to now proved negative. […] Pending the unlikely confirmation of this first hypothesis we are reduced to the second one, displeasing from the methodological viewpoint because it does not explain the code universality, and because it does not provide any model of primitive translation" (Monod 1971: 136).

Ten years later, in *Life Itself* (1981) Francis Crick wrote that "[…] the genetic code is as important for biology as Mendeleev's Periodic Table of the Elements is for chemistry, but there is an important difference. The Periodic Table would be the same everywhere in the universe. The genetic code appears rather arbitrary, or at least partly so. [...] If this appearance of arbitrariness in the genetic code is sustained, we can only conclude that all life on earth arose from one very primitive population" (Crick 1981: 46–47).

The '*appearance of arbitrariness*' envisaged by Francis Crick became a certainty only a few years later, because it was shown that any codon can be associated with any amino acid (Schimmel 1987; Hou, Schimmel 1988; Schimmel *et al*. 1993) thus proving that there are no deterministic links between them. It is an experimental fact, in other words, that the genetic code is made of *arbitrary rules*, and the idea of descent from a common ancestor does explain its presence in all living organisms.

One may expect that this put an end to the *stereochemical theory*, but in reality it did nothing of the kind. As the history of science has taught us, when some data are in contrast with an established theory, what happens is that a *protective belt* is built around it and it is claimed that the contrast is only apparent.

In our case the protective argument has been the idea that the genetic code is arbitrary *today*, but not at the beginning, when the code first appeared on the primitive Earth. For that event we have no direct evidence and only two theoretical options: it was either chemical determinism or arbitrariness. The first, as Monod underlined, is "far more appealing" whereas the second is "displeasing from the methodological viewpoint" because it implies that "the code as we know it today is the result of random choices".

The arbitrariness of the code, in other words, appears to imply that its evolution is, to all practical purposes, unknowable. This is why the stereochemical theory is still holding the field, despite the fact that "[…] the numerous attempts to verify this hypothesis have up to now proved negative", a conclusion that is as valid today as it was in Monod's times.

A way out of this impasse, however, does exist, because it has been shown that the arbitrariness of the genetic code does not prevent us from reconstructing its evolution (Barbieri 2019), and the sections that follow provide a brief summary of this point.

1.2. The ancestral adaptors

The origin of the genetic code was due, in principle, either to chemical determinism or to arbitrariness. In the case of chemical determinism, any codon would have been associated with one and only one amino acid and there would have been no ambiguity in the code; in the case of arbitrariness, any codon could have been associated with any number of amino acids and the first genetic code that appeared on Earth would have been *ambiguous*. This means that a sequence of codons was translated some time into a protein and some other time into a different protein, and the ancestral apparatus was inevitably producing *statistical* proteins. Which in turns means that the evolution of the code was necessarily a process that reduced its original ambiguity. But how did it take place?

The rules of the genetic code are realized by *adaptors*, structures that are formed by transfer-RNAs and synthetases (more precisely *aminoacyl-tRNA synthetases*), the molecules that first activate amino acids with ATP and then attach them to the transfer-RNAs.

The transfer-RNAs are small molecules (75–90 nucleotides long) with a basic cloverleaf structure that has been highly conserved in evolution, which strongly suggests that they descended from a common ancestor. The synthetases belong instead to two distinct superfamilies and descended therefore from two ancestors. In both cases, the ancestral transfer-RNAs and the ancestral synthetases were far fewer and less diversified than their modern descendants, and this means that in the course of evolution they became increasingly *diversified* and increasingly *interdependent*, until the point was reached in which any codon was associated with one and only one amino acid and a *non-ambiguous* genetic code came into existence.

This evolution has been illustrated by Jacques Ninio (1982) with a beautiful metaphor. He pointed out that in any hotel, in addition to the familiar keys that open individual doors, there is a pass-key that opens all doors. At first, one may think that the pass-key is the most complex of all, but the truth is exactly the opposite. The pass-key is the simplest because what is complex in a key is not the ability to open a door but the ability to open one particular door *and not all the others*.

Ninio remarked that the transfer-RNAs can be compared to keys that open individual doors, whereas their common ancestor was like a pass-key that could open all doors. The evolution of the genetic code, in other words, was a process of diversification of the transfer-RNAs that steadily increased their complexity by *decreasing* the number of amino acids that they could associate to each codon.

The amino acids are attached to the transfer-RNAs by synthetases that perform two distinct operations: on one side they recognize a specific amino acid, and on another side they recognize a specific structure of a transfer-RNA. The result is that each transfer-RNA gets attached to a specific amino acid because it contains a region that is recognized only by the synthetase that is carrying that amino acid. This means that the evolution of the genetic code consisted in two parallel evolutions: one that differentiated the transfer-RNAs by evolving individual features in each of them, and one that differentiated the synthetases in such a way that they could recognize those individual features.

The transfer-RNAs, in other words, evolved in parallel with the synthetases, very much like a set of locks that evolved in parallel with a set of keys until the point was reached in which any key could fit into one and only one lock. But why did the adaptors evolve in that way? What were the *causes* that induced them to diversify and to acquire unique individual features?

1.3. The ancestral ribosomes

The molecular machines that make proteins, the *ribosomes*, are made of ribosomal-RNAs and ribosomal proteins. The ribosomal RNAs are among the most conserved molecules in evolution (Woese 1987; 2000) and contain regions that have the ability to form peptide bonds (Nitta *et al.* 1998). This suggests that the ribosomal-RNAs appeared very early on the primitive Earth and some of them could stick amino acids together in no specific order and produce statistical proteins (Woese 1965). The first ribosomal proteins were therefore statistical proteins, but what were their functions?

A particularly illuminating information has come from the discovery that ribosomes are formed by the self-assembly of their components and it has been possible to find out the contribution of individual ribosomal proteins by studying what happens when the ribosomes are reassembled without anyone of them in turn. These experiments have shown that the ribosomal proteins fall into three major categories: some are necessary for function, others are required for self-assembly, and those of the third group have a stimulating effect but are fundamentally disposable (Kurland 1970; Fox 2010).

At first sight there does not seem to be a reason for the presence of disposable proteins, but in reality an explanation does exist. It comes from a general principle in engineering that Burks (1970) expressed in this way: "there exists a direct correlation between the size of an automaton – as measured roughly by number of components – and the accuracy of its function". In our case, this principle means that there was an evolutionary advantage in increasing the number of ribosomal proteins because that was making the ribosomes more heavy, more resistant to thermal noise and therefore less prone to errors.

A similar principle accounts for the evolution of an increasing number of functional ribosomal proteins. Any complex system can improve its efficiency by increasing the number of controlling operations (Ashby 1962), and it is probably for this reason that the number of ribosomal proteins with functional roles did increase in evolution. The same is true for the ribosomal proteins involved in self-assembly: by increasing their number it was possible to produce ribosomes that could reassemble more easily and more efficiently from their components.

By increasing the number of the ribosomal proteins, in short, it became possible to reduce the translation errors and to improve the performance of the ribosomes in protein synthesis, and this does explain why the number of those proteins did increase in evolution. In effect, the number of ribosomal proteins is 57 in *Bacteria*, 68 in *Archaea* and 78 in *Eukaryota*, which clearly show there has been a tendency to increase their number (Lecompte *et al.* 2002). On the other hand, there are 34 ribosomal proteins which are universally conserved in all organisms and they are probably the ribosomal proteins that evolved in the primitive systems before the common ancestor split into *Bacteria*, *Archaea* and *Eukaryota*.

The increase in number of the ribosomal proteins, on the other hand, was accompanied by a parallel increase in size of the ribosomal RNAs, and the ancestral ribosomes steadily expanded their dimensions and eventually gave origin to enormous machines with molecular weights of over 2 million in prokaryotes and over 4 million in eukaryotes. But what were the *causes* of this evolution?

1.4. The mechanism of ambiguity-reduction

The ancestral systems could only produce statistical proteins and yet life went on and evolved even in those times. There were two main reasons for this. The first is that the primary functions were performed by the RNAs and these molecules were fairly faithfully transmitted from one generation to the next by molecular copying. The second is that the same protein functions could be implemented by different molecules, and life could continue even if the proteins of the descendants were slightly different from those of the progenitors. More precisely, life could continue even if the progenitors transmitted to the descendants the same RNAs and the same *families* of statistical proteins. There was however a condition that had to be met: the statistical proteins of a progenitor could reappear in a descendant only if the statistical differences between them were not cancelled out by the ambiguity of the genetic code.

The ancestral systems, in other words, could produce viable descendants only if the ambiguity of the genetic code was low enough to allow the same families of statistical proteins to reappear in each generation. This amounts to saying that the ambiguity of the genetic code could not exceed a prefixed limit, but within that limit the ancestral systems could go on indefinitely producing descendants that were statistically similar to the progenitors.

Evolution was bound to favour any improvement in the translation apparatus of the ancestral systems, and we have seen that the translation errors could be reduced by increasing the number of the ribosomal proteins. This increase, on the other hand, could be *perpetuated* only if a higher number of protein families could reappear in the descendants, and this was possible only if the ambiguity of the genetic code was reduced. The ambiguity of the code, in turn, could be reduced only by increasing the number and the diversity of the synthetases that were attaching amino acids to the transfer-RNAs.

An increase of the ribosomal proteins, in short, was favoured by evolution because it was reducing the translation errors, but could be achieved only by reducing the ambiguity of the genetic code, and this in turn could be achieved only by increasing the number of the synthetase proteins.

The evolution of the ribosomal proteins and the evolution of the synthetases, in other words, were two interdependent processes and both were favoured because the first was reducing the translation errors and the second was reducing the ambiguity of the genetic code (Barbieri 2019).

The synthetases and the ribosomal proteins, in conclusion, evolved in parallel and the mechanism at the heart of their evolution was a systematic reduction in the ambiguity of the genetic code, a reduction that went on until any ambiguity was completely erased. At that point any sequence of codons was translated into one and only one protein and *biological specificity* came into existence.

The above scenario may look entirely speculative, at first, but in reality it does have consequences that can be tested. It implies, for example, that the universal ribosomal proteins and the synthetases were the first *specific* proteins that appeared in the history of life, and this is in agreement with the molecular phylogenies (Woese 2000; Fox 2010; Petrov *et al.* 2015).

What is particularly important, in our case, is that chemical determinism is no longer a theoretical necessity. The arbitrariness of the genetic code is an experimental reality but its existence does not prevent us from reconstructing the evolution of the genetic code.

2. The organic codes

2.1. From the common ancestor to the first cells

The fact that all living organisms contain a virtually universal genetic code implies that that code evolved in a population of primitive systems that is known as the *common ancestor*. The phylogenetic trees, on the other hand, have shown that all cells belong to three primary kingdoms, *Archaea*, *Bacteria* and *Eukaryota*, and the first cells that appeared on Earth were the first representatives of these kingdoms (Woese, Fox 1977; Woese *et al.* 1990; Woese 2000). The cells share a few universal features in all kingdoms, but most of their characteristics are unique to each kingdom, which means that they evolved independently in the descendants of the common ancestor. They have, in particular, different types of cell membrane, and this gives us a major evolutionary problem.

The cell membrane is the site of two fundamental processes – the exchange of matter and energy with the environment– but it is also the site of *signal transduction*, the process that transforms the signals from the environment (*first messengers*) into internal signals (*second messengers*). First and second messengers belong to two independent worlds and laboratory experiments have shown that the same first messenger can activate different second messengers and that different first messengers can activate the same second messenger (Alberts *et al.* 2007) which means that there are no necessary connections between them.

The membrane receptors that implement signal transduction, furthermore, are molecular adaptors that create links between first and second messengers just as the transfer-RNAs create links between codons and amino acids. In signal transduction, in short, we find all the essential components of a code: (a) two independents worlds of molecules (first messengers and second messengers), (b) a set of adaptors that create a mapping between them, and (c) the proof that the mapping is arbitrary because its rules can be changed in many different ways. All of which amounts to saying that signal transduction is based on *signal transduction codes* (Barbieri 2003), and we have the problem of understanding why did they evolve.

The origin of the genetic code was a major turning point in the history of life, and yet it was not enough to create a modern cell. The reason is that the descendants of the common ancestor could produce specific proteins but not *specific responses to the environment* because they had not yet evolved an efficient system of interactions with the outside world. They had biological specificity in protein synthesis, but not in their relationships with the environment. This suggests that the descendants of the common ancestor evolved along independent lines and gave origin to distinct types of cells by combining the universal genetic code with different types of signal-transduction codes (Barbieri 2016).

The genetic code and the signal transduction codes appeared very early in the history of life and have been highly conserved ever since. In addition to these foundational codes, however, many other organic codes have been discovered in living systems. Among them, the *sequence codes* (Trifonov 1989, 1996, 1999), the *sugar code* (Gabius 2000, 2009), the *splicing codes* (Barbieri 2003; Fu 2004; Wang, Cooper 2007), the *histone code* (Strahl, Allis 2000; Turner 2000, 2007; Kühn, Hofmeyr 2014), the *compartment codes* (Barbieri 2003), the *tubulin code* (Verhey, Gaertig 2007; Janke 2014), the *ubiquitin code* (Komander, Rape 2012), the *molecular codes* (Görlich *et al.* 2011; Görlich, Dittrich 2013; Dittrich 2018) and the *lamin code* (Maraldi 2018). Our next problem, therefore, is to find out the roles that these codes had in life.

2.2. Two types of evolution

The reconstruction of the molecular trees of life was first obtained by comparing individual molecules in different species (Zuckerkandl, Pauling 1965; Woese, Fox 1977), but a much more powerful approach became possible by comparing entire genomes (Snel *et al.* 2005; Jun *at al.* 2010). One of the most important results of this extended technology was the discovery that all modern eukaryotes belong to 5 or 6 major groups that radiated from a common ancestor (Baldauf 2003; Adl *et al.* 2005; Keeling *et al.* 2005).

This tells us that there have been two major events in the evolution of the cells. The first was the appearance of a population of primitive systems that evolved the genetic code and has become known as the *Last Universal Common Ancestor* (LUCA); the other was the appearance of the *Last Eukaryotic Common Ancestor* (LECA) the population from which all modern eukaryotes have descended.

The universal ancestor appeared around 3.5 billion years ago, whereas the eukaryotic ancestor arrived two billion years later, around 1.5 billion years ago (Harold 2014). The crucial point is that throughout that immensely long period the evolution of the cells took place in two completely different ways.

The fossil record has revealed the presence of fossilized bacteria in Precambrian rocks, and has shown that the stromatolites built by cyanobacteria two and three billion years ago are virtually identical to those built by their modern descendants (Barghoorn, Tyler 1965; Knoll 2003). The bacteria, in other words, appeared very early in the history of life and have conserved their complexity (in terms of size, shape and number of components) ever since. This point has been beautifully illustrated by Nick Lane: "... the bacteria and archaea have barely changed in 4 billion years of evolution. There have been massive environmental upheavals in that time. The rise of oxygen in the air and oceans transformed environmental opportunities, but the bacteria remained unchanged. Glaciations on a global scale (snowball earths) must have pushed ecosystems to the brink of collapse, yet bacteria remained unchanged. [...] Nothing is more conservative than a bacterium" (Lane 2015: 158).

The eukaryotes, instead, did the opposite. They repeatedly increased the complexity of their cells and eventually broke the cellular barrier and gave origin to countless multicellular creatures. This gives us a major problem: why have the prokaryotes *not* increased their complexity throughout the history of life while the eukaryotes have become increasingly more complex?

An unexpected solution to this problem has come from the discovery that the eukaryotes evolved many more organic codes than prokaryotes. This suggests that the prokaryotes did not become more complex because they did not evolve new organic codes whereas the eukaryotes increased their complexity because they continued to bring new organic codes into being (Barbieri 2017).

2.3. Codes and complexity

In prokaryotes there are far less organic codes than in eukaryotes, but can we explain that experimental fact? A natural explanation does exist, and is suggested by the fact that the prokaryotes became committed to fast replication and adopted a drastic *streamlining strategy* in order to achieve that goal. Let us illustrate this point with two examples.

In bacteria, the transcription of the genes is immediately followed by their translation into proteins, but such a fast link could hardly have been present in the ancestral systems. A direct coupling between transcription and translation required the abolition of all intermediate steps and could be achieved only by the descendants of the common ancestor that adopted a streamlining strategy. The other descendants maintained a physical separation between transcription and translation and this allowed them to introduce the operations of splicing in between. The prokaryotes, in other words, could not evolve a splicing code simply because they had abolished the separation between transcription and translation that is the very precondition of splicing.

A second example comes from the histone code. The ancestral DNAs were negatively charged molecules that inevitably attracted positively charged ones, but in order to maximize the replication rate it was necessary to remove any interposition of material between genes and signalling molecules, and this is why the streamlining strategy produced genes with no protein wrapping around them. Some ancestral systems, however, did not follow that strategy and continued to carry genes surrounded by positively charged molecules that eventually evolved into histones. The potential to evolve the histone code, in other words, survived only in the descendants of the common ancestor that did not adopt the streamlining strategy of the bacteria.

We have in this way a solution to the problem of complexity: the cells that adopted a streamlining strategy lost the potential to evolve new organic codes and have conserved the same complexity throughout evolution; the cells that did not adopt a streamlining strategy maintained the potential to evolve new organic codes and gave origin to increasingly complex systems (Barbieri 2017).

Another increase in complexity took place with the origin of multicellular creatures, and here too we find that new levels of complexity were associated with new organic codes. Among them: the *Hox* code (Hunt *et al.* 1991; Kessel, Gruss 1991), the *adhesive code* (Redies, Takeichi 1996; Shapiro, Colman 1999; Faria 2018), the *transcriptional codes* (Jessell 2000; Marquardt, Pfaff 2001; Ruiz i Altaba *et al.* 2003), the *apoptosis code* (Basañez, Hardwick 2008; Füllgrabe *et al.* 2010), the *bioelectric code* (Tseng, Levin 2013; Levin 2014) and the *acoustic codes* (Farina, Pieretti 2014; Farina 2018).

The experimental evidence, in conclusion, does suggest that there is a link between the complexity of the living systems and the number of their organic codes.

3. The neural codes

3.1. Hints of a universal neural code

There is a large consensus today that mind is a natural phenomenon and that mental events are caused by brain events. More precisely, it is widely accepted that mind is made of higher-level brain processes, such as feelings and instincts, that are caused by lower-level brain processes such as neuron firings and synaptic connections (Searle 2002). We need therefore to understand *how* does the brain produce the mind and to this purpose it is useful to start from what all animals have in common.

There is ample evidence that virtually all animals have the same basic instincts and feelings. They all have the imperative to *survive* and to *reproduce*. They all experience hunger and thirst, fear and aggression, and all are capable of reacting to stimuli such as light, sound, pressure and temperature. The basic feelings and instincts, in short, are virtually universal in animals, and this means that they appeared in an ancestral animal population and have been highly conserved ever since.

The conservation of the basic instincts and feelings, on the other hand, has been accompanied by an explosive diversification of the brain, a pattern that has also been observed in the evolution of the cell, where the genetic code has been highly conserved whereas the apparatus of protein synthesis has continued to change. In both cases we have a system where virtually everything is on the move, except a fundamental set of rules, and this strongly suggests that a neural code has been highly conserved after its appearance in a common ancestor. This conclusion is also suggested by comparative anatomy.

The processes of the brain are set in motion by signals from the sense organs, but these organs arise from the histological tissues of the body, and these tissues (epithelial, connective, muscular and nervous tissues) are the same in all triploblastic animals. All signals that are delivered to the brain, in other words, are produced by sense organs that arise from a limited number of universal tissues, and represent therefore a limited number of universal *inputs*. The basic feelings and instincts, on the other hand, are found in all triploblastic animals and represent a limited number of universal *outputs*.

What we observe, in short, is a universal set of sense organs on one side, a universal set of animal instincts and feelings on the other side, and a set of neural processes in between. The most parsimonious explanation is that the neural processes in between are also a universal set of operations. And since there is no necessary link between sense organs and instincts or sense organs and feelings, we conclude that the bridge between them is provided by the rules of a *universal neural code*.

The existence of a universal neural code, in other words, is the most parsimonious explanation of the fact that the basic animal instincts and feelings have been conserved in evolution. But of course we would like more evidence in support of this conclusion, and there is in fact a variety of research results that point in that direction.

3.2. A variety of neural codes

The Nobel Prize for Medicine in 2014 was awarded to John O'Keefe, May-Britt Moser and Edvard Moser for the discovery that the cells of the hippocampus use the rules of a unique space code to build an internal map of the environment (O'Keefe, Burgess 2005; Hafting *et al.* 2005; Brandon, Hasselmo 2009).

The existence of a space code in the hippocampus is based on solid experimental evidence and this is important because the neural codes are much more difficult to grasp than the organic codes. The difference between them comes from the fact that organic molecules are *space-objects*, in the sense that their properties come from their three-dimensional organization in space, whereas neural states are *time-objects* in the sense that they arise from sequences of neuron firings in time.

Despite this objective difficulty in the study of the neural codes, a significant number of results has already been obtained. It has been discovered, for example, a *neural code for mechanical stimuli* (Nicolelis, Ribeiro 2006; Nicolelis 2011), a *neural code for taste* (Di Lorenzo 2000; Hallock, Di Lorenzo 2006), a *synaptic code* for cell-to-cell communication (Hart *et al.* 1995; Szabo, Soltesz 2015) and an *olfactory code* (Grabe, Sachse 2018). The processing of many neural signals, in other words, takes place according to codified rules, and our purpose is to figure how they came into being.

The nervous system is made of three types of neurons: (1) the *sensory neurons* transmit to the brain the signals produced by the sense organs, (2) the *motor neurons* deliver signals from the brain to the motor organs (muscles and glands), and (3) the *intermediate neurons* provide a bridge between them. In some cases the sensory neurons are directly connected to the motor neurons, thus forming a *reflex arch*, a system that produces a quick stimulus-response effect known as *reflex action*.

The first nervous systems were probably a collection of reflex arches, as it is still the case in a few primitive animals, and it is likely that the first intermediate neurons evolved as an extension of those arches. Once in existence, however, in addition to *transmitting* electrical signals they started *processing* them and this new function fuelled their evolution into increasingly complex systems. This is because the behaviour of an animal must take into account a variety of cues from the environment, and to that purpose it is necessary that a motor organ receives signals from many sense organs and that a sense organ delivers signals to many motor organs.

The intermediate neurons solved that problem by developing multiple connections between sensory inputs and motor outputs, but they evolved in two very different directions. One was the formation of neural networks that are totally non-conscious and provide a sort of *automatic pilot* for the body. The other was the generation of *sensitive neural states*, the precursors of instincts and feelings, and it was this second process that started evolving the neural codes of the conscious brain.

3.3. The revolution of the universal neural code

Instincts and feelings are referred to as *first-person* experiences because they are experienced directly, without intermediaries. They make us feel that we *control* our body, that we are in charge of its movements, that we live a personal life. Above all, they are quintessentially *private* internal states, and this makes it impossible to share them with other people.

The goal of science is to produce models of what exists in nature, and first-person experiences are undoubtedly part of nature, so we need models that help us to understand them.

Let us take, for example, the case in which a toe is injured. We know that signals are immediately sent to the brain that processes them and delivers orders to the motor organs that spring the body into action. Here we have two distinct players where one (the brain) is the observer and the other (the injured toe) is the observed. It is the observer that receives signals from the toe and transforms them into a feeling of pain, but then something extraordinary happens. We do not feel the pain in the brain, where the feeling is created, but in the toe. Observer and observed have collapsed into one, and the feeling is displaced to the place that gave origin to the whole neurological process.

Something similar takes place when we receive signals from the environment, for example when we look at a tree. In this case, an image is formed on the retina and the retina sends signals to the brain. Again, there is a physical separation between the sender and the receiver of signals, and yet we do not see an image on the retina, where the visual signals are generated, nor in the brain, where they are processed. What we see is a tree in the outside world. This again is generated by a short-circuit between observer and observed followed by a displacement of the end result to the place where the process originated.

This tells us that first-person experiences are nothing elementary and indivisible. On the contrary, they are the result of complex operations where highly differentiated cells act in concert to create a physiological short-circuit between body and brain, between observer and observed, between senders and receivers of neural signals. That kind of complexity was necessarily the result of an evolutionary process that was set in motion when feelings and instincts started playing specific roles in animal behaviour, i.e., when the universal neural code came into being.

The origin of this code, in other words, set in motion a true biological revolution, a major transition that transformed the non-conscious brain of the ancestral animals into the feeling brain of the modern animals. The result was an absolute novelty: it was the origin of *consciousness*, the origin of *subjectivity*, the origin of *first-person* experiences, in short, the origin of *mind*.

This is the *code theory of mind*, the idea that there has been a *universal neural code* at the origin of mind as there has been a universal genetic code at the origin of life; it is also the idea that there are neurological processes that create short-circuits between brain and body and give origin to first-person experiences, to the feeling that we are conscious beings and not automatons (Barbieri 2011, 2015).

Conclusion

Today there are two major paradigms in biology. One is the idea that '*life is chemistry*' or, more precisely, '*an extremely complex form of chemistry*'. The other is the idea that '*life is chemistry plus information*', a paradigm based on the view that hereditary information does not exist in inanimate matter and is *ontologically* different from chemistry. The nature of this ontological difference has been the object of countless debates but a shared conclusion has never been reached, and this explains why the *chemical paradigm* and the *information paradigm* continue to exist side by side. The discovery of the genetic code, on the other hand, has brought to light another fundamental component of the living systems, and this has raised a challenge to both paradigms.

A code is a set of rules that establish a correspondence between the objects of two independent worlds, and can be described as *a mapping between signs and meanings*. Saying that there is a correspondence between object 1 and object 2, is equivalent to saying that object 1 is the *sign* of object 2, or that object 2 is the *meaning* of object 1. In the Morse code, for example, the rule that 'dot-dash' corresponds to letter 'A', is equivalent to saying that letter 'A' is the meaning of 'dot-dash'. In the same way, the rule that a codon corresponds to a certain amino acid is equivalent to saying that that amino acid is the *organic meaning* of that codon.

Meaning, in short, is the inevitable product of a code because there cannot be codes without meaning (Barbieri 2003). All we need to keep in mind, is that meaning is a mental entity when the code is between mental objects, but it is an organic entity when the code is between organic molecules. Meaning, on the other hand, is ontologically different not only from matter and energy but also from information, and this tells us that it cannot be accommodated into the two existing paradigms.

The discovery of the genetic code, in other words, suggests that biology requires a third paradigm, a theoretical framework that can be referred to as the *code paradigm* because it states that "*life is chemistry, information and codes*".

The idea that meaning is a natural entity, ontologically distinct from matter, energy and information has been proposed more than 30 years ago, in *The Semantic Theory of Evolution* (Barbieri 1985) but of course it can be accepted by the scientific community only if it is proved that the genetic code is a real code and not a metaphorical entity. Now this proof has finally arrived and we can look forward to a future where biology fully acknowledges that meaning is a fundamental component of life.

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Neurosemiotics: Blurbing a field beyond the "two cultures divide"

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1. Our semiotic experience, through partial and integrative lenses

One of the defining characteristics of the human species is our incessant drive to construe meaning (Deacon 1997; Halliday 1978; Ibáñez, García 2018; Peirce 1998; Leeuwen 2005). Perhaps inevitably, this ubiquitous trait has been a hotspot of research across diverse scholarly traditions. The classical study of semiotics adopted a humanistic approach, first focusing solely on the properties of signs (e.g., reference, symbolism, indication, metaphor, analogy) and eventually embracing a wider outlook on interpersonal communication that was sensitive to social dynamics and cultural niches. On the other hand, more recent trends have favored scientific, biologically-grounded perspectives, such as those of biosemiotics (Emmeche *et al.* 2000; Hoffmeyer 2015; Kosoy, Kosoy 2018; Sharov 2016; Sharov *et al.* 2016; Hateren 2015), behavioral science (Carey 2009; Mareschal *et al.* 2010; Murphy 2004), neuropsychology (Faust 2012; Shallice 1988), and social cognitive and affective neuroscience (Falk, Scholz 2018; Fiske, Taylor 2013; Pezzulo *et al.* 2019). Nevertheless, interdisciplinary pursuits in these traditions have been unsuccessful in establishing synergies among the neurological, sensorimotor, cognitive, perceptual, visceral, and interactive processes that jointly shape our semiotic experiences (Brier 2015; Ibáñez, García 2018).

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To forge a productive ethos that captures those convergences, we must overcome the so-called "two cultures divide", namely, the artificially imposed schism between social and natural or physical aspects of our existence (Ibáñez *et al*. 2017; Snow 2012). A new framework must be conceived to transcend the segregation between theoretical and methodological traditions, exploit their common grounds, and produce new knowledge in a variety of arenas – including basic research, theory building, clinical science, data analytics, social media studies, behavioral economics, and education, among others. This is, in a nutshell, the core mission of neurosemiotics.

Neurosemiotics has been defined as an "epistemological domain which includes the scientific investigation of the neurological processes underlying communicative behaviour in all its forms as well as the prerequisites for such behaviour", including "the perception of the environment as meaningful, both globally and discretely, and the general capacity to engage in symbolic interactions" (Bouissac 1987: 204–206). Accordingly, neurosemiotics aims to study communication from a perspective that is both social *and* biological, going far beyond the abstract conceptualization of signs. This cross-disciplinary arena targets diverse and complex phenomena, including multiple aspects of the development, organization, real-time unfoldment, and external outputs of the neurocognitive mechanisms that underlie the emergence and exchange of explicit and implicit meanings during human activity, be it through language, facial expressions, gestures, bodily movements, visceral processes, or images of any kind. Such a multidimensional space demands the implementation of a variety of methods and tools from a range of disciplines, crucially including neuroscience (e.g., brain imaging, brain stimulation), neuropsychology (e.g., anatomo-clinical correlations), behavioral sciences (assessments of outward performance), cognitive science (e.g., behavioral and kinetic measures), linguistics (e.g., text analysis), and ethology (e.g., animal communication).

Yet, despite its unquestionable richness, the vast realm of neurosemiotics has been notoriously underexploited. Admittedly, the field has been acknowledged in various works, such as encyclopaedias of semiotics (Bouissac 1998) and neuroscience (Jorna 2009), as well as chapters explicitly (Grzybek 1993; Müller, Wolff 2003) or tacitly (Baggio 2018; Deacon 1997; Plebe, Cruz 2016) related to it. However, to the best of our knowledge, no systematic research program has yet been erected on neurosemiotic premises. Still, numerous scholars have long been nurturing the agenda of neurosemiotics though segregated studies on emotion, social interaction, language, and gesture (Ibáñez, García 2018). Promisingly, as implied in previous research

(Falk, Scholz 2018; García 2019; García *et al.* 2017; Ibáñez 2019; Ibáñez, García 2018; Ibáñez *et al.* 2017), such fragmentary developments can and should be integrated to create an initial empirico-theoretical background for neurosemiotics to thrive into autonomous maturity. Indeed, pertinent insights are already available at the core of (and at the crossing between) neuroscience, cognitive science, behavioral studies, neuropsychology, social sciences, social studies, biosemiotics, experimental psychology, linguistics, pragmatics, and philosophy, to mention but a few contributing specialties.

2. Sketching the territory of neurosemiotics

As proposed in what is intended to become a launching pad for a full-blown neurosemiotic program (García, Ibáñez, forthcoming), the field can be conceived as encompassing at least four distinct but interrelated territories.

A first subfield would be concerned with charting the multidimensional relations between the human organism and various types of signs. The body proper can act as an organizing principle for this area, leading to two main lines of research. One would be specialized in body-based signs, including those rooted in the dynamics of our limbs, faces, postures, and visceral systems. Another one can deal with more culturally driven semiotic systems, such as language, music, and numeric processing. In tandem, these two strands can illuminate the multiple ways in which single individuals organize and map semiotic experiences against the backdrop of our distinctive biology.

A second subfield would adopt a fully interactive perspective and focus on communication and the construal of meaning. One subset of studies should target linguistic phenomena, clarifying the role of phonology and morpho-syntax in the structuring of utterances, exploring multidimensional aspects of embodied and multimodal semantic systems during verbal exchanges, and delving into the complexities of spontaneous dialogue. Also, beyond verbal domains, additional studies must examine the biological underpinnings of our social instinct, considering the role of emotions, empathy, theory of mind, moral cognition, and interpersonal cooperation in the mutual shaping of meaningful experiences. More ambitiously, these topics should be explored in terms of their manifestation across particular sociocultural settings, including daily conversation, social media, educational institutions, and political spheres, among several others.

A third subfield would embrace a wider outlook and investigate how signs and meanings emerge and unfold across time and space. Studies in this direction should investigate neurosemiotic differences and commonalities across species, considering not only synchronic but also phylogenetic and ontogenetic determinants, from both culture-specific and cross-cultural viewpoints.

Finally, a fourth subfield would set forth an epistemology of neurosemiotics. The goal of this arena would be to discuss how accruing knowledge in the field is pursued, structured, challenged, and integrated within and across intervening disciplines. Philosophical, methodological, theoretical, and meta-theoretical vistas can coalesce to provide solid conceptual foundations for the field at large.

3. Concluding thoughts

In brief, apt conditions are given for neurosemiotics to transcend its current nominal status and become an active plethora of scholarly innovations. The very premises of the field pave the way for a truly synergistic framework capable of forging new theoretical and empirical vistas beyond classical differentiations between the natural and the social sciences. Our semiotic experiences are every bit as social as they are neural, every bit as cultural as they are biological, every bit as phenomenological as they are physical. By circumventing the artificialities of the "two cultures divide", neurosemiotics can consolidate the pluralistic framework needed to avoid unduly partial views of what makes us human.

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Scientific results in biosemiotics: Then and now

Kalevi Kull[1]

In 1987, which was seen as marking 25 years from what was considered to be the beginning of semiotics proper (under this name) in the Soviet Union in 1962, volume 20 of the journal *Sign Systems Studies* (*Труды по знаковым системам*) asked the main members of the Tartu–Moscow school of semiotics for their responses to the following three questions (Ivanov *et al.* 1987):[2]

1. What are the scientific results achieved during this time that you consider the most significant?
2. What areas of research do you consider the most promising in the future?
3. What are the scientific hopes that were pinned in the 1960s on semiotics, but that, in your opinion, did not materialize?

Now, in 2020, it is 20 years from the beginning of the Gatherings in Biosemiotics (2001) as an annual international event, and just 25 years after the first international session under the name *biosemiotics* took place at a major biological conference[3] that was convened as a part of the conference of the International Society for the History, Philosophy and Social Studies of Biology, held in Leuven (Belgium) in 1995.[4]

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2 "1. Какие научные результаты, достигнутые за это время, Вы считаете наиболее значительными? 2. Какие направления исследований Вы считаете наиболее перспективными в будущем? 3. Какие научные надежды, которые возлагались в 1960-е гг. на семиотику, по Вашему мнению, не оправдались?" (Ivanov *et al.* 1987: 3).

3 On the details about other early biosemiotics meetings, as well as an account of biosemiotics of the 20th century, see Kull 2005. A more extensive history of biosemiotics is provided by Favareau 2010.

4 The ISHPSSB meeting in Leuven on July 20–23, 1995 included a section on biosemiotics, which was held over two sessions with two presentations in each. The presentations were: Manfred Laubichler – "The riddle of context dependency: How semiotics can inform biological theory"; Kalevi Kull – "Semiosis and co-adaptation"; Jesper Hoffmeyer – "Biosemiotics: towards a new synthesis in biology?" and Sahotra Sarkar – "Decoding 'coding': Text, context and DNA". (The proceedings of the meeting included of two additional abstracts for the biosemiotics section, but their authors were not present: these were Günter Wagner and Junyong Kim and their paper "A structuralist approach to the character concept in evolutionary theory", and Joachim Wolff – "Neurosemiotics: Mechanisms of

We should also remember, that it is 30 years from the workshop "Models and Methods in Biosemiotics", organized by Thure von Uexküll and his colleagues in Glottertal, Germany, in June 7–9, 1990, which was followed by the 2nd Biosemiotic Workshop on the main theme "Biosemiotic Models – New Approaches to Rehabilitation" in May 9–11, 1991, and the third, on the theme "Umwelt und Umweltbegriff – die Umweltlehre Jakob von Uexküll's", in June 20, 1992. In these Glottertal meetings, attended by Thomas Sebeok, Jesper Hoffmeyer, Martin Krampen, Roland Posner, Thomas Ots, among others (I was in the 3rd of these), the International Society of Biosemiotics was planned to establish. For that purpose, a text – *Preamble* – was prepared (1991), which stated:

> The International Society of Biosemiotics (IBS) promotes science which describes biological phenomena as sign processes explaining them in the framework of the semiotic paradigm.
>
> The semiotic paradigm is understood as requiring the connection of phenomena and empirical data by meaning relationships which are circularly and triadically constituted (as sign, interpretant and referent). It serves as a necessary complement to the mechanical paradigm which describes phenomena and data as linear and dual relationships (as a structure of causes and effects).
>
> This means that the abolishment of separation between natural and human sciences has become a concrete task.
>
> This enterprise needs a joint effort of natural scientists (geneticists, cytologists, students of medicine, etc.) and human scientists (linguists, psychologists, philosophers, etc.) to discuss issues
> – serving to clarify and develop a common transdisciplinary terminology
> – aiming at the elaboration of models in the framework of the semiotic paradigm and
> – promoting the planning and execution of research projects in which conceptions and methods of the natural and human sciences complement each other.

The German version of this remarkable document (probably written by Thure von Uexküll) had the following text:

meaning assignment to endogenous and exogenous signals in the brain: How do they relate to the multilayered organization of brain functions?") Some of the contributions were published in the special issue on biosemiotics in the *European Journal of Semiotic Studies* vol. 9(2), 1997.

> Präambel
> Die internationale Gesellschaft für Biosemiotik (IBS) will Wissenschaft fördern, die biologische Vorgänge als Zeichenprozesse beschreibt und damit im Rahmen des semiotischen Paradigmas erklärt.
>
> Unter dem semiotischen Paradigma versteht sich die Verknüpfung von Beobachtungs-Daten durch Bedeutungsbeziehungen die triadisch und zirkulär (als Zeichen, Interpretant und Bezeichnetes) konstituiert sind. Es dient zur notwendigen Ergänzung des mechanischen Paradigmas, das Beobachtungsdaten durch duale Beziehungen linear als Ursache/Wirkungs-Gefüge beschreibt.
>
> Damit ist die Überwindung der Trennung von Natur- und Geisteswissenschften zu einer konkreten Aufgabe geworden.
>
> Dies erfordert die Zusammenführung von Naturwissenschaftlern (Genetikern, Cytologen, Mediziner usw.) mit Geisteswissenschaftlern (Sprachforschern, Psychologen, Philosophen usw.) zu Diskussionen, die
>
> 1. der Klärung und Entwicklung einer gemeinsamen (transdisciplinären) Terminologie dienen,
> 2. die Erarbeitung von Modellen im Rahmen des semiotischen Paradigmas zum Ziel haben, und
> 3. die Planung und Durchführung von Forschungsprojekten fördern, in denen sich naturwissenschaftliche und geisteswissenschaftliche Denkanzätze und Methoden ergänzen.

Biosemiotics has always been seen (by most biosemioticians) as a science that is not restricted to any particular school of thought. Its study object is meaning-making in living systems, which includes the mechanisms and phenomena related to the semiotic attributes of life: coding, translating, referring, anticipating, perceiving, interpreting, sensing, acting, searching, recognizing, choosing, remembering, learning, knowing, forgetting, imitating, representing, modelling, communicating, etc. It uses knowledge and methods from various areas of biology and semiotics. Biosemiotic models – if adequate – have an obvious fundamental role in biology, and in semiotics.

In what follows, let me apply the same three questions from 1987 to the recent decades (and future) of biosemiotics, and try to give brief answers, from the perspective of my own decades in this undertaking.

1. What are the scientific results achieved during this time that you consider the most significant?

By "significant scientific results" one should obviously mean: (i) the discoveries and (ii) the ordering and systematic analysis of a considerable amount of material. From this point of view, it may not seem that much has been successfully accomplished. However, in case of discoveries, one may not recognize a discovery in its early stage (or is not sure enough yet), even while recognozing that some seeds or sprouts of the discovery are certainly there. In the systematic work, its seems that much more has been done with theoretical (e.g., conceptual analysis) than with experimental or empirical material. Nevertheless, a small sampling of that work done is listed below.[5]

(1) A monographic overview of biosemiotics, authored by Jesper Hoffmeyer (2008a), which followed his earlier book on biosemiotics (Hoffmeyer 1996), is certainly both a necessary and important achievement, as it provides a rather detailed semiotic interpretation of biological phenomena based on many concrete examples, and links together many problems needing further analysis and development in biosemiotics. Another outstanding monograph is *Incomplete Nature* by Terrence Deacon (2012), following his *Symbolic Species* (Deacon 1997), which focuses on the origin and evolution of semiotic phenomena in living systems. Several edited volumes complement these works (e.g., Emmeche, Kull 2011).

(2) General analyses of the roots and history of biosemiotics were also published during this time, particularly the textbook anthology with commentary by Donald Favareau (2010) and an anthology of zoosemiotics (Maran, Martinelli, Turovski 2011). In addition, earlier biosemiotic work by Gregory Bateson (Hoffmeyer 2008b), Thomas Sebeok (Cobley *et al.* 2011), Giorgio Prodi (Cimatti 2018), Adolf Portmann (Jaroš, Klouda 2021), Howard Pattee (Pattee, Rączaszek-Leonardi 2012) and several other scholars in biosemiotics has all been the subjects of full-length volumes. The work of Jesper Hoffmeyer was reviewed in two volumes (Emmeche *et al.* 2002; Favareau *et al.* 2012); and the impact of Umberto Eco to biosemiotics was reviewed the vol. 46(2/3) of *Sign Systems Studies*, to provide just a few such examples here. Studies on the legacy and applications of Jakob von Uexküll's work have grown in number remarkably during this period, also (e.g., Mildenberger 2007; Brentari 2015; Michelini, Köchy 2020; for a review on

[5] See also an earlier account in Kull 2012.

recent Uexküll-studies see Kull 2020). Interest in the analysis of applicability of Peirce's approach and models for biosemiotics has also been extensive (El-Hani *et al.* 2009; Stjernfelt 2014; Romanini, Fernández 2014; etc.).

(3) The general biosemiotic research problems, and the main tasks and results of biosemiotics were collectively formulated and published (Kull, Emmeche, Favareau 2008; Kull, Deacon, Emmeche, Hoffmeyer, Stjernfelt 2009; Favareau *et al.* 2017).

(4) Extensive reviews on the existing data about organic codes (Barbieri 2015) and biocommunication (Baluska *et al.* 2018; Gordon, Seckbach 2016; Witzany 2011; 2012; 2014; Witzany, Nowacki 2016; etc.) were published. This is a rich material for further biosemiotic analysis.

(5) A multi-year and deep discussion was held about the relationships between the codes and interpretation processes in the realm of prelinguistic semiosis. This discussion will obviously continue in some extent, however, it has already led to a rather good understanding of the topic (Deacon 2015; Deely 2009; Champagne 2009; Cobley 2014; 2016: 75–90; Gare 2019; Markoš 2010; Rodríguez Higuera 2019; Vega 2018; discussion in *Constructivist Foundations* vol. 15(2): 122–163 (2020); etc.).

(6) The Peircean tradition in semiotics and the legacy of Jakob von Uexküll turned out to be very useful starting points, which have received (and continue to receive) the major attention in biosemiotic studies. However, these ceased to play the role of the only and single basis for biosemiotic studies in the last few years. Remarkable roles have also played by the ideas of Ferdinand de Saussure, Gregory Bateson, Adolf Portmann, Hans-Georg Gadamer's hermeneutic approach, the works of Thomas Sebeok, Juri Lotman, Umberto Eco, and others. We therefore observe a certain plurality of approaches, together with attempts towards their integration, and also some interesting critique of several of the above-mentioned approaches.

(7) A detailed and profound analysis of basic concepts (and of the whole conceptual apparatus) of biosemiotics has started, which includes the biosemiotic glossary project organised by the editors of the journal *Biosemiotics* Morten Tønnessen, Alexei Sharov and Timo Maran, as well as several independent works. I would particularly emphasise the developments in the analysis of the concepts of *protosemiosis* (Alexei Sharov and Tommi

Vehkavaara), *agency* (Alexei Sharov), *umwelt* (Riin Magnus, Carlo Brentari, *et al*.), *scaffolding* (Jesper Hoffmeyer; vol. 8(2) of *Biosemiotics*), and *constructivism* (vol. 10(2) of *Biosemiotics*). Also, several concepts that were initially formulated outside of the semiotic approach (for instance, *affordance*), have become reformulated and included into the conceptual apparatus of biosemiotics (e.g., Campbell *et al*. 2019).

(8) A very important biosemiotic re-interpretation and analysis of the classical problems of general biology and philosophy of biology has been started. The inclusion of biosemioticians in the Third-Way-of-Evolution group is remarkable in this context. Biosemiotics has contributed to the discussions on evolutionary theory and its extended synthesis (vols. 9(1) and 11(2) of *Biosemiotics*, etc.), on the epigenetic turn (Markoš, Švorcová 2019), and on biological mimicry (Maran 2017; vol. 12(1) of *Biosemiotics*), to name just a few examples.

(9) The links between biosemiotics and the humanities were analysed (Cobley 2016; Wheeler 2006; etc.), including in the fields of ecosemiotics (Maran 2018), ecocritics, environmental history, ecological philosophy etc. (by Timo Maran, Kati Lindström, Andreas Weber, among others). The impact of biosemiotics to ecocriticism and to studies of environmental history has likewise been remarkable.

(10) The most important theoretical development of the recent decade, according to my understanding, concerns the primary mechanism of interpretation. Semiosis, even in its simple forms, includes the process of choice, which requires the simultaneity of possibilities, or, in other words, the appearence of being in the present, the subjectivity. This turns the attention of biosemiotic research to the microscale of time, to the processes taking place within a second.

Let me emphasise that the question as answered above focuses exclusively on the scientific aspects of the biosemiotic project. In addition to this, of course, noticeable organizational developments of biosemiotics as an institutionalized community and field of study took place during this period, some of the most important of which I list here only very briefly:

(i) the persistence of the annual international Gatherings in Biosemiotics conferences since their inaguration in 2001;

(ii) the Book Series in Biosemiotics, published by Springer Nature since 2007, of which 19 volumes have been published as of now (and which was preceded by a collective volume, *Introduction to Biosemiotics: The New Biological Synthesis*, edited by Marcello Barbieri in 2007);
(iii) the internationally peer-reviewed journals on biosemiotics – the short-lived *Journal of Biosemiotics* (one volume with two issues published in 2005) and the long-lived *Biosemiotics* since 2008 (for a review of the first ten years of this journal, see Maran, Sharov and Tønnessen 2017);
(iv) the International Society for Biosemiotic Studies (and its website), founded in 2005; the global network via various channels;
(v) university-level courses on biosemiotics (as well as on zoosemiotics and on ecosemiotics) being taught in several well-regarded universities worldwide; increasing number of students writing their Masters and Doctoral level theses in biosemiotics; pedagogical videos on biosemiotics appearing on the web (Victoria Alexander);
(vi) many events on biosemiotics besides the annual Gatherings (for instance the conference on Biosemiotics and Culture, in Oregon, 2013; the annual Code Biology conferences; the recent series of fortnight web-seminars on biosemiotics under the name of the Biosemiotics Glade, since April 2020; etc.).

All these organizational activities certainly support and further the ongoing scientific work itself.

2. What areas of research do you consider the most promising in the future?

The main area that deserves attention, I think, is the mechanism of *interpretation* and its various forms. While the mechanisms of codes, and the forms of codes, in living systems were rather well understood already decades ago and became later well described in many particular cases, the theoretical and empirical analysis of the primary processes of *interpretation* and the phenomena directly related to it (e.g., *choice, intention, subjective time and space, biotranslation, semiosis itself*) in the biological realm – and the implications of such analyses – should and will be an area of major development in biosemiotics in the future.

Too, a review and deep analysis of the models of semiosis is necessary for a fundamental theory of general semiotics that could link various different approches that have been rather separate so far is still very much needed. It will be fascinating to describe and understand how, from the interaction of codes, emerges an imaginary dimension leading to mind, in a way that is characteristic to life itself.

This means turning our attention to the time structure of semiosis, i.e., to microsemiotics. Meaning as use (or meaning as function) has been traditionally studied on the basis of established habits. This could be called macrosemiotics. And here belongs also the study of codes. Meaning emerges, however, at the tiny moment of choice, in the process of interpretation. Its working as such from the cell to the brain and beyond will be a fascinating area of research, with extensive implications.

Accordingly, the latter will bring in a renewed interest into studying the semiotics of metabolism, into the dynamics of allosteric codes and the ways of readaptation in metabolic networks, in semiosis as a distributed phenomenon, and in describing the nature and relevant steps of minimal semiosis, minimal choice, and interpretation. This, in turn, will have important implications for understanding of an ecosystem as a semiotic system.

Thus, there will be a need for re-thinking, again and again, what is the nature or mechanisms of biological *goals* and *needs,* as related (whether universally or not) to semiosis in the cell, in the organism, and in the in holobiont.

A detailed analysis of semiosis based on case studies of various particular species will be likewise necessary. This includes the studies of the ontogeny of umwelt (e.g., of some insects, spiders, fish, etc), and a detailed study of the unfolding of meaning-making and the emergence of new types, or levels, of semiosis in individual development. The goal will be the establishment of semiotic developmental biology.

And finally: the re-writing of biology, again and again, so that the aspect of the organism's own knowledge and meaning-making processes will become a natural and fundamental aspect in the knowledge about, and the ongoing study of, life.

3. What are the scientific hopes that were pinned on biosemiotics in the 1990s that, in your opinion, did not materialize?

First, there is a general problem: large parts of the humanities do not accept pre-linguistic or non-linguistic meaning-making. Even within semiotics, particularly in Italian and largely in French and Latin American semiotics, biosemiotics is not seen as a field that is necessary for understanding human semiosis. However, the acceptance of biosemiotics in the humanities – particularly via ecosemiotics – is already much wider than is its acceptance in biology proper. For mainstream biology mostly still does not even see the problem of knowledge in organisms as a problem necessary to the understanding of life. This raises a question whether there is yet something absent in biosemiotics itself that should be addressed.

My view has been that in biosemiotics, there is more to discover for biology than for the humanities. Yet its current reception seems to be just opposite. However, since biosemiotics has so much deepened my own understanding of biological processes, and of life itself, I believe that the current situation tells us more about the socal aspects of science – i.e. about the contemporary acceptance and popularity of certain views – than it does about the semiotic science of life and its discoveries itself.

Notably, a clear trend towards biosemiotics is demonstrated by some recent works that directly analyse the problem of biological meaning-making, while yet still not using semiotic concepts (for instance, Tommasi *et al.* 2009; Koch 2019; Ginsburg, Jablonka 2019). Semiotics is simply not known by biologists, it is not a part of their education – therefore, they hesitate to use the semiotic models explicitly.

An additional aspect that may play a role in this situation may stem from the simplistic understanding of what a "sign" is. In the common view, semiotics is defined as the study of signs, while a sign is understood as an "object" that possesses a meaning due to social convention or experience. According to a more profound theory of semiotics, of course, this is not at all the case. An object is only an aspect of signhood (in the Peircean model), and moreover, if one thinks of this object as "a perceived whole with a certain structure or form", then there are certainly semiotic processes in which an "object" in this rather anthropomorphic sense does not exist. This is also a reason why it might be better to define semiotics as the study of meaning-making, instead of the study of signs – or even in some better way.

Thus, my hope or belief in the 1990s, it turns out, overestimated the capacity of understanding in the society of biologists. That said, we should wait a minute and honestly acknowlege that there is clearly more to learn, from this persistent non-acceptance –namely, that the formulations that one can read in the writings of biosemioticians, including myself, have lacked sufficient clarity and explanation.

An additional aspect here – and what became clear after a closer study of existing semiotic theories – is that semiotics itself is not well integrated. That there is as yet much too little that semiotics can provide as a safe set of basic concepts and models (without getting lost in the woods of the Peircean apparatus) when one has been suggested to use semiotics in one's own field of research. Semiotics is not easy because the number of its models is large.[6]

It was also rather unpredictable that some scholars close to biosemiotics have given up facing theoretical diffficulties, particularly difficulties of the methodological or metaphysical kind. Some were frightened by the critique of neo-Darwinian biology expressed in biosemiotics, some by what they may have seen as the unusual (within the natural sciences) methodologies that would be necessary for the study of meaning, which implies that the classical setup of experiment with the condition of *ceteris paribus* and the principle of *experimentum crucis* should be updated for biosemiotic research, due to the nature of the living object of study itself.

In summary: there was a hope that more biologists would become interested in semiotic models, and that among biologists proper, the interest in the biological mechanisms of semiosis will be wider. The semiotic turn in biology, therefore, has so far been really slow (even though I always wanted it to be slow, in order for it to be truly persistent).

In theoretical work, the difficulty of problems is often rather unpredictable. Facing a truly new problem, or even doing rather standard research, you may not know what the problem itself is hiding. And if you are happy, it does hide something unexpected to be revealed. Which means that it would have been uninteresting if all our hopes in the 1990s would have materialized. However, and there is no doubt in this – we have found ourselves to live and work in an area which does teach us a lot – which is biosemiotics itself.

Coda

The literature on biosemiotics has grown already so big in these last two decades, that one person cannot read and know it all. Therefore, each of us in biosemiotics will evaluate the situation in one's own individual way that will be somewhat different from that of their colleagues.

There are several ways how to delimit and describe the periods in science. One of these would pay attention to the openings in the field after passing away of an influential leader. In 1993, Juri Lotman died, and semiotics in Tartu had to search and find their new ways. Biosemiotics stepped

6 As my colleague Israel Chávez has stressed – while indeed a semiotician is assumed to be in command of Peircean triadic concepts, any semiotician should no less be in command of the types of oppositions in the Saussurean and phonological traditions (*pers. comm.*).

to the scene. In 2001, Thomas Sebeok died, and biosemiotics built a global network. In 2019, Jesper Hoffmeyer died. His legacy[7] also demonstrates yet invisible free spaces that will be filled by unpredictable achievements in understanding.

The annual Spring Schools in Theoretical Biology (Estonia), which have lasted already for 45 years and still continue, uses a snail as its logo. The meaning of the snail-symbol was explained by a verse: "The snail is like a theoretician. / It carries all it has with it, / moves on slowly but persistently, / develops in a spiral and strives for harmony."[8] Indeed, the development of biosemiotics has likewise been slow, but persistent. And I think that demonstrates the strength of this view and its research program.[9]

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7 See a rich review by Tønnessen, Sharov and Maran (2019).

8 Sutrop, Kull 1985: 29. Interestingy enough, a snail was also selected by Jesper Hoffmeyer for the title of his first monograph on biosemiotics, whose title in Danish is *En Snegl På Vejen: Betydningens Naturhistorie* (*A Snail on the Trail: The Natural History of Signification*) from the saying that "A snail / on the trail / is a sign of rain / in Spain."

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II Past

Twenty years with the Gatherings in Biosemiotics

Donald Favareau[1]

Introduction

Well, dear friends, this year marks our 20th year together and congratulations are due all around – not just for our sheer longevity, but for the fact that, together, old friends and new, we have been able to keep the original animating spirit of the inaugural 2001 Gatherings in Biosemiotics alive. Being, along with Kalevi Kull, one of the only two people fortunate enough to have been present at each of the prior two decades' worth of Gatherings in person, I have been asked to update my 2012 *Twelve Years with the Gatherings in Biosemiotics* report to share a few observations of what has transpired in the eight years hence.

Let us pick up, then, exactly where the 2012 report left off. That report concludes thusly:

> We read of how the ancient Greeks realized the deep connection between friendship and the advancement of wisdom, and yet today the world of inquiry that they initiated is full of "academic disciplines" where unceasing combat and self-advancement, zero-sum thinking, and a deep distrust of, and rivalry with, one's supposed 'colleagues' is the norm. The Gatherings in Biosemiotics – indeed, the very *project* of biosemiotics as initiated by Thomas A. Sebeok in the manifesto cited at the outset of these remembrances – was designed specifically to oppose that odious model of intellectual barbarism, and to replace it with a community of inquirers who, *united in that very inquiry,* would also function as a community of friends. Twelve years on, I do believe that the majority of people in the community of biosemiotics have tried exceedingly hard to stay true to this vision – and that it has been the upholding of the spirit that was introduced at the outset of the original Gatherings in Biosemiotics, more than any other single factor, that has contributed most effectively to their success in doing so. (Favareau 2012: 72)

I am happy and proud to report that both we as a community, as well as each of the ensuing conference hosts who were so gracious with their time and energy – Franco Giorgi in Castiglioncello, Italy (2013), Paul Cobley

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at Middlesex University, London, U.K. (2014), Luis Bruni at Aalborg University Copenhagen, Denmark (2015), Jana Švorcová and Karel Kleisner at Charles University, Prague, Czech Republic (2016), Ekaterina Velmezova at the University of Lausanne, Switzerland (2017), Terrence Deacon and Yogi Hendlin at the University of California Berkeley, USA (2018) and Alexei Sharov and Stanislav Bushev at Moscow State University, Moscow, Russia in (2019) – all stayed true to our initial vision of the Gatherings as a place for egalitarian open-minded inquiry and multidisciplinary exploration into the role of signs in life.

And perhaps here, too, would be a good time to explicitly thank all of the many dedicated student helpers, as well as all of the building maintenance and facilities people, who worked so hard behind the scenes in order to make each of these Gatherings the seamlessly delightful experiences that they were for us attendees. Thanks, too, to all of the patient hoteliers, restaurant service staff, and pub-owners who put up with our many exuberant late-night dinners and after-dinner discussion sessions in so many marvellous venues all over the world. We have benefited much as a community from all of these people's unheralded indulgences and efforts.

Each one of these Gatherings, as can be seen from the abstracts and accompanying local hosts' reminisces that follow, not only valiantly held up our best traditions, but was in its own right a unique and memorable contribution to our shared journey as a community – as I'm sure this year's 20th anniversary Gatherings will likewise be, under the wise auspices of our hosts Ľudmila Lacková and Claudio J. Rodríguez Higuera at Palacký University, Olomouc, Czech Republic.

Gatherings in Biosemiotics 2012–2020

For this quick review of the last eight years, I will, as earlier, focus not so much upon the ensuing years' development specific ideas, nor upon the conventional 'markers of success', that the community of biosemioticians has accomplished in this interim – both of which are considerable, in my opinion – but rather, will take this opportunity to share a few very personal reflections on some aspects of our Gatherings from 2012 and 2020 that made a particularly memorable impression on me. The local host's remembrances of the event that precede each Gatherings' abstracts collection will provide, of course, much more insight and in-depth detail than will my anecdotal overview, which is only intended to convey a bit of the spirit of each event.

The 2012 Tartu Gatherings marked a particularly profound inflection point in the trajectory of our community's development, as it was at this Gatherings that the International Society for Biosemiotic Study that sponsors these Gatherings was re-organized to provide a more equitable distribution of labour – with the jobs of Secretary, Treasurer, and Webmaster (all previously done by the Vice-President) being awarded to Paul Cobley, Luis Bruni, and Sara Cannizzaro, respectively; with Jesper Hoffmeyer remaining in the role of President, and Timo Maran taking on the role of Vice-President for the next three years.

It was at the conclusion of this Gatherings, too, that our long-time colleague and ISBS founder Marcello Barbieri initiated his own International Society for Code Biology, which has already proven itself to be a great success, with its own website, top-tier journal publications, and annual conferences, all of which can be read about here: http://www.codebiology.org. Founded over disagreements on how a scientific inquiry into the nature of sign relations should proceed, warm relations yet remain between the members of the ISBS and the ISCB, and the ever-increasing success of the Code Biology project is testament to Marcello's wise decision to create it.

The 2013 Castiglioncello Gatherings were organized by neuroscientist Franco Giorgi – a regular in our biosemiotics Gatherings and community since 2007 – in beautiful Castiglioncello, Italy, not far from his own University of Pisa, in a historical nineteenth century castle with magnificent views of the sea. Among its many signal pleasures was a dedicated nighttime session on biosemiotics that was open to the entire public and conducted in the local language. Hosted by Franco, and featuring himself in discussion with Luis Bruni, Stephen Cowley, and Vinicius Romanini, this event was both well attended and well received by the local audience that showed up for it, and it is to our discredit, I think, that we have not done something like this subsequently at our Gatherings. Hopefully future iterations of our Gatherings will include this kind of local, open-to-the-public component.

The 2014 London Gatherings were organized by Paul Cobley, whose association with the organizers of the original 2001 Gatherings goes back many years prior to that event. Current President of the International Association for Semiotic Studies and a close colleague of both John Deely (who Paul alone was finally able to convince to come to our Gatherings on this one and only occasion) and Tom Sebeok in the years leading up to formation of the Gatherings as a dedicated venue for the exploration of biosemiotics *per* *se*, Paul came to the rescue when worsening political developments made it impossible for us to hold the Gatherings in Istanbul, Turkey that year as anticipated, under the auspices of our long-time colleague Yağmur Denizhan. The 2014 Gatherings went off without a hitch, however, and we attendees had the additional honour of being able to attend Paul's own Inaugural Professorial Lecture at Middlesex University London during one of the last nights of the conference.

The 2015 Copenhagen Gatherings at Aalbog University Copenhagen were organized by Luis Bruni, who was still a graduate student studying under Jesper Hoffmeyer when he presented at the inaugural conference in 2001. Now a tenured professor in Media Technology and the Digital Humanities, Luis opened the conference with a day-long workshop dedicated to "The Psychophysiology of Meaning-Making" that was composed largely of the student members of the Augmented Cognition Lab that he founded at the university. This session featured inspiring and provocative examples of empirically-based biosemiotics, as each of the students shared their research findings (and conducted an in-person live EEG experiment, with myself as the subject), and neatly brought us all full-circle, as the student of the professor at the 2001 Gatherings was now the professor of the students at the 2015 Gatherings.

The 2016 Prague Gatherings, similarly, were organized by Assistant Professor Jana Švorcová and Associate Professor Karel Kleisner, both of whom were students of Anton Markoš when they came into our community as early as the Second Annual Gatherings in 2002, and who are now both well-published faculty members of the Department of Philosophy and History of Science and the Faculty of Science, respectively, in historic Charles University in Prague, where the 2016 Gatherings were held for the third time since their inception. Charles University in Prague has always been one of the three main centres of biosemiotic support and investigation, along with the University of Tartu in Estonia and the University of Copenhagen, Denmark, and the idea for the International Society for Biosemiotic Study was first proposed there during our Gatherings in 2004. The fact that it is also one of Europe's oldest universities, in one of its most beautiful cities, of course, added to the delightful feeling of being there.

The 2016 Gatherings most poignant moment, without a doubt, was also its saddest and most unscheduled one, for on the day after the conference started, Czech freedom-fighter, philosopher and biologist Zdeněk Neubauer

(1942–2106) – much-beloved mentor to almost all of our Czech colleagues in attendance, and a memorably insightful presenter at our two previous Prague Gatherings, passed away at the age of 74. His life was beautifully commemorated at the conference a few days later in a moving talk and slide-show presentation put together by the conference organizers and his influence lives on in the work of all of our Czech colleagues.

The 2017 Lausanne Gatherings was organized by philologist and historian of epistemology and language sciences Ekaterina Velmezova at the University of Lausanne, Switzerland, on the shores of beautiful Lac Léman (the northern part of what is colloquially known as Lake Geneva). A colleague in biosemiotics since the 2012 Tartu Gatherings, Ekaterina, like Luis, provided a first day 'mini-conference' where her students could share the results of their research joining biology and semiotics with the visiting biosemioticians, and vice-versa. Chaired by long-time biosemiotics colleagues Myrdene Anderson, Prisca Augustyn, and Filip Jaroš, this intergenerational exchange set the stage for the productive and joyous conference that followed.

The 2017 Gatherings, too, in retrospect, marked yet another kind of an inflection point in our community's history, in that in the months that preceded it, we lost two of our most beloved senior members, John Deely (1942–2017) and Eliseo Fernández (1935–2017) to cancer, and during which time also the founder of our project and of the Gatherings, Jesper Hoffmeyer (1942–2019) had suffered a cerebral haemorrhage from which he ultimately would not recover. These losses hung heavily over most of us at the Gatherings, and the fact that it was yet still so genuinely joyous – and so genuinely in the spirit of our three dear friends – was testament to the dedication of our organizers and to the cohesion of our community.

The 2018 Berkeley Gatherings, organized at the University of California Berkeley by long-time colleague Terrence Deacon and somewhat newer but no less important colleague Yogi Hale Hendlin, was only the second Gatherings thus far to be held outside of Europe – this time on the West Coast of America, neatly bookending the 2011 Gatherings that was held on the East Coast of America, in New York City, and hosted by Victoria Alexander. Bringing together most of our European "regulars" with a plethora of exciting American scholars and colleagues, many of whom were alumni of Terry's decades long reading group dubbed "The Pirates", the 2018 Gatherings were marked by a number of memorable moments, including a live video feed presentation and talk with anthropologist Eduardo

Kohn from Central America, as well as one with Jesper Hoffmeyer from Copenhagen, in what was to be his final face-to-face appearance with us at our Gatherings.

The conference also included a dedicated panel presentation on the teaching of biosemiotics, a lively poster session featuring presenters from Mexico and Latin America, and a pizza-fuelled "movie night" presentation, where we watched the fascinating and inspiring 2017 documentary film on the life and work of pioneering cell biologist Lynn Margulis, entitled *Symbiotic Earth*. At this year's Gatherings, too, Yogi officially took over the role of our Society's Webmaster, giving it its first major redesign and overhaul since it first went online in 2005. Finally, the 2018 Gatherings marked the inauguration of the first annual Jesper Hoffmeyer Award for Promising Young Scholar in Biosemiotics, which is awarded to the best paper presented by a student at the Gatherings. This year's winner was Tyler Bennett of the University of Tartu, for his paper entitled *Terrence Deacon's Cognitive Penumbra and Charles Peirce's Late Classification of Signs.*

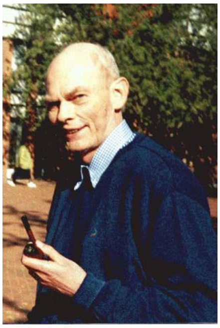
The 2019 Moscow Gatherings. In 2019, biosemiotics "came home" to one of its founding centers. Organized by Alexei Sharov and Stanislav Bushev, the Gatherings took place at the Moscow State University where, 30 years prior, Alexei himself helped organize what was perhaps the first biosemiotics conference so named, during a time when he was teaching a seminar of the same name in the MSU Faculty of Biology. These were the years when the famous Tartu-Moscow school of semiotics was shifting from a primarily cultural to a more biosemiotic approach towards examining the role of signs in living systems (Kull 1999), and Alexei, along with Sergey Chebanov in St Petersburg and Kalevi Kull in Tartu, was instrumental in establishing the foundations that would allow the Copenhagen biosemioticians to join forces with the Tartu-Moscow school by the time of the inaugural 2001 Gatherings.

All three of these pioneers in biosemiotics were in attendance at the 2019 Moscow Gatherings, as they were at so many of our Gatherings over the course of the last 20 years, and the feasts that we had at the end of each day's session were true Russian affairs, with tables full of delicious food and drink that were endlessly replenished until none of us could eat another bite. A gorgeous boat ride on the Moskva River ended the conference, and the winner of this year's Second Annual Jesper Hoffmeyer Award for Promising Young Scholar in Biosemiotics went to Ivan Fomin, of the National Research University Higher School of Economics, Moscow, for his paper entitled *Multi-level Iconic Signs in the Processes of Biological and Cultural Evolution.*

The 2020 Olomouc Gatherings, in addition to their already milestone status as our 20th anniversary may also, in retrospect, mark yet another inflection point in our journey together as a community. Originally scheduled for July 2020, the outbreak of the COVID-19 global pandemic caused cancellations of conferences around the world. Responding nimbly to the ever-unfolding unpredictability of the situation, in May, organizers Ľudmila Lacková and Claudio J. Rodríguez Higuera of Palacký University in Olomouc, Czech Republic, tentatively rescheduled the event to take place in November 2020, such that we may still be able to celebrate our 20th anniversary together in the proper year. Much remains uncertain at the time of this writing,[2] with severe travel restrictions still in place, and much of the world in government-mandated "stay at home lockdown". Still, our community endures, over e-mail and in video conferencing with one another, and I am certain that when the history of the 20th anniversary Gatherings gets written, it will have proven to have been as successful and productive an event as all nineteen that have preceded it.

Torches held and passed, 2001–2019

It would be remiss to end these recollections of our first twenty years as a community without a few words of honour for the friends we lost, who added so much to our Gatherings, and to our joint project of biosemiotics, in their time with us.


Peder Voetmann Christiansen.

Peder Voetmann Christiansen (March 8, 1938 – February 28, 2016) was perhaps the first to leave us, and while he was only physically present at the inaugural 2001 Gatherings, his long association with, and influence upon, the group of Danish intellectuals who would later form the core of the contemporary biosemiotics community cannot be underestimated. A theoretical physicist whose cross-disciplinary seminars brought together almost all the members of the Copenhagen biosemiotics group in the late 80s, it was he who introduced them to the works of Peirce (Emmeche *et al.* 2019: 367). Peder passed away peacefully in his home in Denmark on February 28, 2016 at the age of 78.

[2] May 2020.

John Deely, in the conference *Biosemiotics and Culture*, Oregon, May 2013.

John Deely (April 26, 1942 – January 7, 2017) likewise was only physically present at one actual Gatherings – the 2014 Gatherings at Middlesex University, London organized by Paul Cobley – but his active involvement with biosemiotics for at least a full decade before the first Gatherings took place, and indeed, all throughout its development right up to the time of his death, is intimately bound up with our project and our community. By far our most brilliant philosopher and historian of semiotics, John was actively supportive of our project from the beginning, and with his colleague Thomas Sebeok, was instrumental in the late 1980s and early 1990s in publishing some of the very first English language papers from our group and in arranging for biosemiotics panels to take place at so many international semiotics conferences. Although extraordinarily busy with his own many duties with the Semiotic Society of America and the International Association for Semiotic Studies, John could nevertheless would also always be seen in the company of his many biosemiotician friends at each of these conferences, and a memorial session dedicated to his influence upon us was conducted at the 2017 Lausanne Gatherings.

Eliseo Fernándes with his wife Marcia, at Leigo, during the Tartu *Gatherings in Biosemiotics*, July 2012.

Eliseo Fernández (May 29, 1935 – May 13, 2017) joined us in person for the first time at the Seventh International Gatherings in Biosemiotics, held at the University of Groningen in the Netherlands, in 2007. But it turns out that, unbeknownst even to him, he had a role in the history of our community going back at least as far back as 1989. For we find Eliseo's 1989 seminar paper entitled *From Peirce to Bohr: Theorematic Reasoning and Idealization in Physics* cited by Danish Semiotics of Nature Group's Peder Voetmann Christiansen in a 1990 seminar paper entitled *Peircean Local Realism Does Not Imply Bell's Inequalities*, and it was Chistiansen's work on Peirce, as we noted above, that

Jesper Hoffmeyer and John Collier, at Leigo, during the Tartu Gatherings in Biosemiotics, July 2012.

directly inspired the members of the early Copenhagen biosemiotics community, including Claus Emmeche and Jesper Hoffmeyer, to start incorporating Peircean ideas into their own work (*ibidem*). A soft-spoken yet incredibly well-read and insight-ful thinker, Eliseo was with us for all eight consecutive Gatherings from 2007 to 2015, regaling us with thought- provoking meditations on signs and science that were often delightfully hand-illustrated with whimsical animal illustrations by himself and his daughter, Silvia Fernández. Eliseo was an important and empathetic presence in our Gatherings, and his kindness and intellect are sorely missed. A memorial conference presentation in his honour was delivered at the International Association for Semiotic Studies World Congress in 2019, in his hometown of Buenos Aires, Argentina.

John Collier (March 28, 1950 – September 29, 2018), philosopher of science and information theorist, made his first appearance at our Gatherings in 2002, at the Second International Gatherings in Biosemiotics held in Tartu, Estonia, and is listed on the programmes of nine Gatherings in total, including Gatherings 2, 6, 8, 10, 11, 12, 13, 15, and 18, although ill-health in his final years caused him to have to not be able to appear for 2 or 3 of these. Holding a degree in Earth and Planetary Science from MIT, as well as degrees in Analytic Philosophy from UCLA and in the History and Philosophy of Science from the University of Western Ontario, John's interests were in applying Dynamic Systems Theory to Peircean pragmaticism so as to arrive at more fully explanatory understandings of 'life' and 'mind'.

Holding positions at the University of Melbourne, University of Newcastle, The Konrad Lorenz Institute for Evolution and Cognition Research and finally, the Philosophy Department of the University of Natal, Durban, South Africa, John retired from the latter as a Full Professor and Professor Emeritus in 2013, and remained a familiar and always welcome presence at our Gatherings for 16 unforgettable years.

Jesper Hoffmeyer (February 21, 1942 – September 25, 2019) was, in all but official title, the *de facto* "central figure" around whom our Gatherings community first coalesced, given that it was his 1997 monograph, *Signs of Meaning in the Universe* that was (and perhaps still is) many of our members' first real introduction to the project of biosemiotics. Described as a "thinker, scholar, science communicator, biochemist, biosemiotician, and saxophonist" in his obituary in the *Biosemiotics* journal that he helped found, Jesper's contributions to our community are so vast, so varied, and so fundamental, that it would be foolish for me to attempt to list them here – and probably superfluous also, since anyone reading this will no doubt already be well acquainted with them. Jesper attended and presented at virtually all of our Gatherings from 2001 to 2016, save two, both for medical reasons, before suffering a cerebral haemorrhage on August 2, 2016, less than a month after returning home from the Sixteenth Annual Gatherings in Prague. Having just completed the first full draft of the English translation of his latest book, *7 Ting vi Plejer at Tro på (Doubtful: Seven Things that We Used to Believe In)* a few days prior, Jesper valiantly fought on for the next three years, wheelchair-bound and barely able to speak clearly or swallow, working on this and other manuscripts on biosemiotics, and even appearing for a final time at the Berkeley Gatherings in 2018, via video-conferencing link. He passed away on September 25, 2019 and his funeral was postponed until enough close friends from the international biosemiotics community could be there with him on Sunday, October 27, 2019. Jazz music and Danish standards were played at Jesper's funeral, and in the silence outdoors afterwards, birds in the trees sang their signs invoking a recurring motif in *Signs of Meaning* (53, 140, 142).[3]

Wendy Wheeler, in the workshop *Living Organisms and their Choices*, Edinburgh, November 2018.

[3] *Addendum*: Long after this chapter was written, and with no time left to change the text, our dear friend and colleague in biosemiotics, **Wendy Wheeler** (February 9, 1949 –

The Road Goes Ever On

As can be seen from the above, our Gatherings community is now entering into the period where many of its original members are growing old and passing away – which is, of course, a natural part of every such community. Happily, newer members are joining every year to take their place, and many of the "newcomers" mentioned in the 2012 version of this article are now "established regulars" in our community and even Society position-holders – as again, and indeed, it should be. And quite a few of we "old-timers" remain. But more important, perhaps, than who's where, when, is that the project itself lives on.

In his own reflection about our Gatherings for the 2012 volume, Jesper Hoffmeyer noted that: "Myrdene Anderson, at the first Gatherings in Biosemiotics, pointed out that in anthropology, the term 'gatherings' was used to denote remnants from the past. I have nothing against this connotation, since I indeed hope that something will be left to the future from our gatherings" (Hoffmeyer 2012: 55), while Claus Emmeche, his co-organizer of the first Gatherings, opined that: "one the nice things that emerged from the Gatherings meetings was a feeling of comprehension. That is, even though people came with a wide variety of disciplinary backgrounds and special expertises, the open and informal atmosphere that was enacted clearly meant that a feeling of coherence appeared, suggesting that we were all on the same track towards something bigger, maybe closer to a fulfilment of a theoretical biology that would be at the same time, a handy tool for understanding the complexity of living nature" (Emmeche 2012: 74).

Twenty years later, both these quotes seem as timely as when our very Gatherings began. Whither, then? We cannot say. And that is largely the point – to be friends along the path that together our steps create. May it continue to be a good journey for all who walk it![4]

June 25, 2020), passed away after a long battle with cancer. She will be remembered in a special presentation at the Gatherings in Biosemiotics 20, and for her signal contributions in joining biosemiotics with literary theory, as well as for her tireless promotion of biosemiotics within the humanities. An obituary of our dear friend Wendy can be found here: https://doi.org/10.1007/s12304-020-09391-y (Westling 2020).

4 This article was supported by National University of Singapore Academic Research Grant #R-124-000-077-115.

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Minding nature and semiotic growth: A conversation with Jesper Hoffmeyer

Claudio J. Rodríguez H.[1]

In 2014, Jesper Hoffmeyer's book *Biosemiotics*[2] was published by Tallinn University Press in its Estonian translation.[3] On December 4, he gave a lecture, "Biosemiotics: Bridging the science-humanities gap" at Tallinn University,[4] followed by the presentation of the book. During the next days, December 5–6, Jesper participated in the conference "Creative Continuity", organized in Tartu by the Department of Semiotics. This meeting celebrated the 50th anniversary of *Sign Systems Studies*, the journal of semiotics published by the University of Tartu. The conference included guest lectures by Edna Andrews, Francesco Bellucci, and Jesper Hoffmeyer himself.[5] The following interview was held on December 6, 2014, in Tartu, over a cup of coffee.[6]

Claudio Rodríguez: How many translations are there of your book? I know there's an original version in Danish,[7] there's an English translation and now there's an Estonian translation. That's it, right?

Jesper Hoffmeyer: The Estonian translation is the second one.

C.R.: And it's based on the English translation, if I'm not wrong.

J.H.: Yes. Because nobody reads Danish. And you need to have a little philosophy background, a biology background, and to be able to read in a Scandinavian language. That's too much. There are very few people meeting those three requirements.

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[2] Hoffmeyer, Jesper 2008. *Biosemiotics: An Examination into the Signs of Life and the Life of Signs*. (Hoffmeyer, Jesper; Favareau, Donald, trans.; Favareau, Donald, ed.) Scranton: University of Scranton Press.

[3] Hoffmeyer, Jesper 2014. *Biosemiootika: Uurimus elu märkidest ja märkide elust*. (Gigantum Humeris.) (Puhang, Ehte, trans.; Ott, Margus; Rünkla, Liisi, eds.; Kull, Kalevi, afterword.) Tallinn: TLÜ kirjastus.

[4] Recording of this lecture is available at https://kultuur.err.ee/303120/video-semiootilise-bioloogia-tippteadlase-jesper-hoffmeyeri-loeng.

[5] Recording of Jesper Hoffmeyer's lecture "Cassirer's challenge: On semiosis and systems" is available at http://www.uttv.ee/naita?id=20983.

[6] See also another interview with Jesper Hoffmeyer from the same year: Kull, Kalevi; Velmezova, Ekaterina 2019. Jesper Hoffmeyer: Biosemiotics is a discovery. *Biosemiotics* 12(3): 373–379.

[7] Hoffmeyer, Jesper 2005. *Biosemiotik: En afhandling om livets tegn og tegnenes liv*. København: Forlaget Ries Forlag.

C.R.: Did you translate the English version yourself?

J.H.: I tried to get it translated first. I paid a woman from New York who was Danish actually, but she had lived in New York for some ten years. And then my good friend Don [Donald] Favareau saw it and said: "This is not English". (Laughs.) So I had to give it up. And then there was a PhD student from Los Angeles of Danish descent. She translated a few pages and it was in perfect English. She got it right. Except that she got it all upside down. She didn't understand my point. So I gave up. Then finally we got a translator from the Midwest, Purdue University. An anthropologist who had a Danish name. And he also translated some ten pages. And it turned out that he didn't read Danish. (Laughs.) So I gave up and tried translating it myself. I spent ten months translating it.

C.R.: You also got help with the book. Who did the edition?

J.H.: Yes. Donald Favareau was very very helpful. He is a philosopher and a neurolinguist, but he comes from the Bronx in New York. He knew all the tricks of street language.

C.R.: And now the Estonian version is the first true complete translation that you didn't participate in.

J.H.: Exactly. And I can't control it.

C.R.: I've also seen that there are some shorter texts translated to other languages.

J.H.: Oh, yes. I had my former book translated to Japanese and English of course. And to Swedish and Norwegian.[8] It's a bit stupid with Scandinavian languages. If people can read a book like mine, they can also read English.

C.R.: Was it *Signs of Meaning in the Universe*?[9]

J.H.: Yes. It had a different title. The Danish title[10] couldn't be translated, so I had to invent another title. I would have preferred to call it "Minding Nature". And for a long time I thought that was ok but suddenly they said: "Oh, this doesn't work," so I finally gave up. I didn't call them for a couple of months. They're the ones trying to sell the book. But I always hated this title, *Signs of Meaning in the Universe*.

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[8] See the bibliography of all translations of all Jesper Hoffmeyer's books in: Emmeche, Claus; Favareau, Donald; Kull, Kalevi 2019. Jesper Hoffmeyer 1942–2019. *Biosemiotics* 12(3): 365–372.

[9] Hoffmeyer, Jesper 1996. *Signs of Meaning in the Universe*. Bloomington: Indiana University Press.

[10] Hoffmeyer, Jesper 1993. *En snegl på vejen: Betydningens naturhistorie*. København: Rosinante/Munksgaard.

C.R.: Why?

J.H.: It's just so grandiose. I'm more of a modest man. I'm not talking about the whole universe. But that's the American way and people like the title.

C.R.: Peirce did talk about how the universe is perfused with signs and it's a current theme now in semiotics.

J.H.: But that's one of those quotations that I never really liked. I think he's misunderstood. You can easily understand it to mean that everything in the world or in the universe is signs, and that's not what he meant. He only meant that everywhere you can have *signhood*, if you like. But it's not there. If everything were a sign, it wouldn't be interesting. I mean, we have to have a material world and then we have a world of signs. If you say everything is a sing, then it's just reductionism.

C.R.: And we wouldn't have a differentiation between things in order to have signs. Therefore, we wouldn't have any signs at all.

J.H.: It would be useless. Senseless. That's called *pansemiotics*. Very few people subscribe to that. […] You don't have a semiotic foundation unless you have thirdness in the picture. […] I think you must meet science head on and confront it. You have to encounter the ontology. You can't just skip it over. Somehow you must deal with the question of teleology, you can't just "put it under the carpet" as we say in Danish. That's what I do in my book, I think.

C.R.: With a "hard-scientific approach" we still have a sense of prediction. It seems to me that in biosemiotics there's a lack of predictive power.

J.H.: Well, how could you predict living things? You can never predict them. Of course you can predict that this man has cancer and he will die from it, but sometimes he actually survives. Prediction is good in physics, but taking it as a measure of how fruitful a scientific approach is, I think, is false, because it makes it important to make science about things that are not predictable. And again we're back to ontology, because the world isn't predictable. And well, we're stupid so we can't predict it, but if you ask around, the ordinary scientific person will think that the world is predictable. Very often this goes very well with religion, because if you believe in God, then he has the power to make miracles. But all the rest is science. I think that, basically, the Peircean understanding of the world is chaotic; it's the study of chaos, and the real question is in understanding how necessities could arise. Science gets it the other way around: It takes necessity as the premise. The world is ruled by necessities. That's why you can make predictions, because it necessarily goes that way. So the problem is not necessity. The problem is why they can predict at all. In biosemiotics and in Peirce it's the opposite. The world is indeterminate, so the problem is, where does determinacy come from? Where does necessity come from? Where does law come from? And Peirce explicitly says that he thinks that natural laws are also habits taken by the universe, if you like, so he has an evolutionary ontology.

C.R.: You've talked about how biosemiotics can be a bridge between the sciences and humanities. But how can a lack of prediction bring scientists closer to the humanities in any way?

J.H.: Well, I don't think that it's the lack of prediction that would necessarily make them closer. But the moment you accept that the world contains creativity, I think we have to go back, I'm afraid, to the church question again here. In the XVII century, Giordano Bruno was burnt by the church. And the reason was that he committed a heresy – a very serious heresy in the eyes of the Catholics – by claiming that God was present in the world as creativity. And that makes you take God not as a transcendental fact, inherent in the universe. According to the theology of the highest degree, God is transcendental. Now look, we almost figured that science and religion, or rather Christianity, are opposed, but what happened here was actually that the church and the scientific world agreed. This is heresy also in natural science. The world is passively ruled by laws, that's why it's predictable. Passive matter ruled by laws. Now, Giordano Bruno knew, saw or understood this. He didn't even have a telescope or anything like that, but he philosophically reached the idea that the world contained many universes. Or that there are many worlds in the universe. Many suns and many stars and so on. He did all this by philosophical-mathematical reasoning around the year 1590. And he was burnt. Science and the church agreed totally on this picture: The world that we have in which nature is passive. The church of course says that it's ruled by God. Scientists don't like that. They prefer it being ruled by natural laws, so natural law is a substitute in their thinking for God. This is very interesting, I think. Actually, they are very religious and believe in natural laws instead of God, but that's the same. In religion of course there are more ethical things that fortunately are not present in science. I'm discussing with theologists all the time in my work.

C.R.: It's very interesting how the type of people that biosemiotics attracts is not only scientists or people in the humanities who are interested in how life happens.

J.H.: Biosemiotics has an open-minded view. Metaphysically we distance ourselves from the scientific ontology If you don't [hold a religious view], you also don't have to believe in Newton. There is something wrong with [the Newtonian picture], because I couldn't exist if Newton was all there was. I mean, that's a logical impossibility. You can't have life in a world ruled by Newtonian laws. My idea was wrong too, that the world is actually semiotic, and that it comes for free. Take for instance creationists or the intelligent design people. If you see their arguments, they say that Darwinism can't explain this. I think they're right: You can't explain it. But we have to do better. The reason Darwinism isn't capable of explaining it is that this principle of natural selection is insufficient, because it doesn't allow for creativity. Again, that's the thing. You have to find out how to reframe science so that it allows creativity to be there. That's what semiotics does. Because semiosis – whatever it may be – implies that an interpretant is formed that somehow relates the system, organism, whatever, to something in the now that will be important in the future. That's why animals or organisms use signs in order to orient themselves so their activities could become fortunate. There is this element of future-directedness behind all kinds of semioses. For this to be the case you have to have a kind of agency, if you like. Something which has, as Darwin would say, *striving*. Something that distinguishes living systems from dead systems. A stone has no striving. It takes no interest whatsoever in what's around. But if you take the simplest bacteria, they will take an interest in their surrounding world. They'll try to interpret what they meet. You can discuss whether this deserves to be called interpretation of course. A lot of humanistic people would not tolerate an extension of the concept, so we might perhaps invent another term. But think about Peirce and you will see that he actually uses the term of the interpretant. Maybe the good thing about Peirce is that he depersonalizes interpretation, while the humanities always tend to have the human person in the center. That's part of the humanities: Humans are, of course, in the center, so they will tend to see interpretation as some human activity. Peirce sees logic because his approach is logical. He sees that thinking necessarily goes by signs. The sign is this triadic logical guiding principle, if you like.

C.R.: With chemotaxis we have a way of describing organism interaction, but what is chemotaxis lacking? Because we can have a stochastic model of chemotaxis.

J.H.: Sure, you can do that. Probably. We even know all the fifty proteins in *E. coli*'s chemotaxis, or they will be known sometime soon. So what's the difference? Why not staying with it? Because it doesn't tell you what it is about. A purely biochemical description is ok. Let's say they really do describe it, but they never get the sense of it. The sense of it is historical. You need the time dimension there. So if you take all those proteins and ask: why are they organized in this way? The biochemist can't answer this question.

C.R.: They just answer with the mechanism.

J.H.: Yes, but then you need evolution. Of course, you think, natural selection or something like that. And even at the level of bacteria natural selection might be the main principle. That's ok, but you need the historical dimension. So why do they talk about information? Those biologists always say: It's all about information. Why do they do that if they can just explain it as biological chemistry causality? They do it because it says something. It tells them that something is for something else. And that's what we call signs. I know the reason why mathematicians invented information theory: So that it has this feeling of being an objective science, but that's not how biology is. They don't use it like Shannon information or something like that, so they deceive you. It's deception. They don't know it, but you can see it. Strange. Those clever guys, why can't they see such a simple thing?

C.R.: How do you make a difference between semiotic causation and teleonomy?

J.H.: I don't need to make it. I define what I mean by semiotic causation and then that's it. It's just to get rid of all this philosophical tradition. Because you have to get rid of it: it's an inhibitor. It stops you from thinking. In this way sometimes philosophy is a bad thing. (Laughs.) That's one of those things that I like about science: That scientists don't like philosophers. In Denmark my colleagues call me 'the philosopher' and it is not meant as a compliment. They mean it as 'well, this is bullshit. It's not worth talking about it.' But the good thing about all this is that, in a way, you dismiss philosophy and it opens the doors to think things that philosophers would never think of, and sometimes it changes philosophy. In that way, I think we shouldn't be afraid of skipping a little of this traditional discussion. I prefer to rename the teleological thing in a very precise description like semiotic causation defined as bringing about effects through interpretation activity.

C.R.: I know we were talking about how biosemiotics works as a bridge between the humanities and science, but biosemiotics itself is not even a bridge inside semiotics. There are many branches of semiotics, and there are many types of semioses. For instance, we can talk about the semiosis of theater or the semiosis of street signs. How do we put these things together?

J.H.: I don't think we should. I mean, it's ok that people specialize inside something that I would call anthroposemiosis. Doing that, you need a lot of concepts that you would need in the biological world, so it's all ok. The thing is that somehow those two words are really at the bottom level. From the biological side you must see that maybe you shouldn't deal with human consciousness, the human mind, mental processes, because that's for the humanities to do. But you should at least make it plausible that such phenomena could arise in the world, and this brings us towards the bridge. But then, if you take what I'm writing in my book, you can see that I'm making a lot of extensions towards the humanities.

C.R.: Do you think anthroposemiotics in all its forms – in literature or anything else – could be explained away with biosemiotics?

J.H.: No. Not for any regards or purposes. I think they need the conceptual apparatus. There are so many brilliant psychologists, brilliant people in all these different branches, and of course, that work can't just be skipped away. No. Biosemiotics tells a story – not to use this way of speaking – about what a human being is, a story that emphasizes the body, puts the mind out of the brain. In my latest book,[11] I defined cognition as an interface, so you have a system and this system is connected to all the other systems through an interface. You know, the interface is a protocol to link how this should be done. And that's what a governing system does for us: It connects us to the world.

C.R.: Talking about getting scientists to join biosemiotics, do you think that more can be done to do that? Clusters of researchers appear, but rarely. Why do you think is that?

J.H.: In a way, I think biosemiotics should inform biology, but biology should continue doing what they're doing. They should be aware that they can't see and explain the world just on the basis of natural selection and an information concept that is totally much too full for their purposes. They are unfortunately well schooled in philosophy. Often,

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[11] Hoffmeyer, Jesper 2012. *Overfladens dyb: Da kroppen blev psykisk.* [*Depth of the surface: When the body became psychic.*] København: Forlaget Ries.

they don't see the limitations of their own concepts, but I think biosemiotics is a free framing of biological theory. It's not a reframing biology. Biology is okay in many senses. But the theoretical apparatus is, I think, poor. It could be enriched. If it became enriched, I'm sure that biologists and biochemists would do a better work, ask better questions. They wouldn't think that the mind was explainable through neurons.

C.R.: Are there things that you would change from your book *Biosemiotics* at this point?

J.H.: Oh yeah. Obviously, I would. I think that the triads I used to illustrate the Peircean thinking are too naïve. Too simplified. That's what bothers me the most. Now I rarely use those triads anymore because it's not possible to make a graphical representation. I think at least I would change it. Perhaps I'd even remove it. But on the other hand, in this new book I also did it. But I didn't use triads graphically.

C.R.: Where do you see the future of biosemiotics?

J.H.: I thought I had invented this concept. Then, of course, I understood that people had been working along those lines for years actually, but I never had any idea that I was creating a new school of thinking or anything like that. I thought of this because it explained the world, I thought, in ways that were much better then. The energy I have devoted to it is very much my personal interest. I think this is a better way to see it. It's a better way to do biology. Probably a better way to do a number of other things. I never teach biosemiotics to my students. I couldn't allow myself to do that, because sometimes they come to ask me if they could do a MA degree in biosemiotics. I always tell them: How would you earn your money? (Laughs.) This is just the kind of project that nobody accepts so far. But it's not wholly true. There are some people in industry who see that maybe there are some dead ends in biotechnology. I think that the name *technology* tends to blind people and researchers. I would think that it might be useful and sometimes things won't change until industry, agriculture, medical systems, etc. make pressure. So, let's see what happens. I'm not so sure that it will die out.

C.R.: You have to be hopeful.

J.H.: We have inspired a lot of people, I think. I would like to see semiotics grow, of course. But you know what happens when things grow: You lose control. (Laughs.) And suddenly it will change.

Two letters on Bertalanffy, Rosen, and interpreting agent

Howard Pattee,[1] **Kalevi Kull**[2]

Here we publish our correspondence from May 2020, between Williamstown, Massachusetts, USA, and Tartu, Estonia.

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May 3, 2020

Dear Howard,

hope you are well.

A little question. When you were in Buffalo (what year that was?), did you also meet Ludwig von Bertalanffy? If yes (or if in any other occasion), I'd be very interested on your impressions and thoughts about him.

With very best and warm wishes to you from Tartu – here's a nice spring now –

Kalevi

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May 4, 2020

Dear Kalevi,

I'm glad to hear from you.

I was at the Center for Theoretical Biology at Buffalo from 1971–75. Bertalanffy had just left (he died in 1972). Rosen was primarily responsible for inviting him as visiting professor and Rosen was also responsible for inviting me the following years.

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My impression of Bertalanffy comes mostly from his updated *General Systems Theory*, George Braziller, 1968.[3] The book covers many disciplines, physics, biology, psychology, epistemology, and points out their limitations. I agree with most of his views. However I find no evidence in the book that a "General Systems Theory" exists.

In Rosen's and my view, the most general theory of systems is that hierarchical levels of complementary models are necessary in all sciences. This was first discussed by us (Pattee link[4]) in *Hierarchical Structures*, Whyte, Wilson, and Wilson, eds. Elsevier, 1969. Bertalanffy wrote a paper "Levels of Organization" in 1952 (in *Problems of Life*, Wiley, 1952[5]) but he did not follow this up.

Bertalanffy did recognize that the "genetic code represents a vocabulary" of words (proteins) and that this implies a "grammar" if the genes are to express an organized system rather than a "word salad" of unrelated words. He also argued that a good evolution theory must involve these grammatical constraints of the genetic language (*GST* p. 165). With this I fully agree.

We are well for our old age, and fortunate to be cared for. The COVID virus has us quarantined but it is not going to disappear until we have a vaccine. I have stopped trying to follow the current scientific literature and read only classics that I should have read 50 years ago.

Best wishes,

Howard

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3 Bertalanffy, Ludwig von 1968. *General System Theory: Foundations, Development, Applications*. New York: George Braziller.

4 https://www.academia.edu/6806673/Physical_Conditions_for_Primitive_Functional_Hierarchies. Pattee, Howard 1969. Physical Conditions for Primitive Functional Hierarchies. In: Whyte, Lancelot Law; Wilson, Albert G.; Wilson, Donna (eds.) *Hierarchical Structures: Proceedings of the Symposium held November 18–19, 1968 at Douglas Advanced Research Laboratories, Huntington Beach, California*. New York: American Elsevier Publishing Company, 161–177.

5 Bertalanffy, Ludwig von 1952. Levels of organization. In: Bertalanffy, Ludwig von, *Problems of Life: An Evaluation of Modern Biological Thought*. New York: John Wiley and Sons, 23–54.

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May 10, 2020

Dear Howard,

thank you very much indeed for your detailed response, this is helpful.

You say you read classics. This is an important thing I have learned from you – one should read only the best texts.

And I'm so glad to hear that you are well.

I've started a video-seminar on biosemiotics as travelling stopped earlier this spring.[6] So we meet now every fortnight – from Terrence Deacon in Berkeley's morning to Don Favareau in Singapore's evening, with afternoon in Europe. Discussing fundamentals of biosemiotics.

With very best wishes to you and your wife,

Kalevi

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May 17, 2020

Dear Kalevi,

Your mention of discussions with Deacon and Favareau about the fundamentals of biosemiotics triggered my expressing these thoughts that have been brewing for a long time. I will state them rather bluntly in order to be brief.

It is clear to me that the concept of *interpreting agent* is fundamental not only for biosemiotics but also for understanding physics and life. It is also vague and ambiguous. I assume that a Peircean *irreducible triadism* is a conceptual, logical and linguistic necessity for any theory of the interpretation of signs. The most obscure concept in this triad is the *interpreter* or *interpreting agent*.

Significantly, it is also the most obscure concept for the process of measurement in physics, which has the same triadic elements. In physics the sign is some aspect of the physical universe chosen by the *interpreter* (often with

6 The first seminar being held on April 3, 2020.

the help of *conventional* artifacts called measuring devices). The *object* is therefore a *symbol*, often a natural number. The problem is that everything is largely *interpreter-dependent*.

In physics this triadic process is the well-known *measurement problem*. It is a problem because nobody agrees on the requirements for an *interpreting agent* (the observer) Apparently scholars have the same problem with Peirce's many attempts to define it. In my opinion, the main contribution of biosemiotics so far is the de-anthropomorphizing of classical semiotics by recognizing that *interpreters* evolved long before humans. So, we say the single cell *interprets* its genetic symbols.

The history of the measurement problem has shown similar de-anthropomorphic trends. It began ca. 1935 with the interpreter (observer) at the human consciousness level (e.g., Schrödinger's cat and Wigner's friend). Today there is the view that measurement can take place at the cell level without human brains. (Note: The vast literature named "interpretation of QM" is confusing because it refers only to the many ways humans interpret quantum theory. It does **not** refer to the *interpreting agent* of the measurement process itself.)

In physics the question remains: What is the simplest type of *interpreting agent* that transforms a quantum *sign* to a classical *symbol*? Biosemiotics needs to answer the general questions: What are the necessary properties of an *interpreting agent*? How do *interpreting agents* arise and evolve? My view is that understanding life and its origin will require these answers.

Now, back to our COVID quarantine and ADLs (activities of daily living).

Howard

P.S. Feel free to share my comments.

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May 21, 2020

Dear Howard,
I am very glad of your letter.

Indeed, that is what I've learned (and inherited) from you – that biosemiotics faces the measurement problem. The measurement problem which appears in any event of detection or knowledge-creation.

As you say, this leads to the question of necessary and sufficient properties of interpreting agent. These properties could be inferred from the understanding of the process of interpretation – which is the other side of the same problem.

The features that closely participate in interpretation, are (primitive) doubt, (primitive) choice, coexistence of possibilities, immediate presence of other, indeterminacy. Thus the task is to construct a minimal model that would combine these features, or rather in which these features would emerge. As a model of interpreting agent.

It is amazing how difficult this problem is. However, it feels that we slowly get closer and closer to its understanding.

Our last seminar was on the concept of agent, the forthcoming will focus on representation. These are related, of course.

With all best wishes (from all of us)

Kalevi

III Future

The not-so-distant future: The perception of biosemiotics in 2050

Claudio J. Rodríguez H.[1]

1. The future

What's in a prediction of the future? A hopeful calculation or a depiction of our wishes? Making predictions about what things will look like in the future is usually quite a hard enterprise, and we are reminded of old-time depictions of what our present – their future – would look like. We usually laugh at those depictions as not just inaccurate, but bordering on the ridiculous. Flying cars, odd cones as headgear and weird beeping sounds are all familiar retrofuturistic images that help us illustrate the point: We humans shape the familiar into the unfamiliar when making general predictions about what lies ahead. Even with that in mind, we keep venturing into the future armed with possibilities and aspirations.

As we commemorate the 20 years of Gatherings, we also want to peer into the next years, even if we know the truth about flying cars.[2] By remembering what we have been through as a biosemiotic community, we can also hope to see a what is expecting us in the coming decades, but more importantly, we can set our minds to new, important tasks to take on in order to make these aspirations more plausible.

2. The question

We decided to approach the biosemiotic community with a question that encapsulates this concern: What do you think biosemiotics will look like in 2050? The answers, while few, were telling of the optimistic uncertainty that we face ahead. Entertaining the possibility of precognition with some sense of acumen entails being mindful of where we stand within the larger world of academic perusals.

The biosemioticians who decided to place a bid for our shared future had different reactions to the question, but their general optimism is refreshing.

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[2] They remain, at the time of this writing, an unfulfilled promise.

Both the younger and the more seasoned researchers hint to the expansion of the biosemiotic project into more mainstream areas, to the extent that many involved seem to believe in a future where our current division of intellectual labor has changed, a landscape archaeologically rich and full of new peaks. That does not mean the answers given shared the same theoretical outcome. Instead, they see things from different sides: science, art, technology, society. We are certainly reminded of the variety of perspectives even within a shared program.

3. The predictions

So what expects us in 2050? How do we begin to address this question? Biosemiotics as a research project is realized in publications, teaching, conferences and influence over other research programs, so predictions partially focus on these areas of biosemiotics. The place of biosemiotics within the life sciences and academia at large – perhaps even society – are one of the main places of predictions, and rightly so: Yogi Hale Hendlin expects Biosemiotics to fully turn into a "truly interdisciplinary art-science" by this time, leaving behind its original humanities-only origin and taking a bigger role in the sciences as "the Extended Evolutionary Synthesis comes fully online". With this will come a call for biosemioticians to deepen their hold on scientific research and taking on a more empirical role, but in order for this future to happen, biosemiotics must extend its reach, be taught in universities, invite new people, work with scientific institutes and think-tanks and cultivate master-apprenticeship relations to foster a stronger new generation of biosemioticians.

Israel Chávez (University of Tartu, Estonia) shares a similar opinion: "the future and the scientific status of biosemiotics depends, to a great extent, upon its institutional and academic success within biology", pointing to the need for an open interdisciplinary approach not only in the breadth of topics treated, but also in methods incorporated and imported from one discipline to another. The future of biosemiotics, as Chávez sees it, depends on the development of biology, and predicting what biological discoveries and views will be dominant in 30 years is risky business.

The veteran voice of Anton Markoš (Charles University, Czechia), on the other hand, may not be as vocally optimistic, but his dream of a new doctrine of vitalism, free from the baggage of the word as an insult and misunderstanding, interlocks two branches: "one would be biology as we know it today – ideoscopic (sensu Deely)[3] science adhering to the culture of modern science and studying physical and physiological facets of the living. The second branch – cenoscopic (Deely again) school of thought will grow from germs like theoretical biology of S. Kauffman, eidetic biology of Z. Neubauer, and above all, contemporary biosemiotics".[4]

The naturalization of human semiosis, elusive as it may seem, is one of the developments aimed at by Victoria Alexander (Dactyl Foundation/ ITMO University, USA), who hopes "the signaling processes underlying purposeful, creative and intelligent behavior within and among cells" will be explicated in the coming future. There is also hope for a more direct application on health and social issues and for biosemiotics as a philosophical framework to explore the decentralization and self-sustainability of societies.

Regarding the academic status of biosemiotics, Morten Tønnessen (University of Stavanger, Norway) expects the field to be widely known in life science studies as "the philosophy of the life science". At the same time, Ľudmila Lacková sees biosemiotics becoming a "fusion between humanities and science", a field blurring the boundaries of biology, philosophy, environmental sciences, linguistics and semiotics, an everexpanding area of knowledge "oriented towards a dynamic and communicative facets of the living".

Along similar lines, Alexei Sharov (National Institute on Aging, USA) expects very concrete developments: the Gatherings in Biosemiotics will count with double or triple the attendance, a rapid increase in applied and case studies being published and a decrease in purely theoretical discussions. He also expects the creation of new centers associated to semiotics and an institute of center for the study of biosemiotics in Europe. Among his other predictions, Sharov expects gender parity for biosemiotics, but also he believes that funding "will remain low compared to science in general".

In very specific terms, Paul Cobley (Middlesex University, Great Britain) believes the the humanities and social sciences will become "outmoded terms for some of the areas of applied commercial and economic research that will exist in the 2050s" in small but important research centers after the dissolution of most universities in the 2030s. Cobley believes that purely theoretical research in biosemiotics will be mostly put aside in favor of commercially related, short-term financially beneficial research. In his detailed (and frightening) picture, Cobley expects biosemiotics to inform

3 Deely 2009.

4 This would come, for him, as a direct result of the idea that "life is a semiotic category", with semiosis at work in interpretation, observation, minding of the environment *qua* biosphere and playing along the borders of rules (Markoš, Švorcová 2019).

projects directly related to surveillance technology and profitmaximizing techniques,[5] with the pursuit of learning a minority concern of the past.

Kalevi Kull (University of Tartu, Estonia) observes trends in the development of current biosemiotics as marking a common ground for the future of the discipline. The fact that non-human semiosis has been gradually, but steadily incorporated into general semiotics points to the necessity of biosemiotics concepts for all semiotic endeavors in the future. Meanwhile, the continuous integration of the different schools of semiotics – such as Peircean, Greimasean and Lotmanian semiotics – under a shared set of concepts will allow a biosemiotic coalescence that secures the role of the discipline as a key to general semiotic thought. Kull sees the increased acknowledgment of Uexküllian theory in different fields as a way for biosemiotics to become noticed outside of the realm of semiotics. When it comes to its relative position to biology, despite the slow change of the latter, recent developments on evolution and cognitive biology have steered the direction of biological theory towards a more sympathetic discipline to the concepts used by biosemiotics, which means that in the coming 30 years biosemiotics could become an accepted part of biology.

Kull is also hopeful that in the coming years biosemiotics will come to a concise formulation of the fundamental model of semiosis, that there will be a wider compatibilization of cognitive concepts with semiotic concepts – making experimental approaches more viable – and that the temporal aspect of semiosis, long overlooked by theoreticians, will become a key aspect of biosemiotic theory.

In personal communication with Kalevi Kull, Sergey Chebanov (Saint Petersburg State University, Russia) sees the decreased interest in and lack of communication between semiotics and mathematics as a result of the problems in creating a solid computer model of consciousness and the change in focus on AI as a human-machine interface. The fact that biosemiotics is not a growing interest for biologists can be explained, Chebanov believes, by the lack of an interest in non-human semantics, a state of affairs that satisfies semioticians and biologists alike, the first because of the problems of anthropomorphism in biosemiotics, and the second, because biologists deal with

[5] Some of these, Cobley expects, may run along the lines of "'Crowd Behaviour and Control in the New Urban Centres', 'Making Surveillance Technology More Like the Human Eye', 'Homogenizing Language for Business', 'Ubiquitous Computing and the Transformed Environment', 'Mimicry and Cold-blooded Species: Lessons for the New Climate', 'Re-creating Species Made Extinct in the Last 20 Years', 'Maximizing Technology Company Profit without the Need to Produce Life Enriching Technology', 'Sickness and Evolution: Predicting the Costs of Ill Workers', etc.".

information without the need for a proper definition of what *information* means.

Chebanov sees possible areas of empirical research for biosemiotics in the study of the genome, immunology, brain biochemistry, ethology and the intersection between these areas, with bioaesthetics and ecosemiotics as open to setting a new standard for biosemiotic empirical studies. In the near future, biosemioticians should "master biology" and biologists should study semiotics, but a problem stems from "restrictions on the use of algorithmic and strictly methodical research techniques in biosemiotics (as in semiotics in general, including the semiotics of mathematics)". Biosemioticians in the coming decade will then need to be more engaged with biologists and viceversa, and there may be developments in the way of a quasi-algorithmic representation of biosemiotic processes. For the development of biosemiotics, Chebanov however believes that high-level interactions with biologists will be crucial.

4. The Future

There is no consensus on what the future of biosemiotics will look like, and it makes sense: Predictions of this kind are an extension of how we wish to portray what we currently see in our surroundings. Perhaps the next generations of biosemioticians will occupy a different language, unrecognizable from our current talk about semiosis. Or perhaps biosemioticians of the future will be concerned with both the syntagmatic trends of semiotics in general and the paradigmatic status of the hard sciences in relation to semiotics, leading to a divide between different schools of thought and the methodological impact this may have on researchers.

One important thing for all of us to keep in mind is that a large portion of that future will be defined by the same people engaged in the discussion, teaching and dissemination of biosemiotics as an intellectual and practical pursuit. New ideas flourish constantly, and as we present them to our peers and to those looking to learn more about the field, we are paving the way for others to create new roads and clear new paths in the forest of semiotics. The coming decades, with all the unexpected names, topics and breakthroughs that may come with them, will surely depend on uncontrollable factors, but as we lay the groundwork for that unknown, the work we do today must remain rigorous and open to debate and discussion in the hopes of a wider-reaching, institutionally strong biosemiotics.

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IV Programmes of the Gatherings in Biosemiotics 2012–2019

The 12th Gatherings in Biosemiotics Tartu, Estonia July 16 – July 21, 2012

Kalevi Kull, Silver Rattasepp, Timo Maran[1]

On the occasion of the Tartu Gatherings in 2012, a book that reviewed all earlier Gatherings in Biosemotics was published by the University of Tartu Press, edited by Silver Rattasepp and Tyler Bennett (both PhD students in semiotics at that time).[2] The motivation to compile such a volume certainly reflects our enthusiasm in biosemiotics, our belief in the importance of this field. However, in addition, we wanted to mark an important period in biosemiotics, which could have been better understood via a self-description of the events in these years. Indeed, the eleven years since the first Gatherings (and ten since the 2002 Gatherings in Tartu) was the period that gave us not only many scientific results, but also the society for biosemiotic studies, the journal *Biosemiotics*, the biosemiotics book series, a remarkable growth of interest in semiotic biology and an interest towards it or at least attention from other fields of science and the humanities.

In that volume, we described the 2012 Gatherings prospectively at the stage of planning the meeting,[3] and below are some specifications in the programme as it actually took place.[4]

Gatherings in Biosemiotics XII were organised by the Department of Semiotics, University of Tartu, together with the Jakob von Uexküll Centre of the Estonian Naturalists' Society, and the Estonian Semiotic Society. The Gatherings attracted around 100 participants from at least 27 countries – more than in any previous year. The sessions took place in the newly renovated building at Jakobi St. 2, in which the whole third floor hosts the Institute of Philosophy and Semiotics, together with its library, with a

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2 Rattasepp, Silver; Bennett, Tyler (eds.) 2012. *Gatherings in Biosemiotics*. (Tartu Semiotics Library 11.) Tartu: University of Tartu Press.

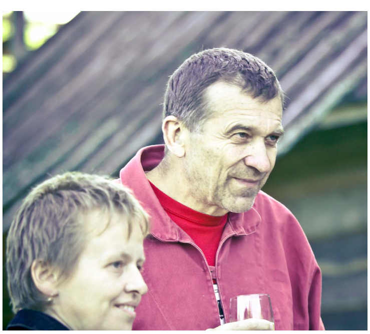
3 Kull, Kalevi; Maran, Timo; Rattasepp, Silver 2012. The 12th Gatherings in Biosemiotics: Tartu, Estonia, July 16–21, 2012. In: Rattasepp, Silver; Bennett, Tyler (eds.), *Gatherings in Biosemiotics*. (Tartu Semiotics Library 11.) Tartu: University of Tartu Press, 121–125.

4 Another post-event account has been published in Estonian: Laanisto, Lauri 2013. Keskmise defitsiit: Gatherings in Biosemiotics, 16.–21. juuli 2012, Tartu. *Acta Semiotica Estica* 10: 253–258.

In Estonia (Leigo), 2012. Left to right: Daniel Mayer, Stephen Cowley, Ekaterina Velmezova, Natalia Abieva, Jesper Hoffmeyer.

In Tartu, 2012. Marcello Barbieri.

In Tartu, 2012. Ted Baenziger and Almo Farina.



In Estonia (Leigo), 2012. Fatima Cvrčková and Anton Markoš.

A session at Leigo, Estonia, 2012. Myrdene Anderson presenting.

A coffee-break at Leigo, Estonia, 2012. Left to right: Han-liang Chang, Frederik Stjernfelt, Don Favareau, Yağmur Denizhan.

separate room for the Sebeok's Memorial Library. A large convenient auditorium hall was at our disposal. In one of the days, the sessions took place out of town in the countryside at Leigo farmstead, surrounded by beautiful lakes; we listened to some of the talks sitting closely together around a fireplace in the farmhouse, while other discussions were held in the open air sitting on the lawn. The day ended by cleansing the bodyminds in a traditional Estonian smoke sauna, accompanied by nude swimming in a natural pool (a new experience for several colleagues).

The programme of the Gatherings included two specialized pre-seminars and fifteen sessions, usually with three talks in each. All the main approaches within biosemiotics were represented. As a part of the conference, a general meeting of the International Society for Biosemiotic Studies took place on July 20.

In the lobby, the Uexküll Centre presented a small exhibition for the participants of the conference about the rich archival material about Uexküll that had just arrived in Tartu from Germany. There was also an exhibition of the latest books and magazines in the field of biosemiotics of the 21st century.

All in all, this was a very rich event, wide in scope of talks, with long discussions. Now looking at photos, we can see many happy people both in the auditorium, and particularly in the greens at Leigo.

PROGRAMME[5]

16 July, Monday
Pre-seminar I: Biosemiotics and the Study of Culture

Chair: *Riin Magnus*

Timo Maran – Biosemiotic criticism: Modelling the environment through literature

Kadri Tüür – Zoosemiotic theory in the analysis of nature writing

Chair: *Timo Maran*

Morten Tønnessen – In the gaze of the other: Describing cultural affordances by conducting comparative umwelt mapping in animal studies

Natalia A. Abieva – Concrete *vs*. abstract semantics in mental images

[5] In addition to oral presentations, "Merleau-Ponty's ontological bridge between biosemiotics and culture" by Louise Westling and "Semiotic animal in a transmodern world: Hovering between zoosemiotics and anthroposemiotics" by Farouk Y. Seif were presented as posters in the lobby of the lecture hall.

Chair: *Kadri Tüür*

Grzegorz Kapuscinski – Dog-human communication: Semiotic phenomenon on the verge of nature and culture

Farouk Y. Seif – Semiotic animal in a transmodern world: Hovering between zoosemiotics and anthroposemiotics

Silver Rattasepp – The philosopher and the leaf insect

Chair: *Morten Tønnessen*, *Nelly Mäekivi*

Roundtable. Biosemiotics and the study of culture – possibilities, problems, perspectives (*Morten Tønnessen*, *Nelly Mäekivi*, *Katya Mandoki*, *Kalevi Kull*, *Timo Maran*)

17 July, Tuesday

Pre-seminar II: Language and life[6]

Chair: *Stephen Cowley, Kalevi Kull*

Stephen Cowley – The double interface: Beyond discursive "knowledge"

Morten Tønnessen – A foray into the hinterland of language: In search of the dark matter of our enlightened worlds

Ekaterina Velmezova – On the semiotics of "interjections"

MAIN PROGRAMME

Greetings from the Tartu City Council (*Mihhail Lotman*)

Introductory words from the local organizers

Session: Openings (Chair: *Kalevi Kull*)

Jesper Hoffmeyer – The semiotics of human nature

Jana Švorcová, *Anton Markoš* – The language of life

Peter R. Wills – Genetic information, mechanical interpreters and thermodynamics: The physico-informatic basis of biosemiosis

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6 This event led to a book project, presented next year: Velmezova, Ekaterina; Kull, Kalevi; Cowley, Stephen 2013. The "Biosemiotic Perspectives in Linguistics" project in its historical, present and future states. In: Giorgi, Franco (ed.), *Proceedings of the Thirteenth Annual Gathering of the International Society of Biosemiotic Studies* (Thirteen Annual Gathering in Biosemiotics, June 4 to June 8, 2013). Rosignano Marittimo: International Society for Biosemiotic Studies, p. 62. The book itself appeared a couple of years later: Velmezova, Ekaterina; Kull, Kalevi; Cowley, Stephen (eds.) 2015. *Biosemiotic Perspectives on Language and Linguistics*. (Biosemiotics 13.) Cham: Springer.

Book presentation surprise (*Timo Maran*, *Kati Lindström*, *Riin Magnus*, *Morten Tønnessen*, *Jesper Hoffmeyer*)[7]

Reception (Tartu University Cafe)

18 July, Wednesday
Session: Foundations (Chair: *Donald Favareau*)
Andreas Weber – There is no outside: A biological corollary for poetic space
Kalevi Kull – Modelling of semiosis: Juri Lotman's legacy

Session: Philosophical (Chair: *Gerald Ostdiek*)
Donald Favareau – Including absence
Tommi Vehkavaara – Senses of significance and meaning in the models of biosemiotic sign
Timo Maran – Are ecological codes archetypal structures?

Buses leave for the afternoon events at Leigo farmstead

Session: Developmental (Chair: *Fatima Cvrčková*)
Franco Giorgi, *Louis Goldberg*, *Luis Emilio Bruni* – The egg as a semiotic gateway to reproduction: Digital and analogical communication in the oocyte-egg-zygote transition
Gerald Ostdiek – Scaling life: Developmental semiotics in infancy and beyond
Myrdene Anderson, *Katja Pettinen* – Trans-somatic mindfulness

Session: Evolutionary (Chair: *Andreas Weber*)
Alexei Sharov – The origin of mind: Transition from protosemiosis to eusemiosis
Katya Mandoki – Evolition: A reassessment of Rothschild's biosemiotics
Stephen Cowley – Interactivity: Origins and consequences

Gatherings dinner (at Leigo farmstead) with an intro by Father *Ted Baenziger*
Sauna
Buses back from Leigo to Tartu

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7 The book presented was: Maran, Timo; Lindström, Kati; Magnus, Riin; Tønnessen, Morten (eds.) 2012. *Semiotics in the Wild: Essays in Honour of Kalevi Kull on the Occasion of His 60th Birthday*. Tartu: University of Tartu Press.

19 July, Thursday

Session: Codes (Chair: *Vinicius Romanini*)

Marcello Barbieri – Code biology – a new science of life

John Collier – Codes and their interpretation in endobiosemiotics

Joachim De Beule – Overcoming the tragedy of the commune in the Hawk-Dove game through conventional coding

Session: Endosemiotic (Chair: *Jesper Hoffmeyer*)

Argyris Arnellos, *Alvaro Moreno* – Internalization of functions as a model of minimal semiosis in autonomous systems: Towards a scientific biosemiotics

Fatima Cvrčková – Periphrasis and paraphrasis in cellular regulatory pathways

Jan-Hendrik Servaas Hofmeyr – Modelling the cell as a formal system that writes its own production rules

Session: Zoosemiotic (Chair: *Karel Kleisner*)

Almo Farina – Acoustic patterns of the Red-billed Leiothrix (*Leiothrix lutea*), an invasive species in the Mediterranean scrublands

Filip Jaroš – Felids, their coat patterns, camouflage and signs

João Queiroz, *Frederik Stjernfelt*, *Charbel Niño El-Hani* – Dicisigns in mimicry

Session: Human-animal (Chair: *Victoria Alexander*)

Riin Magnus – The semiotic challenges of the guide dog and blind person team

Nelly Mäekivi – Communication in zoos and communicative zoo

Karel Kleisner – Seeing each other: An international comparison of the eye colour effect on perception of trustworthiness, dominance and attractiveness

20 July, Friday

Session: Processes (Chair: *Marcello Barbieri*)

Victoria N. Alexander – Creativity: The negation of self-reference through misinterpretation

Daniel Mayer – Hymenomorphism

Sara Cannizzaro – Biosemiotics as systems theory: An investigation into biosemiotics as the grounding for a new form of cultural analysis

Session: Information (Chair: *John Collier*)
Kathrine Elizabeth Anker – Bio-logos: Asking for the logic of life through a study of artificial life art and biosemiotics
Vinicius Romanini – Biosemiotic information
Yağmur Denizhan – Information in biological individuation

Session: Historical (Chair: *Luis Emilio Bruni*)
Han-liang Chang – Iconicity and mimicry: A philological excursus
Davide Weible – Augustine and the ape: A biosemiotic investigation into the nature of life
Sergey Chebanov – Results of the development of biosemiotics

Session: Paradigmatic (Chair: *Alexei Sharov*)
Marco Annoni – Meaning in medicine: Toward a biosemiotic model of placebo effects
Ramsey Affifi – Not pedagogy but "biogogy": On linking biosemiotic and education research
Daniil Berezhnoy, *Vera Serkova*, *Kira Nikolskaya* – Semiotics as an instrument for animal cognition research: Experimental study

General meeting of the International Society for Biosemiotic Studies

21 July, Saturday
Session: Continuity (Chair: *Tommi Vehkavaara*)
Krystyna Bielecka – Symbol grounding problem and causal theory of reference
John Pickering – Why biosemiotics cannot solve the symbol-matter problem
Eliseo Fernández – Semiosis and phase transitions in biology: The place of biosemiotics within a genuinely evolutionary conception of nature

Session: Uexküllian (Chair: *Timo Maran*, *Anton Markoš*)
Morten Tønnessen – On the notion of induced semiosis, with emphasis on anthropogenic semiosis
Ondřej Bradáč – Reflection of Jakob von Uexküll's thoughts from the point of view of Czech theoretical biologists and philosophers from Charles University of Prague
Torsten Rüting – Uexküll's contribution to an interdisciplinary concept of vision and knowing

Final remarks

The 13th Gatherings in Biosemiotics Castiglioncello, Italy June 4 – June 8, 2013

Franco Giorgi[1]

The thirteenth Biosemiotics Gathering was held in Castiglioncello (Italy) from June 5th to June 8th and organized under the auspices of the International Society for Biosemiotic Studies (ISBS). It was jointly sponsored by the Scuola S. Anna of Pisa and the Comune of Rosignano Marittimo and with the patronage of the University of Pisa and Regione Toscana. The meeting took place in the relaxed atmosphere of the Castello Pasquini, a famous natural resort for having been the center of many Macchiaioli painters. The abstracts presented at the Gathering offered a wide variety of approaches ranging from meta-biosemiotics and linguistics up to complexity and cognition. Altogether 40 oral and 3 poster presentations were given in four full days. The Gathering was preceded on June 4th by a Workshop organized by Stephen Cowley and Bruno Rossi centered on such topics as Health, Cognition and Cognitive Rehabilitation. The aim of the workshop was to review some of the state-of-the-art topics and the innovative aspects that characterize much of recent research in consciousness studies. To this end, Franco Giorgi opened the workshop by giving a keynote lecture on the biosemiotic perspective of consciousness. On the following day, Don Favareau gave an introductory lecture at the Gathering to examine the close relations between living systems and their sign systems.

Besides providing scholars with the possibility to discuss some of the highly debated topics on semiosis and on the biosemiotics of the nature/nurture relationships, the Gathering's participants were also given the opportunity to participate in some extramural activities in Castiglioncello. These consisted in one evening discussion offered to the public on themes related to the understanding of signs and meaning in everyday life entitled *I segni della Vita e la Vita dei segni*. Stephen Cowley, Vinicius Romanini and Luis Emilio Bruni, being all well acquainted with the Italian language, were so kind to put themselves on the stage and provide the public some excellent thought-provoking reflections. A second evening was spent in the local theater where people were entertained with a musical program entitled *le*

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Note della Vita e la Vita delle note primarily centered on the music and songs from Puccini and Mascagni. During the Gathering special attention was also given to young people, especially of PhD students or research assistants, and for this reason two of them were awarded with a Springer prize in recognition of the excellence of their work.

In Castiglioncello, 2013. Left to right: Franco Giorgi, Jannie Hofmeyr, Timo Maran, Alessandro Samsa, Jesper Hoffmeyer, Sara Cannizzaro, Luis Bruni, Victoria Alexander, Kalevi Kull, Don Favareau.

PROGRAMME

4 June, Tuesday
Workshop: Cognition, Health and Semiosis
Giovanni Manetti – Semiotics
Franco Giorgi – Consciousness: A biosemiotic perspective
Mauro Mancuso, *Nadia Magnani*, *Anna Cantagallo*, *Giulia Rossi*, *Donatella Capitani*, *Vania Galletti*, *Giuseppe Cardamone*, *Ian Hamilton Robertson* – Awareness of human communication in traumatic brain injury patients

Bruno Rossi, *Maria Chiara Carboncini*, *Luca Bounfiglio* – Consciousness and related mechanisms: Psycho-physiological and neuro-psychological aspects of spontaneous eye blinking

Massimo Bergamasco – Mind, body and virtual enviroment

Stephen J. Cowley – Health and suffering: The non-local in practice and theory

Sarah Bro Pedersen, *Stephen J. Cowley* – Interactivity in emergency medicine

Daniel Angus, *Andrew Smith, Janet Wiles* – Discursis: Computational discourse analysis for health communication

Rasmus Thorup – Health, cognition & material environments in cognitive rehabilitation: How can material rehabilitation environments facilitate or hinder cognitive abilities of citizens with acquired brain injury?

Luis Emilio Bruni – Towards a heterarchical approach to biology and cognition

GATHERING'S MAIN PROGRAM

5 June, Wednesday

1. Meta-Biosemiotics (Chair *Kalevi Kull*)

Don Favareau – Introductory remarks

Søren Brier – Peircean biosemiotics as a transdisciplinary endeavor

Andreas Weber – "Enlivenment": A program for a first person ecology

2. Ecosemiotics (Chair *Victoria Alexander*)

Josef Lhotský – Symbiosis: The pivotal concept for current biosemiotics

Timo Maran – Semiotics meets species conservation: Translation and modeling

Renata Slavíková, *David Püschel*, *Hana Gryndlerová*, *Anton Markoš*, *Jan Jansa* – Underground encounters: Mutual benefits of mycorrhizal partners

3. Language & Sign-systems (Chair *Jannie Hofmeyr*)

Lucie Čadková – Do they speak language?

Stephen Cowley – The embodiment enigma: Can biosemiotics help?

Joanna Rączaszek-Leonardi – "Meaning" is not "mapping": Codes and constraints in semiotic processes

4. Language & Sign-systems (Chair *Stephen Cowley*)

Ekaterina Velmezova, Kalevi Kull, Stephen Cowley – The "Biosemiotic Perspectives in Linguistics" project in its historical, present and future states

Kalevi Kull – Acquisition of sign relations, or learning: Taxonomy and meronomy of signs

Gerald Ostdiek – Science, signs, branding and belief: Or how biosemiotics can save the world

6 June, Thursday

5. Complexity (Chair *Gerald Ostdiek*)

Victoria Alexander – Toward a biosemiotic definition of chance

Yağmur Denizhan, *Mehmet Ozansoy*, *Vefa Karatay* – Complexity as sustained informability

Arno L. Goudsmit – Explorations on closure in a domain of dynamic geometry

6. Somatic communication (Chair *Timo Maran*)

Claudia Albanese, *Charles Max*, *Gudrun Ziegler* – "Languaging" universals – the biosemiotics of facial kinetics

Louis J. Goldberg – Face recognition as a semiotic system

Karel Kleisner, *Tomáš Kočnar*, *Jan Havlíček*, *Robert Mbe Akoko* – Local specifics and universal cues in cross-cultural perception of attractiveness: A view from semantic morphology

7. Biosemiotics across hierarchical levels (Chair *Alexei Sharov*)

Gennaro Auletta – In life semiotics goes together with information control

Stephen Pain – Propositional relations and semiotics of microbiota

Marco Annoni – Placebo responses in medicine: Toward an integrated biosemiotic model

8. Biosemiotics across hierarchical levels (Chair *Don Favareau*)

Eliseo Fernández – Semiosis and control: From biosemiotics to technosemiotics and back

Vinicius Romanini, *Menno Hulswit* – Semeiotic causation and the breath of life

Dongping Zheng, *Giuseppe Leonardi*, *Kristi Newgarden* – Virtual biosemiotics of play in World of Warcraft (wow): An eco-dialogical recurrence quantification analytical approach

7 June, Friday

9. Cognition (Chair *Louis Goldberg*)
Krystyna Bielecka – Explaining frog behavior with representation
João Carlos Major – C. G. Jung: a semiotic bio-logic of the mind
Marcin Miłkowski – Anticipatory representational mechanisms in animals

10. Cognition (Chair *Luis Emilio Bruni*)
Mette Miriam Rakel Böll – Brain, body, behavior: Integrative biosemiotics
Jaime F. Cárdenas-García – The biosemiotics of learning and distributed cognition
Lesley Lancaster – Opening up boundaries: Using social and biosemiotics to examine how infants construct signs

11. Bio-logic modeling (Chair *Yağmur Denizhan*)
Jan-Hendrik S. Hofmeyr – A linguistic model of self-fabrication
Valerio Targon – Genome semiotic modeling
John Collier – Modeling semiotic systems with an eye on biology

12. Bio-logic modeling (Chair *Søren Brier*)
Tommi Vehkavaara – Modeling biosemiosis – two concepts of sign
Alexei Sharov – Protosemiotics: Signs without objects

8 June, Saturday

13. Neighboring epistemologies (Chair *John Collier*)
Tim Ireland – The spatiality of being autonomous
Sara Cannizzaro – Internet memes as internet signs: A biosemiotic study of digital culture
Nelly Mäekivi – Communication in hybrid environments: The case of Zoos

14. Biosemiotics and normative theories (Chair *Karel Kleisner*)
Morten Tønnessen, *Jonathan Beever* – Uexküll in translation: "Darwin and the English morality"
Susan Petrilli, *Augusto Ponzio* – Biology, ideology and semiotics
Jesper Hoffmeyer – Concluding remarks

Every Day Poster Session

Sergey Chebanov – How I see the future of biosemiotics

Bruno Rossi, *Maria Chiara Carboncini*, *Luca Bounfiglio* – Consciousness and related mechanisms: Psycho-physiological and neuro-psychological aspects of spontaneous eye blinking

Jana Švorcová – The organic memory concept in 19th-century biology and its implications for current biological thinking

The 14th Gatherings in Biosemiotics London, UK June 30 – July 4, 2014

Paul Cobley[1]

The 14th Gatherings in Biosemiotics – or GB14 – was held at Middlesex University, London. Owing to circumstances, it was arranged at short notice. In addition, I had only moved to my post at the University a matter of months earlier. Therefore, I remain grateful for the University's support, along with that of colleagues in the International Society for Biosemiotics, in making this meeting run as smoothly as possible.

Nevertheless, even with this support there were still hurdles to traverse and some minor adversity. In two cases, in particular, necessity became a virtue. Firstly, the paucity of accommodation around Middlesex's campus in North West London meant that most delegates stayed in one hotel. Although this situation was not exactly like those week-long conferences where all delegates are in the same building for all the proceedings, meals and sleeping – the legendary ISSS conferences in Imatra, Finland, come to mind as one such example – most of us were still in each other's company for sufficiently lengthy periods to offer an enhanced feeling of community.

Secondly, whether it was because of the realisation of the expense involved in coming to London or for some other reason, nearly a quarter of the speakers with accepted abstracts withdrew from the Gatherings at the final hour. In fact, some of those who did not attend have not yet told me that they were withdrawing; possibly they are, six years later, still roaming round London, lost among the 10 million other souls in this city. However, the gaps left in the programme were put to very good use. Spurred by Kalevi Kull's paper, 'Agency: a biosemiotic approach', we staged a roundtable on agency, chaired by Sara Cannizzaro, which helped cement views on a matter that has been integral to biosemiotics since its inception. We then held a roundtable on biosemiotics and the Four E's, chaired, superbly, by Don Favareau. Regrettably, we did not video- or audio-record this session, but I remember vividly the concluding part of the discussion. There was almost unanimous agreement that Four E perspectives abut biosemiotics, are often cognate

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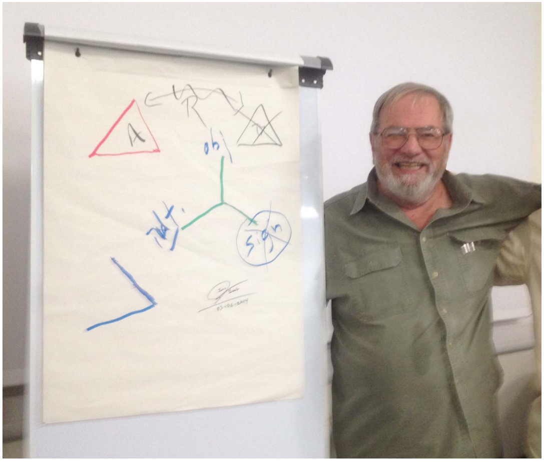
with biosemiotics, and biosemioticians collaborate with Four E-orientated scholars; yet the assembled saw no reason why biosemiotics, which had often developed its array of conceptual materials and terms long before Four E perspectives evolved, should abandon its own terms and throw its lot in with the Four E's for the sake of academic fashion.

Among those that the 2014 Gatherings attracted were the ISBS management team, allowing business meetings to take place and allowing old friends to catch up. Yet, we were also lucky to have others, beyond the management, who made the event a special occasion. John Deely, arguably biosemiotics' 'philosopher-in-residence', attending his one and only Gatherings, flew in from the United States to give his own paper and take an active part in every single discussion during the week; Kobus Marais came from South Africa to introduce his biosemiotically-informed translation project which is now, with a number of associated publications, very familiar in semiotics; Jaime F. Cárdenas-García from Ecuador, joined Gatherings regular, Tim Ireland, for a paper on Peirce and Bateson; and from within the UK, biosemiotics contributors (but not Gatherings regulars), John Pickering and James Carney, came to London from Warwick and Oxford, respectively. Above all, it was pleasing to be able to welcome a number of international Gatherings newcomers such as Elize Bisanz and Ethel Gilliquet as well as stalwarts such as Myrdene Anderson and Eliseo Fernández.

The formal proceedings kicked off in coruscating style on 30 June with Søren Brier's paper, asking 'Can biosemiotics be a "science" if its purpose is to be a bridge between the natural and social and human sciences?' Like the other papers that followed, the quality of presentations seemed to be especially high in 2014. It is invidious to single out any of the papers – and, since most of them have now been published in one form or another, the reader can search them out for themselves – but a personal favourite for me was the exceptionally rigorous, yet humorously presented, 'Turtles really are not just armoured machines' by Jindřich Brejcha and Karel Kleisner. The 2014 Gatherings programme ended at 11am on 4 July, but I had organized a kind of knowledge exchange 'bridging' event on 'Semiotic awareness', featuring a mixture of biosemioticians and commercial semioticians, which took place in the afternoon. The programme is reproduced below, but a flavour of the event is conjured if the papers on death, refuse, the built environment, objects and plants, as well as a performance by DJ Electric Eel, are considered alongside an amazing, as yet unpublished paper, by our late *spiritus rector*, Jesper Hoffmeyer, entitled 'Semiotic awareness: What nature may tell us' and revolving around a famous Danish cartoon depicting awarenesses of Christmas Eve.

Despite the pressure of organizing a conference, as well as being frequently called out of sessions in order to attend to senior management issues on my own campus, GB14 remains my favourite Gatherings, in terms of the collaboration of the participants, the intellectual strides that we took and the conviviality afterwards. The weather was good, too.



In London, 2014. John Deely.

PROGRAMME

30 June, Monday

Søren Brier – Can biosemiotics be a 'science' if its purpose is to be a bridge between the natural and social and human sciences?

John Pickering – Biosemiotics is a hybrid.

Alexei Sharov – Evolutionary constraints or opportunities?

Sara Cannizzaro – Can we can talk about 'smartphone addiction'? More steps towards the biosemiotics' exploration of digital culture.

Maria Isabel Aldinhas Ferreira – Modelling the semiosis of cognition: the case of the universe of brands

1 July, Tuesday

James Carney – Necessary fictions: a biosemiotic reading of narrative

Paul Cobley – Children, modelling and causality – where does narrative come from and what does it do?

Kalevi Kull – Agency: a biosemiotic approach

Kobus Marais – Translating life: exploring biosemiotics from a translation-studies perspective

Jindřich Brejcha, Karel Kleisner – Turtles really are not just armoured machines

Timo Maran – Cultural exposure to a new mammalian species, golden jackal (*Canis aureus*) – a semiotic analysis

2 July, Wednesday

Myrdene Anderson – Dissolving boundaries in space and time: Couplings between exuberant environments and distributed organisms

Tommi Vehkavaara – The interplay of cognitive and action-guiding signs in intelligent animals

Elize Bisanz – On neurons and phanerons: Charles S. Peirce and the laws of mind

Jaime F. Cárdenas-García, *Timothy Ireland* – Peirce and Bateson: The pattern that connects

Matthew Clements – Peirce's ecology: the growth of symbols and environmental abduction

Evening

Paul Cobley – What the humanities are for – a semiotic perspective (Inaugural Professorial Lecture)

3 July, Thursday

Ted Baenziger – Using orchids to teach DNA sequencing, phylogeny and biosemiotics: ladders with many steps

Eliseo Fernández – Semiosis and control – from biosemiotics to technosemiotics and back

Ekaterina Velmezova, *Kalevi Kull*, *Stephen Cowley*[2] – Does linguistics need biosemiotics?

John Deely – *Agere sequitur esse*: from 'nothing but' to 'something more'

Morten Tønnessen – Descartes' dualisms and the epistemology of biosemiotics

Meeting of the ISBS

Meeting of the editorial board of *Biosemiotics*

2 *In absentia.*

4 July, Friday

Karel Kleisner – Form follows meaning: the role of perception in the evolution of semantic organs

Semiotic awareness: An exploratory Knowledge Transfer workshop

Opening – *Paul Cobley*
Commercial signs – *Chris Arning*
Built environment – *Tim Ireland*
Systems – *Søren Brier*
Diversity – *Malcolm Evans*
Consumption – *Lucia Neva*
DJ Electric Eel
Non-human animals – *Timo Maran*
Nature – *Jesper Hoffmeyer*
Objects – *John Deely*
Digitality – *Sara Cannizzaro*
Refuse – *Myrdene Anderson*
Plants – *Kalevi Kull*
Death – *Alex Gordon*

The 15th Gatherings in Biosemiotics Copenhagen, Denmark June 30 – July 4, 2015

Luis Emilio Bruni[1]

In the year 2000, when Jesper Hoffmeyer made the pivotal move to start giving structure to the – until then dispersed – biosemiotics community, by *gathering* a highly transdisciplinary group of researchers in the first conference of its kind, I had the privilege and the fortune to be at the beginning of my PhD project under his supervision. I witnessed the care and humbleness with which he organized the first Gathering and the mesmerizing atmosphere that emerged in this first meeting. In the years to come, and well beyond my PhD project, I became an active participant and collaborator of the Biosemiotic project, always in close contact with the community that Jesper contributed so much to foster.

Fifteen years later, in 2015, it was my turn to take the role of the organizer and bring the Gathering back to Copenhagen – actually for the third time, given that Jesper and Claus Emmeche organized it again in 2003, when I was about to defend my PhD dissertation, precisely on biosemiotic research questions.

The "Fifteenth Annual International Gathering in Biosemiotics" was thus organized with the auspices of the International Society for Biosemiotic Studies and the Department of Architecture and Media Technology at Aalborg University, in our wonderful Copenhagen Campus facing the South Harbor of the city. For this, I counted with the collaboration of the Augmented Cognition Lab, which I had helped to establish the precedent year in my department, and in particular, with the active contribution of Sarune Baceviciute, who was our diligent research assistant at the time. Our colleague Don Favareau, from the National University of Singapore also joined us in the Organizing Committee. Besides Don and myself, the Scientific Committee for this edition included Yağmur Denizhan, Victoria N. Alexander and Paul Cobley.

Based on our lab's mission, on June 29 we organized a pre-conference symposium with the title "The Psycho-physiology of Meaning-Making". We

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invited presentations from researchers working on questions involving the interplay of biology and cognition, and who were examining the relations between physiological processes and meaningful experience (e.g., perception, cognition, communication, purposeful action, etc.) whether in humans or in animals. A memorable moment of the symposium was when Don Favareau consented to be hooked to an EEG cap for conducting a brain-computer interface demonstration, so he could spell his name on a screen through his brain's electric activity.

The sessions of the 15th Gathering featured 42 selected presentations that expanded from evolutionary and developmental biosemiotics to semiotic approaches to ethology, language development, biosemiotics and cognition, cellular semiotics, ecological biosemiotics and the implications and relations of biosemiotics to philosophy and humanities, among others themes.

There had been in the call for papers an invitation to submit contributions on the theme of "multi-level semiosis and integrative approaches", which became ensembled in a special issue of the journal *Biosemiotics* (volume 9(3), 2016) with the title "Multilevel semiosis: Towards a heterarchical perspective", co-edited by Franco Giorgi and myself.

After all the presentations we concluded with a round-table and a very live discussion on pressing ontological and epistemological issues concerning the present and future of biosemiotics with particular focus on systems biology.

At the end, two small ships in the harbor channel contiguous to our campus picked us up. We sailed to the Trekroner Sea Fortress, built in 1713 close to the Copenhagen harbor to defend the city. Away from the city, all alone in this a small island in the middle of the Ørsund channel, with a perfect Scandinavian sunset, the biosemiotic community had the opportunity to enjoy a pleasant dinner, powered by intense and vivid discussions on the future of this exciting discipline. This was a great farewell to start looking forward to 2016.

In Copenhagen, 2015. Don Favareau, Kalevi Kull, Jesper Hoffmeyer.

At Trekroner, Copenhagen, 2015. Our group on the way to social dinner.

PROGRAMME

29 June, Monday

Pre-conference Symposium-Workshop: The Psycho-physiology of Meaning-Making

Luis Emilio Bruni – Introduction: The semiotics of psychophysiology and the psychophysiology of semiotics

Sarah Klein – Writing with Brains - A Situated Analysis of Event-Related Potentials Research

Paolo Burelli – The multifarious meanings of gaze

Karl Kristoffer Jensen – Using efficient Mismatch negativity (MMN) to extract categories from audio

Justin Christensen – Emoacoustics: investigating how auditory perceived distance differently affects emotional response to aversive or appetitive stimuli

Erik Christensen – Brain interactions between therapist and client in music therapy: A pilot project

Workshop and live experiment

Don Favareau, *Sarune Baceviciute* – Physiology and Intentionality: reflections on a live P300 brain-computer interface spelling experiment

Round table

Towards a research agenda on the psycho-physiology of meaning-making

Welcome Reception for the 15th Annual International Gatherings in Biosemiotics

MAIN CONFERENCE PROGRAMME

30 June, Tuesday

Welcome and Opening remarks

Session 1

Kalevi Kull – Phenomenal present, logical conflict, and semiosis

Maurita Harney – Biosemiotics as a key to naturalising phenomenology

Christophe Menant – Biosemiotics, aboutness of meaning and bio-intentionality: Proposal for an evolutionary approach

Session 2
Gerald Ostdiek – Me, myself, and semiotic function: Finding the "I" in biology
Myrdene Anderson, *Katja Pettinen* – Dances of life, culture, language, and mind

Session 3
Alexei A. Sharov – Constructivist approach to multi-level biosemiosis
Claudio Julio Rodríguez Higuera – Just how emergent is the emergence of semiosis?
Hugo F. Alrøe – Levels of semiosis: Three kinds of kinds

Session 4
Jindřich Brejcha, *Karel Kleisner* – How to mate with a big one: Sexual role of turtles' semantic organs
Filip Jaroš – Do cats create a culture?

1 July, Wednesday
Session 5
Michaela Zemková – What can we learn from children about language?
Prisca Augustyn – Psychologism and anti-psychologism in linguistics
Stephen J. Cowley – Symbolic simplexity: Nature's bag of tricks

Session 6
Ekaterina Velmezova – Has Bakhtinian dialogue any relevance to biosemiotics? (A view from historiography and epistemology of human sciences)
Danica Anderson – The use of oral memory traditions embedded in somatic psychology practices by South Slavic female survivors of war and war crimes

Session 7
Yogi Hale Hendlin – Interspecies phytosemiosis
Richard A. Choate, *Donald R. Frohlich* – From physicosemiosis to biosemiosis: Models of viral evolution as bridge
Morten Tønnessen – The ontogeny of precocial *vs*. altricial umwelten

Session 8
Tyler James Bennett – Legisigns are losing ground
Tommi Vehkavaara – Are apparent dicisigns functioning as dicisigns in not very human kind biosemiosis?

2 July, Thursday

Session 9

Eliseo Fernández – Nomological machines and semiotic scaffolding

Theresa Schilhab – How bottom-up and top-down regularities constrain cognition

Luis Emilio Bruni, *Franco Giorgi* – Towards a heterarchical approach to biology and cognition

Session 10

Robert Prinz – Biosemiotic networking – emergence of the cellular self

Franco Giorgi, *Gennaro Auletta* – Microvesicles as semiotic tools for cell communication

Session 11

Maria Asuncion Magsino – Biosemiotic modelling of human sexuality

Karel Kleisner, *Jan Havlíček* – Modelling the first impression in cross-cultural perspective: The role of constrained perceptual variation

Evelina Deyneka – The advances in functional neuroimaging diagnostics of persistent vegetative state as a meeting point for biosemiotics and the semiotics of discourse

Session 12

Jaime F. Cárdenas-García, *Timothy Ireland* – Information as the basis for cognition

Yekbun Adiguzel – Information communication theory in biology and biosemiotics

Biosemiotics journal – Editorial board meeting

General Assembly – International Society for Biosemiotic Studies

Board meeting – International Society for Biosemiotic Studies

3 July, Friday

Session 13

John Collier – Are genes signs and if so what are they signs of?

Anton Markoš, *Pranab Das*, *Josef Lhotský* – Umwelt as a storehouse of evolutionary experience and memory: Cultures and symbioses.

Søren Brier – What is the differences in ontology for Peircean biosemiotics and cognitive semiotics as transdisciplinary paradigms?

Session 14

Tim Ireland, *Jaime F. Cárdenas-García* – The need for a biosemiotic definition of space

Lily Diaz-Kommonen, *Heather Richards-Rissetto*, *Judith van der Elst* – Designing digital tools for a sustainable semiosphere

Session 15

Timo Maran, *Tiit Maran* – The possible effect of animal semiosic competence in the success of reintroduction programs: A case of European mink (*Mustela lutreola*) in Estonia

Pavel Pecháček, *David Stella*, *Karel Kleisner* – The ultraviolet umwelt – an indispensable part of animal's visual world

Shelley Saguaro – 'She can resist the meanings humans give her': a biosemiotic literary critical reading of H is for Hawk

Session 16

Filip Grygar – A phenomenological interpretation of Niels Bohr´s complementary approach to the phenomenon of the living and its application on mechanistic, biosemiotic and hermeneutic description.

Sergey V. Chebanov – Psychophysical parallelism and biosemiotics

Boat tour around Copenhagen's harbor and canals – Departure from the dock at Aalborg University Copenhagen

Visit and welcome to Trekroner – A fort in an artificial island from 1700

Social dinner at Trekroner

Return in boat to Nyhavn – Copenhagen's Jazz Festival starts in the city

4 July, Saturday

Round-table: Biosemiotics and Systems Biology

Closing remarks

The 16th Gatherings in Biosemiotics Prague, Czechia July 4 – July 8, 2016

Jana Švorcová,[1] **Karel Kleisner**[2]

The organization of the 16th Annual Gatherings in Biosemiotics was held by Jana Švorcová and Karel Kleisner from the Department of Philosophy and History of Sciences at Charles University and it took place in Prague from Monday July 4 until Friday July 8 2016. Our department has quite a long tradition of biosemiotics studies mainly thanks to Anton Markoš who is considered as representative of the Prague school of biosemiotics.[3]

We were already experienced organizers since there was also 4th and 9th Gatherings held in Prague in July 2004 and in June 2009. The conference in 2016 started on Monday after registration at 2 pm with opening lectures by Kalevi Kull and Jesper Hoffmeyer. At 5 pm we started the conference officially with the welcoming buffet at Karolinum, our national and cultural monument, and a symbol of Charles University since it is the oldest seat of Prague University (Collegium Caroli) established by Karel IV in the 14th century.

The conference attended more than 80 fellows, which meant more than 50 speakers with 43 lectures and about 12 poster presenters all together from more than 15 countries. The audience represented various professions from theoretical and evolutionary biologist or anthropologist to linguists and semioticians. On Wednesday afternoon we also had a poster session with beer, followed by a conference dinner on Thursday at the river Vltava.

On the sad note, our dear colleague, Zdeněk Neubauer, who re-founded our department after the fall of the communist regime, died on July 5 at the age of 74 years during the time of the conference. Zdeněk was an original thinker, both philosopher and biologist, focused mainly on microbiology and his own concept of eidetic biology. He authored many books and deeply influenced many of his students and colleagues.

Also, the conference in Prague in 2016 was the last one attended by our dear colleague Jesper Hoffmeyer who deceased in 2019.

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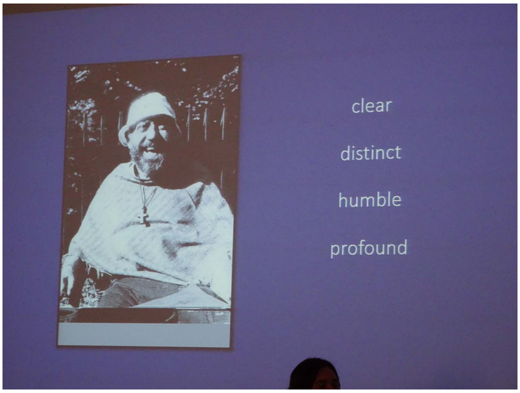
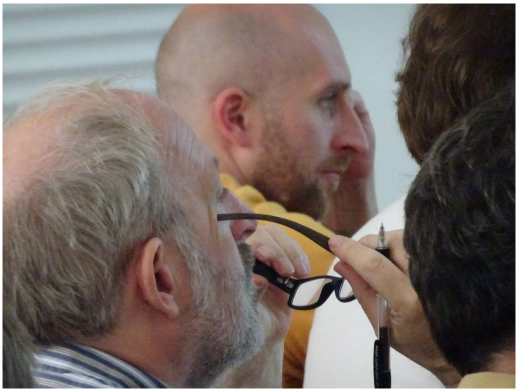
2 Department of Philosophy and History of Sciences, Charles University, Prague, Czechia; karel.kleisner@natur.cuni.cz.

3 Barbieri, Marcello 2008. The challenge of biosemiotics. In: Barbieri, Marcello (ed.), *Introduction to Biosemiotics: The New Biological Synthesis.* Dordrecht: Springer, ix–xii; p. x.

In Prague, 2016. Anton Markoš.



In Prague, 2016. Remembering Zdeněk Neubauer.



In Prague, 2016. Stephen Cowley, Karel Kleisner.

PROGRAMME

4 July, Monday

Chair: *Karel Kleisner*

Welcome and introduction

Kalevi Kull – Unsolved problems in biosemiotics

Jesper Hoffmeyer – Semiotic individuation and free will

Myrdene Anderson, *Elize Bisanz* – Biopower: Entangling moralities and mortalities

Timo Maran – A typological approach to environmental signs with an emphasis on their underdeterminancy

Welcoming buffet at Karolinum

5 July, Tuesday

Chair: *Kalevi Kull*

Dan Faltýnek, Ľudmila Lacková – Arbitrariness is not enough

Henrik Nielsen – Molecular information theory: a common ground between bioinformatics and biosemiotics?

Fatima Cvrčková, *Viktor Žárský*, *Anton Markoš* – Extending the concept of behavior beyond animals: not only a terminological issue

Chair: *Don Favareau*

Anton Markoš, *Jana Švorcová* – Meanings in biosphere: we have never been dead and we have never been individuals

Vefa Karatay, *Yağmur Denizhan* – Prions: a missing link?

Vilém Uhlíř – Representational systems in zoosemiotics and anthroposemiotics: what have the so-called "talking animals" taught us?

Chair: *Timo Maran*

Alexei Sharov – Reciprocal scaffolding and evolution of composite agency

Karel Kleisner, *Jindřich Brejcha* – On the functionality of semantic organs

Christophe Menant – Meaning generation for constraint satisfaction: An evolutionary thread for biosemiotics

Chair: *Victoria Alexander*

Andres Kurismaa, *Lucia P. Pavlova* – Embodiments of interaction: dynamic mechanisms

Matthew I. Harvey – A new perspective on the heterogeneous nature of situated, real-time languaging

Marie-Theres Fester, *Stephen Cowley* – Language, languaging and man-made coding

6 July, Wednesday

Chair: *Alexei Sharov*

Donna West – Interpretants of Zoey's world

Mariana Vitti Rodrigues, *Claus Emmeche* – Animal abduction: Can non-human animals make discoveries?

Morten Tønnessen – A brief history of the cultural semiotic of wolves and sheep

Chair: *Paul Cobley*

Sofia K. Bernstein, *Lori K. Sheeran*, *R. Steven Wagner*, *Jin-hua Li*, *Hiroki Koda* – The vocal repertoire of Tibetan macaques (*Macaca thibetana*): a quantitative classification

Filip Jaroš – The semiotic life of cats: a journey into the feline mind

Laura Kiiroja, *Morten Tønnessen* – Fear not – socialization of captive wolves

Chair: *Fatima Cvrčková*

Victoria Alexander – When mimicry is a sign

Tim Ireland – From life to architecture – to life

Nelly Mäekivi – Intra- and interspecies communication in urban environments

Poster Session

Prisca Augustyn – Natural kinds in linguistics

Alejandro C. Rueda – Breeding success between species belonging to genus *Serinus* and *Carduelis* (*Aves*, *Passeriformes*): The origin of a new species in captivity

Jordi Gómez, *Rosa Díaz-Toledano*, *Isabel Cacho*, *Ascensión Ariza-Mateos* – Mimetic relations between Hepatitis C virus RNA genome, tRNA and host defence mRNAs

Jonathan Griffin – Foundationless objective reality

Anne Hénault – Biosemiotics and cognition

Sang Lee – Tectonic indexicality and architectural semiosis
Helmut K. Löckenhoff – Talks with my elephant: on semiotic transfer
Nicole Rossmanith – Jointly structuring shared spaces of meaning and action: the development of increasingly complex semiotic processes in infant-caregiver-object interactions over the first year of life
David Stella, *Pavel Pecháček*, *Karel Kleisner* – Nondestructive, fast, ultraviolet: the application of uv photography in ecology, taxonomy, and evolutionary biology
Judith van der Elst – Tapping into the languages of the land
Felix Vymazal – Systemic psychotherapy, systemic counseling and hypnotic processes reflected with the nine sign aspects of Peirce
Silvia Waisse, *Fabiana R. Santana*, *Leoni V. Bonamin* – Effects of high-diluted agents for leishmaniasis explained as a biosemiotic phenomenon

7 July, Thursday
Chair: *Sara Canizzaro*
Kalevi Kull, *Ekaterina Velmezova* – Umberto Eco on biosemiotics
Pierre-Louis Patoine – Rethinking art, regulating growth: Lotman's evolution from the artistic text to the semiosphere
Sara Canizzaro – What are the implications of a biosemiotic concept of information for the analysis of emotions in nonverbal communication?

Chair: *Anton Markoš*
Paul Cobley – Freedom, repression and constraints in biosemiotics
Don Favareau – The biosemiotic glossary project: intentionality
Stephen Cowley – Biosemiotics and the natural sciences: Framing or bridging?

Chair: *Stephen Cowley*
Jia Peng – Signs constructed by cultural umwelt: taking moss in chinese culture as an example
Lei Han – Umwelt as a Taoist female principle: Re-reading the Tao Te Ching
Maurita Harney – A feeling for what comes next
Aleksandra Čalić – Biosemiotics and bruxism: What does tooth grinding have to do with sign processes

Journal Editorial Board meeting
General assembly ISBS
ISBS board meeting
Social dinner

8 July, Friday

Chair: *Myrdene Anderson*

Claudio Rodríguez Higuera – Conceptualizing a minimal framework for the implementation of biosemiosis

Lucie Nováková, *Tomáš Hermann* – World is not an object: Work of Zdeněk Neubauer as inspiration for biosemiotics in Prague

Ekaterina Velmezova – Biosemiotics without biosemiotics: A view from the Moscow side of Tartu-Moscow semiotic school

Chair: *Morten Tønnessen*

Petr Tureček, *Jakub Řídký* – What do animals think about speciation?

Tyler Bennett – Dark Romance: Necrosemiotic axiology and the semiotic life cycle

Chair: *Jesper Hoffmeyer*

Krystyna Bielecka, *Mira Marcinów* – A constructive approach to mental misrepresentations in human and non-human minds

Marcin Miłkowski – Is empiricism empirically false? Lessons from early nervous systems

Tommi Vehkavaara – Habits or dispositions – of their biosemiotic and non-semiotic fixation

Biosemiotica Lausannensia: The 17th Gatherings in Biosemiotics Lausanne, Switzerland June 6 – June 10, 2017

Ekaterina Velmezova[1]

The idea to hold the 17th Gathering dedicated to Biosemiotics at the University of Lausanne in Switzerland was accepted by the biosemiotic community during the 16th Annual Biosemiotics Gathering in Prague in July 2016. I would like to acknowledge, first and foremost, that the organization of the 2017 conference became a great challenge for our Lausanne group. To begin with, until 2017 only I myself had participated in the annual Biosemiotics Gatherings and therefore had an idea about the general character of these conferences, both from the point of view of their academic content and their practical organization. Moreover, in 2016 there were still very few scholars in Lausanne who were aware of the very existence of biosemiotics as a discipline: this reality can be partly attributed to the fact that semiotics as such is not currently taught at the University of Lausanne as a distinct branch of knowledge.[2] Amongst those of us who were aware of biosemiotics, there were no biologists: it was at the Faculty of Arts in the Department of Slavic and South Asian Studies (SLAS) that the 17th Gathering was to be organized. Finally, as far as I know, our little Slavic "half-department" (the "Slavic" making up only a part of the whole of the SLAS Department) had never organized any conferences of such scale – spanning over a full week and with several dozens of participants from so many countries and continents at once. It is no wonder, therefore, that even certain aspects of the practical organization of the event (including the creation of an event-specific website[3]) raised questions from the onset.

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2 At the same time, Lausanne students, notably those from the Faculty of Arts, do have opportunity to become acquainted with certain semiotic notions within the framework of other courses – such as, for instance, "Introduction to general linguistics", which makes immediate reference to the famous Swiss "founder" of "semiology", Ferdinand de Saussure.

3 Initially linked to the University of Lausanne website, the page was eventually moved and remains at the following address: https://biosemiotics17.wordpress.com/.

Of course, much preparatory work had been done in order to properly inform our colleagues – slavists and linguists alike – about the 2017 Gathering and about the existence of biosemiotics as such; this work bore its fruits. With an emphasis on the academic particularity of our (linguistic) section of the University of Lausanne's Slavic "half-department" (which focuses on the history and epistemology of linguistic ideas), it was decided that an entire pre-conference day would be dedicated to the history of biosemiotics, biology and linguistics. The sessions held that day were eagerly attended, as it turned out, not only by colleagues from Lausanne, but by external researchers as well. Additionally, throughout the academic semester that preceded the 2017 Gathering, my colleague Sébastien Moret and I held lectures open to students of both the SLAS and the Linguistics Departments within the framework of the MA course "Linguistics and biology in the history of ideas: At the intersection of theoretical influences and models". The students' interest towards the discussed topics was evident and vivid and the results of their very successful work opened up the opportunity to invite the best students from the course to submit their abstracts for evaluation to potentially participate in the Lausanne Gathering. All of our students who (anonymously) submitted were accepted.

It was a great pleasure for me to design the logo of the Lausanne Gathering: a fictional plant *Biosemiotica Lausannensia*:

Biosemiotica Lausannensia.

This plant also appears on the cover of the book that we edited in anticipation of the conference.[4] The book contains introductory articles on biosemiotics composed by Kalevi Kull, Don Favareau and myself:[5] these texts explain the epistemological premises and the main challenges of the (at that time still upcoming) Gathering in Lausanne; they were followed by the program and abstracts of the papers to be presented at the 2017 Biosemiotics Gathering.

The conference was held on the campus of the University of Lausanne, in its Internef building, and offered a very dense program. The first (preconference) day, with nine papers presented at 30 minutes each, was followed by a welcoming buffet, also held on campus. During the three days that followed, a total of 31 papers were presented (also 30 minutes each). Of the papers announced in the program almost all were presented, with only two withdrawals. Don Favareau also organized a symposium in memory of John Deely (deceased in January 2017), with the participation of those who knew the famous semiotician well: Paul Cobley, Kalevi Kull and Myrdene Anderson. The final conference day was followed by a social dinner held over a boat cruise of Geneva Lake. An optional guided tour of the Zürich Zoo (whose former director was zoologist Heini Hediger, who had a special interest in communication between animals) followed the conference.

Jesper Hoffmeyer's absence was particularly sad; while it was not the first Gathering that he had missed,[6] this was seemingly the first time that Jesper was detained due to his illness. For me, as for the organizers, it was particularly sorrowful: the first Biosemiotics Gathering in which I participated was that held in Tartu in 2012, during which Jesper presented a paper; after Tartu (if I remember correctly) I met him at the annual Biosemiotics Gatherings every year – but the Prague conference in July 2016 would be the last where we would meet.

On the whole, the Lausanne Gathering turned out to be a highly interdisciplinary meeting, with the participation of biologists, linguists, semioticians, anthropologists and historians of ideas, amongst others. The conference was held in a very friendly and relaxed atmosphere, with many exciting papers. The pictures documenting the Gathering on the conference site reflect the event well. This very democratic and pronouncedly anti-hierarchical organization of the meeting (no plenary lectures or parallel sessions, the

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4 Velmezova, Moret, Isanina 2017.

5 See respectively: Kull, Favareau 2017; Velmezova 2017.

6 Jesper Hoffmeyer is not mentioned in the programs of annual Biosemiotics Gatherings organized in Urbino (in 2005), in Prague (in 2009) and in New York (in 2011). See, respectively: Farina 2012: 93–95; Markoš 2012: 110–112; Alexander 2012: 118–120.

same conditions for the renowned "stars" – whom we were, of course, very lucky and happy to listen – and students) served as an important example, particularly for the young scholars who participated. There was diversity as well amongst the attendees who came solely to listen: this group was made up of colleagues, students and PhD students from several departments of the Faculty of Arts, as well as from other Swiss universities. In a sense, this biosemiotic conference allowed for a strengthening of both academic and human relations between those who took part. Interestingly enough, I don't recall there being any biologists who attended as audience members – unlike rather the numerous specialists in the humanities, primarily linguists. Describing the 3rd Biosemiotics Gathering, Claus Emmeche made a partly similar remark concerning the fact that during the Copenhagen Gathering in 2003, their participants "had not experienced much openness from [the] colleagues in the biosciences".[7] This remark allowed Claus to reflect upon the need for a "Kuhnian revolution" in order to change the situation. As, with very few exceptions, linguistics can hardly be considered a "normal science" in the Thomas Kuhnian sense of the term, linguists are probably more accustomed to the parallel existence of several "paradigms", which would explain their openness to new academic experiences.

As is often the case at conferences, there were some "backroom activities" in Lausanne, with which their protagonists were very pleased: during the conference, Kalevi Kull and Paul Cobley were busy preparing a *Festschrift* for our dear friend Don Favareau,[8] whose 60th birthday was to be celebrated on June 22, less than two weeks after the Lausanne Gathering. I am aware that this book was prepared and edited in record time: the volume was solemnly presented to Don during the 13th World Congress of Semiotics in Kaunas, but during the Lausanne biosemiotic conference some participants of the volume were still discussing several concrete details of the publication.[9]

The scholars seemed to be satisfied with both the scientific content and the organization of the conference. After the Gathering, all of the members of the Organizing Committee received grateful messages from the participants, who kindly complimented us on our organizational work, something that I found very inspiring: this work, despite its sometimes inevitable routine, had considerably rallied the organizers. Some of them still work at the University of Lausanne (Anna Isanina, Malika Jara-Bouimarine, Sébastien

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7 Emmeche 2012: 83.

8 Kull, Cobley 2017.

9 At the beginning of Kalevi's article the conversation with Don during the Lausanne Gathering is mentioned, demonstrating that the volume was sent to print after June 10 (Kull 2017: 15).

Moret and myself), and others (Mallory Favre, Émilie Wyss) have recently defended (with much success!) their MA theses on the history of ideas. Besides this very important human factor, the conference provided an important impulse towards a rising interest in biosemiotics in its connection with linguistics in our Department and at our Faculty in general (even if neither biosemiotics nor semiotics is yet an established discipline at the University of Lausanne): in December 2018, president of the International Biosemiotic Society Kalevi Kull was invited to Lausanne to deliver a lecture on "biotranslation" to students of the MA course "Translation and translation studies"; during the Research Day organized at the Faculty of Arts in March 2019 and dedicated to the problems of interdisciplinarity, Paul Cobley and Kalevi Kull talked about biosemiotics and were given the opportunity to present the discipline to the Swiss biophysicist and 2017 Nobel Prize Laureate Jacques Dubochet, who also participated in the meeting.[10] In August 2019, at a conference entitled "Discussing semiotics, rethinking the humanities" and organized with the participation of scholars from the universities of Lausanne, Neuchâtel and Tartu, several of the presented papers dealt with biosemiotics. Finally, in 2020, a PhD school on semiotics had to be organized by the universities of Lausanne and Neuchâtel, with some papers on biosemiotics in the program (this event was postponed to 2021 due to coronavirus pandemic). It is no wonder that several of our students have evidently demonstrated their interest in composing MA projects on semiotic problems. In this sense, the 2017 Biosemiotics Gathering was very important for the Lausanne scholars who participated: in addition to new warm human contacts, the conference launched a particular academic tradition that still continues today.

10 See Velmezova 2019.

In Lausanne, 2017.
Don Favareau, Paul Cobley.

In Lausanne, 2017.
Luis Bruni, Franco Giorgi.

Near the University Library in Lausanne, 2017. Timo Maran.

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Velmezova, Ekaterina; Moret, Sébastien; Isanina, Anna (eds.) 2017. *Gatherings in Biosemiotics 2017*. Lausanne: University of Lausanne.

PROGRAMME[12]

6 June, Tuesday
Ekaterina Velmezova – Introduction

Pre-conference Day: Biosemiotics, Biology and Linguistics in their History
Session 1: General Problems through Particular Cases (Chair: *Myrdene Anderson*)

Prisca Augustyn – Animal studies in linguistics

Mallory Favre – Tamaz V. Gamkrelidze's vision on the structural isomorphism of the linguistic and genetic codes

[11] https://www.unil.ch/slas/home/menuinst/recherche/langues-slaves/publications/linguistique.html.

[12] This version of the program includes only those papers which were presented during the Lausanne Gathering.

Ekaterina Velmezova – A "biolinguistic" novel through the prism of reflections on the limits of biosemiotics: Analyzing *The Embedding* by Ian Watson

Session 2: Linguistics, Semiotics and Brain (Chair: *Prisca Augustyn*)
Anna Isanina – Translation theory's conceptual apparatus: Do biological terms represent real cognitive processes behind translation procedure? (A look at examples in Andrey Fedorov's works)
Margarita Makarova – Do the names of colours depend on our visual perception skills? A historical review of the problem
Émilie Wyss – Aphasia as a semiotic problem: Roman Jakobson's point of view

Session 3: Metaphors and Comparisons (Chair: *Filip Jaroš*)
Sébastien Moret – Linguistic teratology
Malika Jara-Bouimarine – The metaphor of life in Charles Bally's work through the prism of (bio)semiotics
Pavel Arsenev (*Rusakevich*) – To see the forest behind the trees: "Biological bias in literary criticism" from formalism to Moretti

MAIN CONFERENCE PROGRAMME

7 June, Wednesday
Organizing Committee – Introduction

Session 1: Theoretical Problems (Chair: *Alexei Sharov*)
Kalevi Kull – On the structure of biosemiotic theory: Are there any rules in organic meaning-making?
Paul Cobley – Is observership the same for nature as it is for culture?
Myrdene Anderson – A serious case of approach-avoidance: Biosemiotics meets Anthropocene

Session 2: Philosophy and Epistemology (Chair: *Paul Cobley*)
Elena Pagni – The implications and relations of biosemiotics to phenomenology and humanities
Jaroslav Krbec, Lukáš Zámečník – Physical world and semiosphere: Rethinking the epistemic cut
Karel Kleisner – Blinded by blending: Natural and artificial signs of social impressions

Riin Magnus, *Tiit Remm* – The self and the other of introduced trees in urban environment: A synthesis of organismic and sociocultural perspectives

Session 3: Perception and Intelligence (Chair: *Timo Maran*)
Franco Giorgi, *Annibale Fanali*, *Francesco Tramonti* – Perception of chaos: Challenge or opportunity
Jonathan Beever – Biosemiotics of sound and silence: Interdependence and value in a noisy world
Victoria N. Alexander – Siri fails the Turing test: Computation, biosemiotics and artificial life

Session 4: Space(s) and Ecology (Chair: *Anna Isanina*)
Timo Maran – Addressing material processes in the framework of biosemiotic ontology
Timothy Ireland – Umwelt <> galaxies > space

Biosemiotics Editorial Board Meeting
General Assembly ISBS
ISBS Board Meeting

8 June, Thursday
Session 1: Biology and Codes (Chair: *Kalevi Kull*)
Alexei Sharov – Dialogue between code biology and biosemiotics
Dan Faltýnek, *Vladimír Matlach*, *Ľudmila Lacková* – Text dependency between length of protein secondary structure and the protein size
Andres Kurismaa – Associative semiosis and epigenetic inheritance of a neural code: Theoretical and biosemiotic problems

Session 2: Organisms, Dynamics and Functions (Chair: *Karel Kleisner*)
Henrik Nielsen – How much of the human genome is functional?
Jean Stevens – The epistemological stakes of the biosemiotic approach
Luis Emilio Bruni, *Franco Giorgi* – A heterarchical semiotic perspective to multimodal perception and cognition
Alin Olteanu – Learning as adaptation

Session 3: Ethology and Cognition (Chair: *Malika Jara-Bouimarine*)
Filip Jaroš – Social cognition of captive chimpanzees in a biosemiotic perspective

Session 4: Zoosemiotics and Ethics (Chair: *Franco Giorgi*)
Aleksei Turovski – An attempt at a zoosemiotic approach to ethological parasitology
Gerard J. van den Broek – The signs of the hunter
Yogi Hendlin – Syllepsis and particularism in biosemiotic ethics

9 June, Friday
Session 1: "A Sign Is *What*?": A John Deely Memorial Symposium organized by *Don Favareau* (Chair: *Myrdene Anderson*): *Don Favareau*, *Paul Cobley*, *Kalevi Kull*, *Myrdene Anderson*; discussion

Session 2: Historical Problems through the Prism of Modernity (Chair: *Luis Bruni*)
Francesca Dell'Oro – Underwater semiosis in Ancient Greek and Roman thought: Sounds, invisible signs and symbiotic communication from Aristotle to Aelianus
Lauri Linask – Lev Vygotsky's natural history of sign operations

Session 3: Emotions and Interpretations (Chair: *Victoria N. Alexander*)
Pauline Delahaye – The semiotics of emotions: Studying a final frontier of living beings
Naoki Nomura, *Tomoaki Muranaka*, *Jun Tomita*, *Koichiro Matsuno* – Time as linguistic system: E-series time for bio-synchronicity
Petr Tureček, *Jakub Jelínek* – Project Cicero: Semantic pareidolia introduced

Session 4: Biosemiotics and Human(ities); Conclusions (Chair: *Don Favareau*)
Evelina Deyneka – Ideograms of the mind: Between the language of thought and neurophysiological semiotics
Aleksandra Čalić, *Stephen J. Cowley*, *Mitja Peruš* – Embodied cognition: Tooth grinding as a cognitive-semiotic mode of action
Sergey V. Chebanov – History and results of development of biosemiotics

Concluding Remarks

10 June, Saturday
Excursion to the Zürich Zoo

The 18th Gatherings in Biosemiotics Berkeley, USA June 17 – June 20, 2018

Yogi H. Hendlin[1]

June 17–20, 2018, from dozens of countries, biosemioticians converged in the International House auditorium on the University of California, Berkeley campus to discuss the state of the art of the discipline at the Eighteenth Annual Biosemiotics Gathering. This Gathering was organized by Terrence Deacon and myself, under the auspices of the International Society for Biosemiotic Studies. The syncretic gathering, like the discipline itself, brought together scholars in natural science, social science, and the humanities, to further develop, like signs themselves *esse in futuro*, what Danish chemist and *ur*-biosemiotian Jesper Hoffmeyer calls "the life of signs, and the signs of life". As promised, this Gathering not only examined the hermeneutics of biological communication, serving also as an interpretive companion to the findings of the Extended Evolutionary Synthesis, but this year pushed biosemiotics once again to address those primordial questions What is life? and Is semiosis co-extensive with life?

Before referring to the specific themes of the 18th Gathering, it is worth reflecting on the unique structure of them. Rather than a standard showcase conference, as biosemioticians are mutualistic scholars, the Biosemiotics Gatherings programmatically are fiercely egalitarian. We have no keynotes (even though we have papers given by many of the leaders in our and other fields), no parallel break-out sessions, no hierarchy – it's a thoroughly rhizomatic organization. Because of this, bachelors students and decorated professors are allotted the same amount of time on stage. The Gathering is held as one big plenary, so that after the first couple days, participants begin to connect disparate corners of the discipline across presentations, so that a sort of dynamic cohesive unity takes place, akin to Schopenhauer's parable of the hedgehogs that come together for (disciplinary) warmth but also must keep a healthy distance to avoid each other's (sub-discipline specific) quills.

This year, the Gathering included two special panels: one reflecting on the successes, methodologies, and challenges of teaching biosemiotics in

[1] hendlin@esphil.eur.nl. A previous version of this report was published as: Hendlin, Yogi Hale 2019. Meeting report: The 18th Annual Biosemiotics Gathering at the University of California, Berkeley. *Biosemiotics* 12: 195–196.

the university setting and beyond, and one discussing the biosemiotics of food *vis-à-vis* the human animal. Both brought in new and familiar scholars to discuss these practically-oriented questions in rich conversation. We also incorporated a few teleconference presentations from scholars such as Jesper Hoffmeyer and Eduardo Kohn, who were unable to attend in person, conserving their ecological footprint but still contributing. As the entire conference was livestreamed, we had other biosemioticians around the globe listening in on many of the presentations. Thanks to the CounterBalance Foundation, we were able to record most of the presentations, which are available on the biosemiotics organizational website.[2]

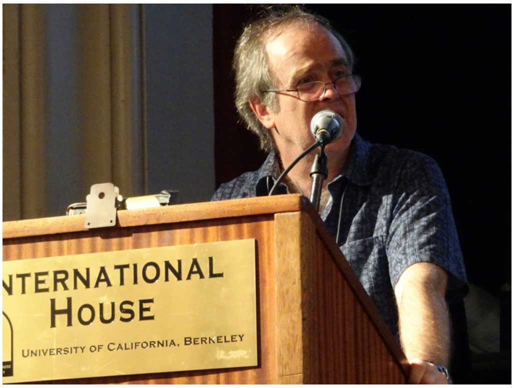
One of the evenings, many biosemioticians also enjoyed watching John Feldman's film on the life and work of Lynn Margulis, *Symbiotic Earth*. The film encapsulates the wonder for nature, and the merits of breaking convention with reductive models in biology, an enterprise that biosemioticians hold dear.

This year, thanks in part to a more inclusive program with poster sessions and geographic proximity, we had an unprecedented number of presenters from Latin America, especially Mexico. Many of these presentations focused on the connections between indigenous cultural semiotics as grounded in biosemiotic and ecosemiotic processes.

With Terrence Deacon as organizer, many kindred thinkers who are part of his informal study group colloquially known as "the Pirates" contributed papers on topics related to unresolved questions sparked by his *Incomplete Nature* and *The Symbolic Species*. Papers on these topics asked about the necessary role of constraints for the emergence of life, how autocatalysis can lead to dynamical "living" systems (however sporadic or periodic), and how different "levels" of semiosis build upon one another. One of the reoccurring themes of the Gathering, in addition to rich Peircean analysis, dealt with question of meaning versus information. This bridge between information studies and biosemiotics stressed the semiotic point that information does not necessarily exist independently or have meaning on its own, but gains this through an interpreter. Because of the vast diversity of "interpreters", from a particular human to, say, a specific species of fire ant, phenomena show up differently to different organisms, and thus only through interpretation by a living being do events crystalize into meanings and significance. This question of how relationships occur between beings, things, and the signs that different species perceive, are acted upon and thus further influence the world, generating a thoroughly non-anthropocentric biology and

2 https://www.counterbalance.net/biosem2018/.

epistemology. While such understandings may be axiomatic to biosemioticians, the necessary application of these insights to information science and studies became clear.

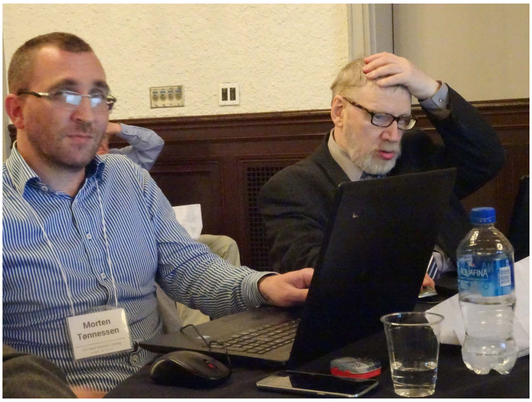


In Berkeley, 2018. Terry Deacon opening the meeting.

In Berkeley, 2018. Yogi H. Hendlin.

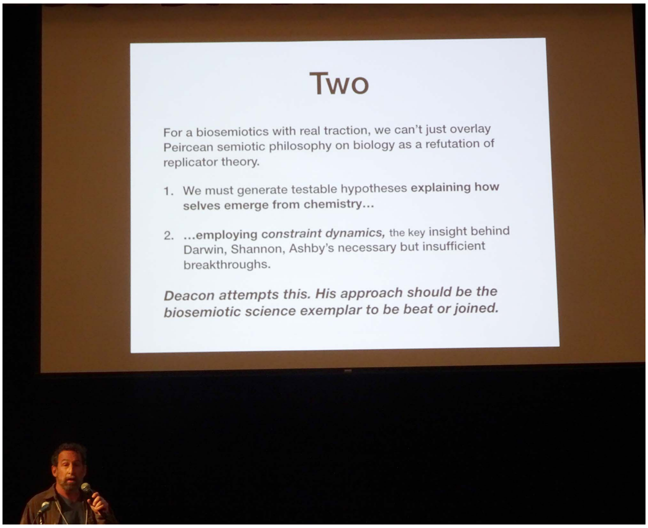
In Berkeley, 2018. Right to left: Gerald Ostdiek, Kobus Marais, Malcolm Evans (in front), Sergey Chebanov.

In Berkeley, 2018. Eduardo Kohn. Chair: Terry Deacon.



In Berkeley, 2018. Morten Tønnessen, Sergey Chebanov.

In Berkeley, 2018. Rightmost: Ľudmila Lacková.



In Berkeley, 2018. Jeremy Sherman makes a point.

PROGRAMME

16 June, Saturday
Bike across Golden Gate Bridge

17 June, Sunday
Introduction (*Terrence Deacon*, *Kalevi Kull*)
Søren Brier – It is Peirce all the way down: Why biosemiotics needs a Peircean triadic semiotic pragmaticist process philosophy to be transdisciplinary scientific
Kalevi Kull – The first qualisigns: Steps towards the biosemiotic solution of the hard problem
Don Favareau – Creation of the relevant next: How living systems capture the power of the adjacent possible through sign use
Ľudmila Lacková, *Jaroslav Krbec* – Triadic conception of relations: Peircean proteomics
Liqian Zhou – Biosemiotics as a new paradigm for biology: A rational reconstruction of the history of biosemiotics
Jeremy Sherman – The elusive evaded interpreting organism
Mel Andrews – Sourcing the semantic: Biosemiosis and the origins of the self-determining subject
Joshua Augustus Bacigalupi – Grounding semiosis in a physical medium, a higher-dimensional superposed constraint terrain

Auguste Nahas – How ought emerged from is the co-origination of normativity and life
Terrence Deacon – How can a molecule become about relationships between other molecules?
Jaime Cárdenas-García – Homeostasis, the reflex arc, information and distributed cognition
Òscar Castro García – Sentience and perception without representation: The case of slime molds[3]

Welcome Reception at the International House

18 June, Monday
Curriculum Panel
Mark William Johnson, *Svetlana Rodriguez-Archinegas*, *Maria Kirlinis* – To what extent are humans like cells and vice-versa? Reconsidering biosemiotic theory in the context of education
Søren Brier – Cybersemiotics as a tool for transdisciplinary philosophy of science teaching
Paul Cobley – The fate of meaning: channeling one's inner biosemiotician
Don Favareau – Not that there's anything wrong with plumbing
Myrdene Anderson – Biosemiotic interventions in curricula and pedagogies
Cornelius Steckner – Urban environment as a source: An introduction to civilizational biosemiotics
Tim Ireland – Design for galactic life on earth
Timo Maran, *Kalevi Kull* – How can we teach biosemiotic disciplines?
John Schumann – Nonphysical symbolic phenomena: Epistemological issues
Hongbing Yu – Teaching biosemiotics to students of the humanities: A bittersweet experience
Morten Tønnesson – Biosemiotic readings in a Norwegian philosophy of science MA course

Poster Session
Marisol Cardenas – Embodied metaphor: ethnography of the imagination toward a ritual aesthetic of the childhood memory
Susana Pliego – Construction of memory in the biosemiotic system

3 Online presentation.

Sessions

Barry Stampfl – Abduction, anxiety and trauma in Sebeok's "The Semiotic Self" and Kohn's "How Forests Think"

Eduardo Kohn – Psychedelic science, biosemiosis, and the afflictions of an ecology of mind: toward a planetary sylvan ethics[4]

Antonino Bondi – Between biological, semiotic and symbolic life: Plasticity, intelligence and habits

Sergey Chebanov – Steps towards the semiotic awareness of biology: Biosemiotics replacing the role of synthetic theory of evolution

Peter Harries-Jones –Diminishing dualism in a world of difference

Phillip Guddemi – Octopus communication informs the Cuban Missile Crisis – Gregory Bateson in 1962 in the prehistory of biosemiotics

Jeremy Lent – "The Tao in one's own nature": The congruence of Asian wisdom traditions and cognitive neuroscience in identifying the source and implications of human uniqueness

Andres Kurismaa – Basic neural anticipation: The problem of afferent synthesis

Jijo Kandamkulthy – Neural plasticity and trans-modal arbitrariness of signs

Tyler Bennett – Terrence Deacon's cognitive penumbra and Charles Peirce's late classification of signs

Henrik Nielsen – The bioinformatics and biosemiotics of protein sorting

John Collier – What makes genes signs?

Poster Session

Salvador Leon – A visual neurobiology approach to the semiotics of art and design

Lucie Nováková – Semiosis in the heart of nature – the eidetic biology of Zdeněk Neubauer

Movie Night

Symbiotic Earth: How Lynn Margulis Rocked the Boat and Started a Scientific Revolution

19 June, Tuesday

Food Panel

Jonathan Hope – (Bio)semiotics of food: Producing, preparing and consuming food beyond an anthropocentric frame of reference

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4 Online presentation.

Victoria Alexander – Eating and incorporation, from symbiogenesis to society

Pierre-Louis Patoine – Semiosis and the sugar civilization

Yogi H. Hendlin – Supernormal stimuli and human (d)evolution: A study in the architecture of akrasia

Poster Session

Sally Ness – The semiotics of acupoint biophoton emissions testing: Signs of luminescence, signs of pathology, signs of logic

José Valencia-Gonzalez – Biosemiotical sensoperceptual mnemonincs in the semiosphere of an ancient sacred dance at Mexico

Caterina Squillace – Dialogue and communication in biosemiotics: the Italian contribution

Sessions

Hamish Pike – Understanding the role of function in protein evolution using a novel semiotic model

Elmo Feiten – From umwelt to me(n)tabolism: Re-mapping the mind-body problem within endo-/exo-perspectivism

Gerald Ostdiek – Can truth and love prevail? A biosemiotic solution to the problem of meaning

Ike Sharpless – Grasping at the elephant, toward an interspecies eudaimonism: Naturalist epistemic humility and the nature of animal agency

Pauline Delahaye – Zoosemiotics of emotions: A new model and its applications

Filip Jaroš – Interactions of humans and chimpanzees in laboratory environments

Mark Johnson – Do cells sing to each other?

Timothy Ireland, *Simon Garnier* – A biology-architecture spanning review of “space” and “information”

Glenn McLaren – Health, biofields, and semiotic corruption

Jann Buttlar – Metastasis of pancreatic ductal adenocarcinoma – convention and fraternization between cancer cells and others

Evelina Deyneka – Extended synthesis paradigms in biology, neurophysiology and artificial intelligence

Katerina Parizkova, *Lucie Nováková* – Eidetic biology of Zdeněk Neubauer

International Society for Biosemiotic Studies Meeting

Biosemiotics journal Meeting

20 June, Wednesday
Sessions

Jesper Hoffmeyer – Meaning and biosemiotics[5]

Frederik Stjernfeldt – Co-localization as the ur-syntax of biological propositions

Michael Epperson, *Elias Zafiris*, *Stuart Kauffman*, *Timothy Eastman* – Quantum origins of ontic emergence

Mathew Slayton – An evolutionary-cognitive model of musical meaning

Pille Bunnell – Language; the Dawning, the Light, and the Dark: Part 1, the Dawning

Ekaterina Velmezova – On the prehistory of the Tartu School of Biosemiotics: A connection with the humanities[6]

Austin Choate – Iconic: A semiotic approach to addressing language deficiencies resulting from ASD

Alexander Kravchenko – The epistemological underside of the code metaphor in biosemiotics

Gary Goldberg – Biosemiotics, two naturalisms and the divided vertebrate cerebrum: It's about time and triadicity

Joanna Rączaszek-Leonardi, *Terrence Deacon* – The symbol un-grounding problem in language acquisition

Kobus Marais – Incomplete culture: Translation as biosemiotic work

Naoki Nomura – Retro-causal scaffolding of e-series time: How does time flow in living systems?

Aleksandra Čalić – Epigenetics and tooth grinding: From hyper-narrativity to hyper-function

Morten Tønnessen – The search image as link between sensation, perception and action

Dinner at UC Berkeley Faculty Club

21 June, Thursday

Napa Valley Winery tour

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[5] Read by Don Favareau, with Jesper Hoffmeyer online.

[6] Online presentation.

The 19th Gatherings in Biosemiotics Moscow, Russia July 1 – July 5, 2019

Alexei Sharov[1]

The idea to organize Gatherings in Biosemiotics in Moscow was initially suggested to me by Kalevi Kull at the Code Biology meeting in Koszeg, Hungary in May 2017. At that time, however, I did not believe that it was possible for me to organize the meeting in Moscow while living far away in the USA. Although I have friends in Moscow who participated in research groups on theoretical biology in 1970s and on biosemiotics in 1988–1990, but they were not affiliated with Moscow State University (MSU) and were not recently involved in biosemiotics research. Thus, I told Kalevi that his idea was not realistic. In a couple of weeks, I was in Moscow visiting my mom, and I received an email from Evelina Deyneka saying that she talked with Kalevi and decided to establish contacts with the Faculty of Philosophy at MSU and discuss the possibility of organizing the Gatherings in Biosemiotics there. She sent me all the contact information, and in a couple days I visited the Faculty of Philosophy, where I met the Dean, Vladimir Mironov, and Deputy-Deans Anna Kostikova, Alexei Kozyrev, and Stanislav Bushev. Stanislav defended his PhD thesis on the topic "Biosemiotics as a paradigm of developing theoretical biology", and thus, he knew what biosemiotics was about. After the official meeting, me and Stanislav had a long talk and decided to try organizing the conference at MSU. The idea was approved by the Dean. Later at the end of June I met Kalevi Kull and Don Favareau at the World Congress of Semiotics in Kaunas 2017. Kalevi explained that the 2018 Gatherings was already planned, and thus, the meeting in Moscow could be aimed at 2019. In April 2018, I had heart bypass surgery, which slowed me down. Thus, I could not attend the Gatherings meeting in June at Berkeley. But I and Stanislav Bushev worked out the preliminary plan of the meeting and prepared slides to be presented in Berkeley. Our plan was accepted at the Gatherings in Berkeley and in November we sent out the Call for Papers. We received over 40 abstracts, of which 37 were selected as oral presentations, and two as posters. Evaluation

[1] sharov@comcast.net. See also another report of this meeting: Gare, Arran 2019. Report on the 19th annual Gathering in Biosemiotics in Moscow. *Sign Systems Studies* 47(3/4): 627–640.

of talks was done by me, Kalevi Kull, and Victoria Alexander. I designed the program trying to put related talks together, assigning high priority talks to first days, and also considering special requests from people arriving late or departing early.

When everything was ready, we realized that many people had problems with obtaining visa to Russia. There are many types of visa, and invitations from MSU were good only for one specific visa type. Some people applied for a wrong visa type. Also it was not clearly explained that dormitory housing was available only to people who used invitations from MSU to receive visa. Irina Busheva, wife of Stanislav Bushev, was responsible for correspondence with all participants and for arranging invitations. Anna Kostikova helped a lot with arranging the meeting room and dormitory accommodations.

The Faculty of Philosophy is in a modern Shuvalovsky Building constructed in 2007. Our meeting room was equipped with leather armchairs and had multiple TV screens in addition to the central screen with a projector. But on the arrival day the air conditioning system was broken, which could have been a disaster in hot weather. Fortunately, a cold front came, and we were ok without air conditioning for a couple days, and then it was fixed. I suggested that moderators of sessions present a short summary of all talks in each session. This helps to keep in mind a larger perspective and better understand the main idea in each presentation.

For coffee breaks we used an adjacent room with tables and sofas. Lunch was in the Main Building of MSU – the famous skyscraper of Stalin's epoch overlooking the Moskva river and the stadium on the other bank. The opening reception and the banquette were arranged in the restaurant "Durdin" located 15 min away by walking from the meeting building. The food was delicious and plentiful. We organized a boat cruise on the Moskva river, passing the MSU building, Gorky Park, and then going through the downtown to Kremlin and beyond. On the way back it was already dark, which gave us a chance to see city lights at nighttime. Another attraction was the mineralogical collection displayed in the Shuvalovsky Building.

In 2019, biosemiotics had its anniversary: thirty years ago, in 1989 there was the first conference on biosemiotics organized by MSU and it was held in a small resort, Sushnevo, a couple hours away from Moscow. Before that, there were related meetings on biology and linguistics in Tartu, but the term "biosemiotics" was put as a name of the meeting thirty years ago. I actively participated in organizing that meeting and led a weekly seminar on biosemiotics at the Biological Faculty.

In Moscow, 2019.
Alexei Sharov,
Kalevi Kull.

In Moscow, 2019. Left to right: Stanislav Bushev, Mikhail Iljin, Ivan Fomin.

In Moscow, 2019.
Arran Gare.

PROGRAMME

1 July, Monday

Welcome and opening (*Anna Kostikova*, *Alexei Sharov*, *Kalevi Kull*)

2 July, Tuesday

Donald Favareau – On the promise and the challenges of using Peirce's sign theory in biosemiotics

Kalevi Kull – A biosemiotic model of semiosis

Vefa Karatay, *Yağmur Denizhan* – Biological individuality: A processual perspective

Tommi Vehkavaara – The first and third person perspectives and the relation of perception and sign-action in biosemiotics

Alexei Sharov – Notion of agency in enactivism and biosemiotics

Jeremy Sherman – Focus on biosemiotic foundations

Morten Tønnessen – How relationality connects the individual and ecological level of biological study

Timo Maran – Reframing wolf as an Estonian national animal: Process and contentions from an ecosemiotic perspective

Riin Magnus, *Nelly Mäekivi* – The eco- and zoosemiotic aspects of species reintroduction: the case of the European mink in Estonia

Sanita Fejzić – A slow cultural revolution at the intersection of biosemiotics, environmental ethics and cultural production

Claudio J. Rodríguez H. – Against universalism in biosemiotic theories

3 July, Wednesday

Tyler James Bennett – Cultural implications of protosigns: Biosemiotics and structural semiology

Victoria Alexander – Group think: The diffusion of signals

Ivan Fomin – Multi-level iconic signs in the processes of biological and cultural evolution

Mikhail Ilyin – Double-edge implications: Relevance of gene expression models to studies of human communication and applicability of linguistic dichotomies to genetic information research

John H. Schumann – Walker Percy's semiotic theory and the issue of non-materiality

4 July, Thursday

Natalie Gontier – Common roots of biosemiotics and applied evolutionary epistemology

Yogi Hale Hendlin – Distributed agency, composite identity, and microorganism influence: A view of world affairs from a biosemiotic interpretation of the extended evolutionary synthesis

Anton V. Sukhoverkhov – Process and semiotic approaches to inheritance and evolution: in search of an integrated theory

Sergey Chebanov – Interpretation techniques in living organisms

Arran Gare – Biosemiosis and causation: Defending biosemiotics through Rosen's theoretical biology

Szura Bruni – The evolution of consciousness: Subjectivity and it's place in nature

David Frank Decker – Umwelten and counterpoints: On the threshold of meaning

Dan Faltýnek, *Hana Owsianková* – Genetic analysis of all cabbage and related cultivated plants using bag-of-words model

Mark Pharoah – From biological mechanism to meaning

Anastasia Kolmogorova, *Alexander Kalinin*, *Alina Malikova* – The restrictions that the fascination theory imposes on the methodology of text data sentiment analysis

5 July, Friday

Jaime F. Cárdenas-García, *Timothy Ireland* – A new biosemiotics paradigm: Bateson information (via Skype)

Alexander V. Spirov – The complexity, spatial distribution and hierarchy of the processes for the genetic information unfolding in an embryo

Nikita E. Shklovskiy-Kordi, *Victor K. Finn*, *Abir U. Igamberdiev* – Natural algorithms, combinatorial power, and generation of meaning in the semiotic structure of the genetic language

Suren Zolyan – On the grammar and grammatical categories of the genetic code

Ľudmila Lacková, *Dan Faltýnek* – How to do things with proteins: A pragmatic view on proteins

Òscar Castro García – From protosemiosis to eusemiosis: In search of a minimal cognition in bacteria and slime molds

Pauline Delahaye – Me, you & all the others: working with emotions in semiotics

Ekaterina Velmezova – Another biosemiotics? Analyzing the intellectual heritage of biologist Lev Berg

Jeremiah Cassar Scalia – Anatomy of a primordial synecdochism: Mimesis, body plasticity and the evolutionary emergence of language
Leonid Zhukov – Biosemiotics as a theoretical discipline

Posters:
Alessandro Samsa – Anthroposemiotics, zoosemiotics, phytosemiotics: Relations between species and evolutionary issues in Sebeok's thought through the lens of speciesism
Devon Schiller – The syllogism in the machine: Biometric art, a semioethical critique of the computational face

In Moscow, 2019.
Tommi Vehkavaara.

V Abstracts for the 20th Gatherings

Applying biosemiotics to the theory and practice of qualitative *v.* quantitative methods

Victoria N. Alexander
Dactyl Foundation, NY, USA / ITMO University, Russia

Social science researchers employ so-called qualitative methods, such as case studies, interviews, documentary evidence, participant observation, and the quasi-quantitative method of survey research. Physical science researchers employ quantitative methods; they take measurements, collect and count data points, and formulate equations that model how systems change. The difference in methods is said to make the social sciences more subjective compared to the hard sciences. But then, complicating things a bit, we acknowledge that the choice of what to measure and to count may bring in subjectivity at the outset of any scientific experiment. Furthermore, on the one hand, we observe that evolutionary dynamics theorists, for example, almost seem to wax poetical when they make mathematical analogies between reproductive fitness and landscapes or between gene selection and game theory. On the other hand, humanities researchers may count word frequencies in novels or histories, make graphs illustrating the shape of a series of events, or compare culture to physical systems, providing insight previously unavailable with purely qualitative methods. Interdisciplinary studies departments worldwide now offer courses combining quantitative and qualitative methods as a compromise intended to resist the privileging of one method over the other. In this talk, I will argue that we have been coming up with answers to the wrong question. Quantitative methods are appropriate for modeling how *any* complex system stays more or less the same. Qualitative methods are appropriate for understanding how *any* complex systems change significantly. I will argue that the processes that cause change involve the qualities of similarity, proximity, and arbitrarity, which inhere in the relationships of the system interactions themselves and are not imposed by an external observer. These local interactions give rise to emergent features that can be modeled quantitatively. Thus the conventional ways of thinking about the objective/subjective dichotomy needs some serious reevaluation.

Uexküll's *Funktionskreis* as multilevel model of perception and action

Prisca Augustyn
Florida Atlantic University, USA

Jakob von Uexküll first articulated the *Funktionskreis* in the context of muscular physiology and contributed to the discovery of the reafference principle. From there, he described many phenomena beyond the level of physiology. The *Funktionskreis* explains processes that entail feedback loops, circularity, cyclicality, cybernetics, repetition and habit. That is why neither functional circle nor functional cycle are adequate translations. Functional circle, being the most generic and most common translation, is not enough to accommodate the aspects of feedback, cyclicality, and repetition/habit. Uexküll applied the *Funktionskreis* to all levels of the life of an organism and its interactions with the environment, including human umwelten. It provides a powerful explanatory hypothesis for all kinds of semiotic processes and extends into thought as cognitive habit. The model of *Funktionskreis* has a developmental component as it needs to be established, repeated, and solidified by experience. Gauging the distance of an object by its size is part of human visual perception that has to be learned. This entails the circularity of the *Funktionskreis* in that it requires many iterations of practice to establish visual habit. The *Funktionskreis* is at the same time a powerful model of the limitations of species-specific semiotic abilities. It explains why we miss a lot of what could be perceived. In the context of developmental psychology, the model of *Funktionskreis* is a powerful antidote to evolutionary psychology. The model of *Funktionskreis* is helpful in explaining cognitive habits that channel our thought in familiar patterns. The *Funktionskreis* is also a helpful model that explains our movements through the physical world in established pathways. It can be a model of predictability of organism-environment interaction explaining all kinds of patterns and habits, tastes, and preferences, narratives and stories. The predictability of organism-environment interaction is part of Uexküll's multilevel model. At the same time, the model of *Funktionskreis* explains our limitations on all levels, because we are bound by the established pathways, both physiological and cognitive. It makes clear how much we are missing, and how much we act in the established grooves that are our habits.

Taxonomy, composition, and the Peirce-Hjelmslev hybrid

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In his division of the sign into the strata of form and substance, Louis Hjelmslev specified the sign function as the correlation of elements of expression and content at the stratum of form, remanding parallel correlations at the stratum of substance outside the sign function. In this, he emphasizes something which Saussure also asserted, but which is not borne out by Saussure's methodology: that the signifier is not the phonic substance in any particular language, and the signified is not the actual thought inside any particular person's mind. The formalism of the sign function precludes a definition of the sign involving an extra-semiotic referent, such as Peirce's index and dynamic object are sometimes construed to do, and also precludes the development of typologies of the sign grounded in such referents, such as those proposed by Kalevi Kull and Terrence Deacon, where sign types are assigned to evolutionary thresholds. Frederik Stjernfelt criticizes the evolutionary taxonomy of signs as well as the notion of compositionality, where more complex signs are built of simpler ones (another prominent idea in Deacon). Stjernfelt also cursorily proposes some synthesis between Hjelmslev and Peirce. At the same time, Stjernfelt upholds a semiotic realism within which the index provides a real bond to the extra-semiotic referent. The two positions might seem to contradict each other, but the Peirce-Hjelmslev hybrid, at least as it is conceived initially by Umberto Eco, can accommodate both perspectives. The formalism of the sign function need not preclude an evolutionary taxonomy or compositional account of signs. Emergence in Deacon's description of evolutionary thresholds and sign types, the compositional character of Stjernfelt's own description of dicisign structure, and the hyperdense metalinguistic regress of *Diagrammatology* and *Natural Propositions*, are all considered in terms of the Peirce-Hjelmslev hybrid, where there may coexist a dimension for both the formalistic differential approach of Hjelmslev and structural semiology, as well as the sometimes naturalistic Peircean understanding of cognition and biosemiotics.

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A code or not a code? Metaphor, metonymy and metaphysics in genetic code descriptions

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"He who differentiates well teaches well."
Jan Amos Komenský

Could the cognitive metaphor theory (CMT) help in clarifying the conundrum regarding metaphors and the genetic code? When it comes to biosemiosis (and the language used to describe it), what is literal, what is metaphorical and to what degree? From popular literature and textbooks to expert discourse, there is a wide mixture of (often inconsistent) use of metaphors and literal descriptions. Hence, many wonder: are genetic *transcription* and *translation* literal or metaphorical? Is DNA 'the book of life' written in 'the language of cells', in 'the language of God'? Are nucleotide bases *letters* of the *DNA alphabet* or less than that? Is the genetic code really a *code* – or not?

Cognitive linguistics provides at least two CMT-related methods that can enable us to systematize what is literal, what is metonymic and what is metaphorical (and how) in biosemiotics. These rigorous and systematic methods can help us avoid the distortions and misunderstandings that ensue from taking metaphors literally or literal statements metaphorically. The first method is the MIPVU (Metaphor Identification Procedure VU University Amsterdam), "based on extensive methodological and empirical corpus-linguistic research" with good inter-coder reliability (Steen *et al.* 2010). The second approach involves Dunn's (2015) methods of 'measuring' degrees of abstractness and metaphoricity; these could help in determining the basic meaning of "code", "information", "language", "alphabet", "letters" etc. from abstract and metaphorical contextual meanings with the *fact-status* and *function-status* decision trees. The CMT (as the theoretical basis) would *inter alia* provide a clearer distinction between metaphor and metonymy.

For example, once the basic meanings of both *language* and *genetic code* are established as types of *literal codes*, then there is contiguity between the two. Hence, calling the genetic code "a language" would be a case of metonymy (or synecdoche). In other words, calling the set of triplet-amino-acid correspondences a genetic ***code*** is a *literal* statement, but calling the genetic code "the language of the cell" would be *metonymic* (not metaphorical), as the two terms are non-identical but contiguous. Similarly, these combined cognitive linguistic approaches will be used to analyze the relationship between DNA bases and letters, triplets and words, genes and sentences, etc. (compare Matlach, Faltýnek 2016)

Having a unified, systematic, and rigorous set of methodologies in metaphor identification can minimize subjectivity and increase the clarity in distinguishing the literal from the metonymic and the metaphorical. This, in turn, will be useful in making (at least some of) the metaphysical undercurrents underlying the confusion explicit for deeper reflection and analysis.

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Signs evolve in semiotic closure

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In this talk I propose a naturalization of signs that generalizes and partly formalizes Pattee's (2008) notion of semiotic closure. I employ it to elaborate why evolution by natural selection can be considered both necessary and sufficient for the origin of signs, and suggest how to extend this view to higher level semiotic phenomena. To do this, I represent generic causal processes heuristically as Shannon-like information transmission channels, thus abstracting away from the details of the substrate to focus on spatial and temporal relationships processes enter into. Any physical relationship can in principle be portrayed as a Shannon channel, with source and destination variables specifying possible start and end states. In general, the values of the variables are not intrinsically given. For a process to be semiotic, these values need to correspond to the states inherently salient to the process itself. Semiotic closure provides a criterion whereby this obtains: an occurrence can be taken to be semiotic if it is informational about consequent occurrences in a variety of domains, including its own potential recurrence. This is satisfied in a rudimentary way if the process is cyclic or homeostatic. Fully fledged semiosis, I argue, arises when prerequisites for natural selection are met (variation, differential reproduction, heredity). I follow Kauffman (1993) in expecting that this takes place after a reproducing process attains a minimum complexity, enough to participate in a wide range of interactions as well as attain alternative steady states whose aspects are conserved during reproduction. Using the transmission channel heuristic, I outline how the interplay of multiple time and ecological dimensions during selection events leads to appearance of new informational relationships, corresponding to Tinbergen's four questions. Specifically, information about how to respond to likely environmental conditions is stored in two semiotically closed relationships which express Hoffmeyer & Emmeche's (1991) code duality: one indicates a favoured ontogenetic path, while the other is embodied in a resulting physiological predisposition. The value of this perspective is, first, that it parsimonizes the conditions for the appearance of semiosis while tying many of its known aspects in a coherent account. Moreover, it provides grounds to argue for explanatory and ontological continuity between physical and semiotic phenomena, by abstracting away from some of their differences and putting them on one conceptual plane. Finally, the same heuristic approach can be applied to clarify aspects of eventual appearance of more complex semiotic activities within and between organisms, up to and including human cultural interaction.

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Facing up the problem of subjectivity: Biopsychism as an answer for the Hard Problem

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The problem of subjectivity is definitely an old question. Some call it the Hard Problem, some point at the fundamental impossibility of resolving it, some even deny its existence, calling it only an illusion. However, while there is no consensus on the horizon and still far more confusion than clarity, the question remains open. What is the relation between objectivity and subjectivity? How to connect theoretically these two aspects of reality? How to approach subjectivity, with its basically non-objective features? Is it possible at all, or will it be forever *terra incognita* for scientific efforts?

Subjectivity, after all, is about being a subject – a subject of experiences, information and signals, but also of decisions, knowledge, and striving. It's, again, about the *first-person* point of view – how anything "seems" to the subject – although you don't need eyes to have your own perspective. Being a subject is being a source: of perception, sentience and action, no matter how simple they are. It is being *toward* the world, *affected* by it and *in relation* to it: perceiving, reacting and acting. Any living being inhabiting its own subjective world – the umwelt – would be "tuned" to certain elements of its surrounding, perceiving them, interpreting, and taking appropriate actions. That is why biosemiotics, according to Favareau, would be a "project whose goal is nothing less than a scientific understanding of how the subjective experience of organism […] comes to play a genuinely causal role in the ongoing co-organization of nature" (Favareau 2010: 43). It becomes clear that the fact of subjectivity or, rather, of multitude of subjectivities in all their diversity (both morphologically and phenomenologically speaking) – in regard to specific interactions of organisms within their individual, first-person environments – needs to be rightly comprehended and described in terms of biology.

It is claimed that all known living systems engage in some cognitive or protocognitive processes, generating in consequence a "kind of minimal subjectivity" (Godfrey-Smith 2016). Every living being would be a self-referential entity which dynamically interconnects with the surrounding – moved by current needs, its particular perspective and possibilities the environment affords. All in way to survive, adapt, and procreate. In other words, the very subjectivity should be understood as an individual, dynamic, and evolutionarily shaped "point of view" of the living entity, constituting in effect its "cognitive reality" (Lyon 2006). Such first-person perspective – the way that world is given to that particular individual – would ground its modes of interaction with the environment: by the way it perceives it, interprets it, and acts in it.

Accordingly, the idea of biopsychism is proposed, claiming that any living entity is intrinsically subjective and cognitive. Such view is supported by the "information resonance" hypothesis, according to which any living being – by its self-referential interaction with the environment – generates subject-related information based on its phenomenology, meaning-making processes, and affordances. In way to solve the problem of unification of objectivity and subjectivity, in other words, aiming to surpass the Hard Problem and the Explanatory Gap, a new approach to the phenomenon of subjectivity is needed – and the biopsychic perspective appears to be a promising theoretical resolution.

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Info-autopoiesis: Source of all information

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Gregory Bateson is well known for defining information as a difference which makes a difference. Such a succinct and deceptively simple definition is certainly subject to possible misinterpretation. One such misinterpretation might involve suggesting that it is a circuitous, self-referential play on the word difference which leads nowhere, since differences seem to be ubiquitous. In this general misinterpretation, the missing important detail is that the organism-in-its-environment, as a representative of all living beings, is at the centre of assessing differences. For us humans, sometimes we are faced with looking at very complex differences such as the ones we might experience in looking and analysing an abstract painting. But that is not where we begin our process of distinguishing differences. We start our process of distinguishing differences at the time of our conception as living beings. When a single human cell becomes two cells, a further division leads to four cells and so on until the emergence of the child from the womb, to begin an additional gestation period out of the womb. This cumulative composite of cells is certain to detect spatial/temporal differences that allow this process to become effective. Without delving into all of the biological complexity that probably plays a role, at some point our five primary senses (touch, sight, hearing, smell and taste) come on line perpetually. Our senses function continuously, consciously or unconsciously, in detecting spatial and/or temporal differences within our dynamic environment. During the initial period of gestation out of the womb, our senses help us sound the alarm to be nurtured when hungry and held close for warmth, but we are possibly unaware that that is the reason why we are doing it.

To begin the journey of determining differences using our five primary senses, it is important to note that our senses deal with commensurable quantities/qualities, i.e., quantities/qualities that have a common measure. For example, the sense of touch (whose multidimensional structure includes mechanoreceptors, thermoreceptors, nocireceptors and proprioceptors) might be, for simplicity, arbitrarily ascribed as being sensitive only to pressure. In that limited role, our sense of touch is able to keep track of all pressure sensations that come into its sphere of action. As might be imagined, from one instant of time to the next, pressure sensations are felt by the human in question and become part of her experience. This is how quantitatively and unambiguously "a (pressure) difference" becomes qualitatively "a (pressure) difference which makes a difference". In a similar way, the other dimensions of the sense of touch contribute with their own unique quantitative/qualitative characteristics, thus in toto contributing to a multidimensional sensory experience that consists of temporal/spatial differences.

Implicit to this conception of information, and applicable to all living beings, is that all information is self-produced or the result of a process of info-autopoiesis. A corollary is that there is no information in the environment, except for the information produced by living beings, or the tools, machines and devices designed, made and used under their control.

A biosemiotic approach to allorecognition: A possible connection between organic codes and the interpretation of their umwelt

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Allorecognition is a faculty of specific cells and organisms through which they can recognize the difference between self and non-self, self and environment and between its own tissues and those from others. Allorecognition appears in the recognition of antigens expressed on the surface of cells of non/self origin. It is known as kin recognition (self/non-self) and kin selection (self/environment). A specific organism capable of making a distinction between itself and strains that once belonged to its own self, as well as their environment is the slime mold. Allorecognition works in immunogenic cells like T and B cells, and in other histoimmunological cells.

We will aim to show the biosemiotic inference of recognition in unicellular organisms – and the explanation of multicellularity by aggregation – through different mechanisms that allow allorecognition. The adaptive immune memory of cells is crucial for our explanation. But it is also important to study its decline and consequences thereof, as it happens with microglia in the brain, for instance.

Studying these models is essential in looking for ways to deal with recognition failure. A biosemiotic understanding of this faculty, both at simple and more developed stages, will have profound consequences in the study of code duality at the level of genetic and phylogenetic foundations. However, there are also ontogenetic patterns as generators of epigenetic landscapes that support the interpretative capacity of a sense-making and decision-making process.

We see here an opportunity to interact with both code and interpretation biosemiotics. Both of these perspectives can be complementary in understanding meaning information. With this, we can bring a new semiotic perspective on how a cellular organism fuses, becomes an aggregated organism, phagocytosis, and even the cycle of life itself. We hope to describe the pathways of the recognition system of cellular organisms.

Finally, this biosemiotic focus is expected to amplify the description of minimal cognition with semiotic details of such recognition pathways.

On *the possible*: Some notes for a structural biosemiotics

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In his 1993 article, "L'acte de communication traductif", Luis Prieto tackles the problem, a propos translation, of how to establish the limits between two languages (*langues*). According to him, the speaking subject will establish the limits of a *langue* by defining the limits of the universe(s) of discourse to which all the elements of a given *langue* pertain. The delimitation of such universes of discourse is made on the basis of two calculations: (i) a calculation of monemes, or proper signs (i.e. bifacial units) and their possible combinations, and (ii) a calculation of figures (i.e. distinctive uni-planar units). For Prieto such calculations deliver, on the one hand, facts that, even though possible to calculate, are not used in the given language (e.g. a given chain of phones that is meaningless, although constructed according to the phonotactical rules of the given language), and, on the other hand, it establishes the limits of the universes of discourse by establishing which word-forms, or utterance-forms, are not possible to calculate according to the principles of a given language (e.g. in Spanish, there is no sequence "/s/+consonant" at the beginning of a word). We would like to extend these principles, *mutatis mutandis*, to all sign systems, for indeed; if a sign system serves to create meaning, a minimum of order and articulation is needed. It is clear however, that not every sign system will, for instance, admit a calculus of figures, simply because not every sign system has figures, but for sure all of them should allow a calculus of signs, or, using Prieto's terminology, a calculus of all the possible *semes* that can be produce by using a given sign system (i.e. all the possible "utterances" that can be produced using a given sign system). Under this interpretation, *the possible* would then refer to the constraints (borrowing the notion, to some extent, from Deacon) imposed to a sign system, and more specifically: to the possibilities that are not used and to the possibilities that are not admitted by a sign system. This means that *the possible* determines what it is beyond the recognition window of a subject when the subject is using a given sign system. On the other hand, Prieto's (1975) model of cognition establishes that to know (orig. *connaître*) an object *a* means to *virtually know* all other objects that are different from object *a*. I suggest that this should be interpreted as virtually knowing all other *possible* objects that can be different from *a*, and all those that are *actually* different from object *a*, since the moment that object *a* is recognized, hic et nunc, as object *a*. Based on the aforementioned calculus, the *possible* would include combinations of signs, or figures, that are meaningless, and combinations of signs, or figures that are *not possible* (like the aforementioned sequence "/s/ + consonant at the beginning of a word in Spanish, the fact that this is a non admitted sequence in the language is proven by Spanish speakers inserting an epenthetic [e] in words such as English's /star/).

By generalizing these affirmations, I will claim that the *possible* includes, virtually, what is beyond the recognition window of a subject when the subject is using a given semiotic structure, but it is of the utmost importance to bear in mind two things. First, that in this case the subject's recognition window is provided by the semiotic structure, not by the subject as such; and second, that the fact that there is a calculation determining such recognition window needs not to be, and often it is not, a conscious operation. On the other hand, subjects (i.e. organisms in general) do have recognition windows that endow them with recognition capacities. This "primary" recognition window does not come from an external sign system, but instead, it has been claimed that it emerges from the subject self. I propose, then, to take the intrinsic organization of an organism as a kind of *semiotic form*, whose constraints (i.e. what delimits the universes of discourse that compose the semiotic structure that determines an organism's phenomenical reality) are given by physical, and biological organization. Accordingly, the recognition window of a subject, or organism, is no longer being provided by an external semiotic system (as it is the case with a phonological system), but it is *emerging* from the subject itself; implying thus that the body of the subject is both a result of semiotic processes, and a semiotic process itself, that is made up of both possibilities admitted and not admitted. As an example to illustrate my position, consider the visual field of humans: we cannot see infrared frequencies, even if we would *know* a color as *virtually* different from colors that belong to the infrared spectrum, the constitution of our own body does not allow us to *know* those colors *actually*. Thus, very much in line with Prieto (1975), I attempt to show that every semiotic structure takes part of another semiotic structure, but the absolute point of departure is the semiotic structure that defines an I-subject (orig. *moi sujet*). This "primary" semiotic structure that defines the *moi-sujet* is the umwelt of an organism, and thus its constraints are biological, or physical constraints, inherent to the subject's body.

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Honoring absent friends and important figures from the first 20 years of the Gatherings in Biosemiotics

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As we as a community celebrate the 20th anniversary of the Gatherings in Biosemiotics, we find it fitting to take some time to remember and honor some of the seminal figures who have contributed so much to our common project, but who are no longer with us to be here with us today. Accordingly, this panel will be a one-hour seminar discussion with the audience on the works and legacies of John Deely, Eliseo Fernández, and Jesper Hoffmeyer and their seminal contributions to the realization of the contemporary biosemiotics project.

The "semiotic work" of the forms between agentivity, selfhood and intra-action: remarques on a dynamic ecosemiotics

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In this talk, we intend to deepen some suggestions starting from Eduardo Kohn's eco-semiotic theory, which establishes a continuity between human and non-human beings concerning how the selfhood and others emerge. In particular, we want to take into consideration two ideas: (i) this emersion is structured according to the different ways in which the power of assignment, practical activity, and reference unfold on each other; (ii) the differential treatment of reference is responsible for the regularity/variation (in non-humans) and the ritualization/institutionalization (in humans) of the patterns of interaction and meaning that punctuate the value of forms within a given collective. In other words, it is a matter of looking for a general logic of thought and action that can guarantee partial reversibility from the perspective of a human agent to that of a non-human and vice versa. In this framework, semiosis is conceived as a trans-specific process of thought and action on and with an environment, which develops through cycles of a transformation of various elements (artifacts, languages, practices, etc.) and which is the result of a process of transformation of values. These cycles of transformation contribute to stabilize and shape global forms of being together.

This concept of semiosis, which derives from the theories of Charles Peirce and Terrence Deacon, has the general objective of examining how different forms of agents – of beings – emerge and interact with each other. The passage from one mode of semiotic production to another, or, in other words, the perception and representation of the future self/other as icon or clue – or, as in linguistic productions or symbols – depends on what Kohn calls aboutness. The concept of aboutness refers to the commitment of each being to extend the legacy of the interpretative habits received, appreciating in each interaction its effectiveness towards the "individual" and "collective" destiny. In a word, timeliness sums up all the nuances that value can assume in non-humans and human beings. Aboutness is naturally life-oriented, but at the same time, it assumes nothing more than the history of transforming the unexpected into habits and habits into innovations. In other words, it is the story of the modulation of forms that are both local, relative to a niche or a specific group of individuals, and global, relative to an environment as a whole. The signs, then, intertwine and reverberate on each other and within each other. This does not prevent forms, conceived as organizations that are at once material, imaginary, natural and cultural, from growing, propagating and showing the nature of the internal bonds that sustain them. The form, therefore, is of a transindividual, trans-specific and trans-temporal nature, and does not refer to conceptual structures for understanding the world, nor to ideal entities, but rather to a concrete process of production and propagation of models, whose logic infiltrates living beings. If, as Kohn argues, the form is not a spirit and not even a thing, the epistemological fulfillment of an eco-semiotic should be to capture the global configurations of environments and at the same time their internal movements, the thresholds that indicate an imbalance or future change. In this sense, the study of human/nonhuman relationships through the prism of attestable forms is ultimately a political commitment to the questions raised by the Anthropocene.

Rats, mice and humans: Importance of cultural and emotional semiotics in urban cohabitation

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This paper will introduce the preliminary results of a study conducted in 2019 about how humans perceive species they have to live with, despite not wanting to do so – liminal species (Donaldson, Kymlicka 2011) –, specifically rats and mice. The results presented here are part of a wider study about rats and mice in cities, their relationship with humans, the nuisances they generate as well as the various and important roles they play in the urban ecosystem.

The study originally focused solely on rats, which are in a difficult societal context in France, especially in Paris: due to heat waves, planned works and floods, rats are becoming more and more present on the surface, instead of being invisible underground as they used to be. However, some of the results suggest that a significant number of participants are not completely positive about being able to distinguish between a rat and a mouse. In order to present a more precise and detailed overview, we decided to study the difference not only between the cohabitation issues humans may have with actual rats mice, but also between the semiotic relationships that humans have with the symbolic rat and symbolic mouse. As such, this paper will present the results for both species, with their similarities and divergences.

We will show that a significant part of nuisances and cohabitation issues are more "preconceived" or "believed" than factual. We will focus on how the cultural and emotional backgrounds of participants influence their semiotic relationship with these species, and how the perceived nuisances, threats or issues can vary according to these parameters.

This study aims to develop a better understanding of the different elements that play a part in issues of cohabitation between humans – especially urban humans – and liminal species – especially rodents. It will show how we can resolve some of the nuisances, not by coercive methods on the actual animals, such as extermination, repellents or removal, but through semiotic work and education on the symbolic animal, its related myths, superstitions, fears and phobias.

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Learning and teaching from biosemiotic and evolutionary perspectives

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Most people believe that reality is experienced through our senses. However, how sure are we that what we sense is the reality? According to 'direct realism', we have immediate access to reality in forms of physical or social 'affordances' of our actions and perception. In contrast, indirect or representational realism argues that our senses and thoughts mediate and represent reality in the form of an internal 'virtual reality' or 'interface'. Modern studies on the perception of a computer-generated Virtual Reality partly confirm the indirect realism theory. For instance, the experience of being in a virtual rollercoaster enables us to experience a similar sensation of speed and acceleration as in a 'real' rollercoaster, even when we are not moving. In this regard, it is supposed that reality, as what we experience with our senses, may just be another virtual reality. Donald Hoffman theorized that experiencing reality as a 'truth strategy' is disadvantageous to evolutionary fitness and a 'perceptional virtual reality' is required. Our senses need to inform us the strategies crucial for survival. Hence, a 'fitness strategy pay-off' tells us that an apple is for eating and a fast-moving object, like a roller coaster, is dangerous (Hoffman 2019). Hence, a rollercoaster in virtual reality is a *sign*, which exists as a digital object, and yet responds to computer inputs through *virtual actions* producing *virtual events* (Brey 2014). In a similar way, virtual money is real enough as it enables sales and purchase of items virtually (Brey 2014).

In teaching and learning, we make use of virtual actions and virtual events as a stimulus for evoking emotions or ideas among students; they are signs that form prior experience influencing the actions and events in the classroom and in their future professional life. Educational tools and media (books, maps, lectures, slides, videos, etc.) represent a studied reality in the classroom space. For instance, anyone nowadays can stay at home and learn geography, history and the culture of a foreign country using multimedia resources. The *advanced* ability to represent, store and transmit knowledge about reality in form of various signs (representations) could be considered as uniquely human. However, it did not emerge in human society; it is just an evolutionary step further in the general ability of any organism to represent reality and act according to this representation. There are many 'developmental niches' (Stotz 2014) with 'semiotic scaffolding' (Hoffmeyer 2015) of individual development in nature and society. Education is meant to create 'semiotic developmental niches' with virtual and conceptually augmented environments. For example, augmented reality, as an overlay that gives information about plants in a park or the history of paintings in a real museum can change the students' perceptions as new meanings and concepts become related to empirical objects. Thus, one's perception of professional or everyday reality is created from the experiences within the learning environment, enabling the learners' conceptual and physical (re)construction of social realities based on accumulated knowledge (e.g. agriculture, economy, science and technology, etc.).

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On the possibility of recognizing animal semiosis

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In *The Visible and the Invisible*, Merleau-Ponty gives the example of an anatomist dissecting an eye. On one hand, the anatomist recognizes that the function of the eye; she recognizes it as the origin of a sense that she herself shares. However, in the absence of sight, the question arises, how could the anatomist ever understand the real import of the organ that they are studying? The salient demarcation here is between emic and etic experience, or knowledge. By dissecting an eye, one acquires etic knowledge of it. However, it is only by sight that one can have emic knowledge of the organ's function. In other words, no matter how intensively or effectively the anatomist studies the eye, if the anatomist cannot themselves see, they will come no closer to emic knowledge of sight.

This state of affairs is emblematic of the situation that confronts any student of animal communication, especially those students concerned with the internal, interpretative aspect of communication. As humans studying other species, epistemological questions abound, when we critically consider the above example. Namely, if we maintain that sensory experience is mediated by sensory organs, when we recognize that other species have sensory organs other than our own, how might we go about studying the emic import of those organs? Moreover, how could we begin to recognize intraspecies communication that is mediated by senses that we entirely lack?

We can say that butterflies can see more colors than we can, that dogs have better hearing than we do, that bats experience a sort of sight via sound. In these cases, we extrapolate from our sense experience, i.e. we abstract from our emic knowledge, and thereby come to some understanding of what is occurring among these other species. But what when another species is endowed with a sense that is wholly unlike any that we have? By a combination of etic and emic knowledge, i.e. empirical research and phenomenological experience, the anatomist understands the function of the eye. Similarly, we approximate an understanding of the bat or butterfly. But what when an organism is endowed with an organ that allows sensory experience wholly unlike our own? How much less likely are we to come to an approximation of that sense than a blind anatomist to an emic knowledge of sight? More pointedly, how are we to even come upon etic knowledge of it, in the course of empirical research?

For the biosemiotician interested in animal communication, one question stands out among the others. Namely, is it possible that other species are communicating via sensory media that are unavailable to us as humans? We know that other species communicate via sounds that we cannot hear, but what if they communicated via a sense that we are entirely without? More pressingly, if it were that other species are communicating via sensory media that we can have no emic knowledge of, how might we at least improve our etic knowledge of these processes? Finally, in the case that our ignorance is unassailable, should an epistemology of ignorance contextualize discussions of nonhuman animals' potential for semiosis, or even discussions of nonhuman animals' in general?

I will present and move towards an answer of some of these questions. I will also discuss the implications of these questions for biosemiotics research.

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Displacement, a phenomenon affecting language

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In this paper I introduce the problem of displacement. This problem has become apparent from the perspective of indigenous languages. However I believe it may point to a more fundamental phenomenon in meaning making and knowledge construction.

As a pillar of Colonial policies. many indigenous peoples were forced to move from their homelands and assimilate into the culture of the oppressor. The consequence of these practices is that many indigenous languages have ceased to be spoken, other languages are still spoken but only fluently by an older generation. The practice of displacement has a number of detrimental effects that are appropriate to address within a biosemiotic framework. As it turns out, languages, and the disappearance thereof, especially those rooted in land-based knowledge systems, are closely linked to biodiversity and the disappearance thereof (Elst *et al.* 2018).

Even though, and luckily, the Colonial goal of culture and language eradication has failed in many cases, the current challenge faced by many indigenous groups is the fact that the land has changed, environmental degradation has taken its toll, yet because there is a generation that has not been able to speak their language, the potential lack of development of such close relationships between land and language has hindered land stewardship. The challenge for land-based knowledge systems is to reconnect and evolve in order to retain language – as well as biodiversity.

The problem of language loss is now widely recognized and language revitalization programs are increasingly supported, but novel approaches are called for to address the challenge of displacement. Based on the premises of biosemiotics, languages come in many forms. From chemical signaling to spoken words, these communication networks are intertwined, and the existence of single, isolated organisms can be challenged on these grounds. Languages are not static. Instead, they evolve as a result of changing organism-environment relationships. Language is essential to communal life, a system of signs that molds behavior. Yet when populations are displaced, for instance as a consequence of environmental degradation, new communication channels need to be forged while others are lost.

Even though the link between the biosemiotic program and the field of linguistics has been addressed in the literature (Favareau, Kull 2015), my work is not so much about integrating their respective theoretical underpinnings as it is to regard human language as an integrated part of the communication channels in the living world. It draws on my own work on spatial language and novel ideas in embodied cognition, focused on how languages come into being, how they function in their broader context and how eventually they may disappear. Such a disappearance is a specific focus of this paper, with a particular concern regarding the factors that contribute to this disappearance, not just at the theoretical level but in line with the more radical ideas of embodied cognition, its existential impact (Wilson, Golonka 2013).

Without getting overly theoretical, I believe the issue of displacement and language loss is important to the biosemiotic program. Within this paper I will discuss my recent work in assisting curriculum development and its relevance for immersive, hybrid knowledge communities across the living world.

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Some notes on the representational aspect of low-level semiosis

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The concept of protosemiosis or semiosis at the lower levels of living goes back to Giorgio Prodi, Thomas A. Sebeok and others. More recently, a typology of proto-signs was introduced by Sharov and Vehkavaara (2015). The criteria for such a typology of protosigns are mostly based on two important presuppositions: agency and lack of representation in low-level semiosis. We would like to focus on an alternative approach to protosigns. In particular, we aim to examine the role of representation in low life-forms. We consider representation independently from the role of the interpretant and interpretation (as an epiphenomenon of agency). We understand representation at the level of protosemiosis (for instance, an interaction between an enzyme and its substrate) as a physical interaction in which one physical object-substrate *signifies something for* another physical object-enzyme simply by interacting with it. The representation (sign-object relation) in protosemiosis is guaranteed by the interaction related to a scope, to a function of the considered object. We argue with the von Neumann argument (Pattee 2001) whereby representation is an epistemic condition of separation of the semiotic from the physical. At the level of protosemiosis, we can talk about a relational representation.

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“An evening with Jesper Hoffmeyer”

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Screening of a one hour edited video of Jesper Hoffmeyer’s last videotaped interview, conducted, filmed and edited by Donald Favareau, entitled “An Evening with Jesper Hoffmeyer”.

On a transdisciplinary potential of the concept of habit: From biosemiotic regularities to sociosemiotic logonomic systems

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My paper is devoted to Charles Peirce's category of *habit*. I will focus on the transdisciplinary potential of this notion, contributing to some of the recent discussions about it (West, Anderson 2016). In particular, I will attempt to theorize on how this category can be used in the conceptual interface between general semiotics, biosemiotics and social semiotics. A starting point of my analysis will be the category of *logonomic systems* (i.e. systems of "rules prescribing the conditions of production and reception of meanings; which specify who can claim to initiate (produce, communicate) or know (receive, understand) about what topics under what circumstances and with what modalities (how, when, why)"), which was proposed in the systemic functional tradition of social semiotics (Hodge, Kress 1988). I will discuss the methodological capacity of this category and will propose an interdisciplinary conceptual interface which would show how this category can be used to bridge social semiotics with general semiotics and biosemiotics through the interdisciplinary vocabulary of such concepts as *habit* (a general rule operative within the organism" (W 4: 249)), *legisign* (sign that is a general type, law, or habit (MS [R] 800:4)), *final interpretant* (habit produced by a sign (ILS 285)), and *regularity* (repeated pattern produced by constraint (Sherman 2017)). Furthermore, I will discuss some of the similarities between biotic habits and social habits. In particular, I will focus on how the relationship between language systems and logonomic systems appears to be similar to that between "template molecule representation" (DNA) and "somatic representation" (body's dynamics) (Sherman 2017). Additionally, I will analyze a number of other concepts that are used in social and political studies to refer to social habits and social legisigns. Those concepts can be semiotically reconceptualized and, thus, used as conceptual tools that would integrate biological, social and linguistic studies, using the categorical apparatus of semiotics as a meta-language.

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Gregory Bateson's concepts of coding and redundancy

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Gregory Bateson approached what we would today call biosemiotics from the point of his unique view of cybernetics and information theory as he was a key participant in the Macy Conferences, which pioneered these fields. His perspective was, in addition, biological because of his heritage and early education (his father, William Bateson, was an important 19th Century evolutionist and geneticist). Near the end of his life, he attempted a synthesis of these intertwined roots of his thought, leavened with the results of his researches over many years into apparently diverse topics, which were nonetheless united by a focus on communication broadly viewed in both humans and other animals. These topics ranged from the social dynamics of peoples in New Guinea and Bali, to the family systems of schizophrenics, to play among otters, to conflicts and peacemaking among octopus.

As part of this synthesis of his thought, Gregory Bateson developed an account of the varieties of what he called styles or types of coding or redundancy, as these relate to perception and communication in the living world.

The basis of Bateson's approach to what he called coding or redundancy is the ability of an organism to predict or guess, better than randomly, what is on the other side of the "slash mark" separating what is known or perceived (X) from what is not yet known or perceived (Y). This identifies a relationship of coding or redundancy between X and Y. Bateson in his mature, synthetic period near the end of his life groped towards a classification of what he variously called types, sorts, or styles of coding or redundancy. This was probably not fully developed to his satisfaction when he died, though he folded aspects of it into the last book published during his lifetime, *Mind and Nature*.

Fortunately, the editors of the *Co-Evolution Quarterly* in 1975 got Bateson's permission to publish a fragment of an early draft of *Mind and Nature*, setting out a number of these proposed types or styles of coding or redundancy, and discussing them in detail. They included: Causal and Correlative; Analogic; Digital; Iconic; Ostensive (in which something points to itself); Part-for-Whole; Evolutionary (or adaptive); and Holographic. This classification of types of coding or redundancy is differently based than Peirce's typology of signs, though they do overlap. It might be useful as another way of thinking about semiotic relationships, either supplementary or orthogonal to the Peircean approach more common in biosemiotics.

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Multi-pathway signaling cascades, trophic cascades, and climate change

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A central element of complex systems theories such as biosemiotics is awareness of the cascading effects of certain changes in state or equilibrium on far away processes and actors. For example, after trophic cascades, as occurred in Yellowstone National Park with the reintroduction of keystone predators (in this instance, wolves), ungulates responded with changed browsing habits, which in turn lead to aspen tree regeneration and increased riparian embankment, which improved river health (Ripple *et al.* 2001). The ripple effects of trophic cascades can also be seen parallelly in multi-pathway signaling cascades.

Semiotic cascades represent the open-endedness of triadic semiosis. "The combined complexity of the environment and of the cellular way of life is reflected as a whole in the aggregate of signaling elements" of a given organism or grouping of organisms (Marijuán *et al.* 2010). As contrapunctal organisms make up each other's *Umwelten*, they may be indirectly affected by perturbations in the larger *Umgebung* (surroundings), even if semiotically they have no direct sense of those changes. Through attending the action signs of other species in their umwelt, organisms can become privy to elements in their *Umgebung* they have no direct perceptual access to, thus potentially rendering them more fit.

With massive human-caused species die-offs (the "sixth great mass extinction"), however, coupled with the 1°C average temperature increase that has occurred in the last decades due to anthropogenic climate change, it is dubious if any organism on earth has not already been highly affected directly or indirectly by climate change, including precipitating major semiosic changes. For example, louder urban traffic leads some species of songbirds to increase the volume of their birdsong, but with distorting effects, increasing the noise-to-signal ratio and likelihood of miscommunication. A major field of study for the discipline of biosemiotics as a conservation science (which I argue, it also is) entails detailing and documenting these semiotic shifts on organism health, behavior, and fitness.

For example, as mosquitos in many regions enjoy increased range due to less temperature constraints, malaria spreads to many additional human and animal populations which prior had deliberately positioned themselves at altitudes outside typical mosquito habitat. Warmer water temperatures are leading to: more algae blooms, which choke off oxygen and kill many aquatic species, decreasing species diversity; coral bleaching; temperature-dependent fish and amphibians producing only offspring of a single sex; and many other instances of semiotic and hence trophic cascades. Through the hitherto relative stability of environmental conditions, organisms used heuristics like temperature to calibrate and vary their cycles, with gene expression mapping onto these background environmental indicators. While temperature is a major factor of climate change, it is but one of the major perturbances in umwelt organisms are forced to confront.

As well as reviewing a few well-known natural science instances of how climate change is changing animal, plant, and other organism experience and signaling through a biosemiotic lens, this presentation will also make the case for biosemiotics to become actively involved in climate science to remain relevant and useful as an applied science, by marshalling evidence of damaged semiosis (heuristics gone awry) – and especially degraded capacity for organism meaning-making – as reasons for swift intervention against political apathy and inaction on the climate crisis (Ghosh 2017).[1]

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1 After all, as is well documented, there are many things that people would do (like quit smoking) for their dogs' welfare that they wouldn't do for themselves.

Agency of coding and decoding: How communicators would emerge?

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Despite wide-spread claim that Claude Shannon created the theory of information he himself in his seminal article of 1948 called his brainchild "A Mathematical Theory of Communication". True, he writes a lot about information, but carefully distinguishes message from signal, transmitter from information source and receiver from destination (Shannon 1948: 381). What he quantifies is not the entire information but its core segment or signal, leaving away the message, its source and destination. Many would call it a great simplification, but it allowed to resolve an engineering problem of designing a device that would process "a set of possible messages, not just the one which will actually be chosen since this is unknown at the time of design" (Shannon 1948: 379). But Shannon contradicts himself. It is neither actually chosen message nor all possible messages but signals that pass from a transmitter to a receiver. The message emerges on the way from receiver to destination. And Shannon gives no clue how it happens. He leaves it away beyond consideration as well as what happens between an information source and transmitter.

The paper reports an attempt to think through segments of Shannon's model left unquantified and elucidated. It highlights only two key questions. What are communicators on both sides, or rather how do they emerge? Why they double (or split) into source and transmitter on one side and into receiver and destination on the other?

The paper considers two options. First, proto-communicators pre-exist to assemble Shannonian communication model. Second, proto-signals pre-exist to escalate into communication circuits shaped Shannon-wise with communicators at both ends. The second option looks more plausible but the first one should not be utterly discarded.

Both cases postulate pre-existing entities that are nothing but prototypes of either communicators or signals without actual communication. What may be substitute(s) of communication in each case? Such a question may be motivated by a Deaconian pursuit for ententional communication in the world that lacks it. It is a world overwhelmed by Boltzmann entropy with a few domains of thermodynamic dysfunctionality. They may surrender to the pressure of chaos. Or they may resist the pressure and turn Boltzmann dysfunctionality into Shannon functionality. This brings information (or its substitutes) into the world lacking information.

At this juncture, both options remain thinkable. One can even try to claim they are complementary. Anyway, let us start from an observable and quantifiable entity: "(Any) signal, represented as a function of one or more variables, may be defined as an observable change in a quantifiable entity" (Chakravorty 2018: 177). Change of what? Into what? Change of chaos into an order. Who makes the change? Either it is an enigmatic and exoteric agent or it just happens on its own. Or to remember complementarity thesis it happens on its own to become its own creator.

Great! An apparent entity changed into its mirror clone becoming its own creature and creator. It is the actual beginning, not just *Logos*. Or rather Λόγος, *Wort, Sinn, Kraft* and *Tat* just follow and reproduce it into multiple shapes with the same elementary trick using the same pattern or series of corresponding modules.

Shannon's "schematic diagram of a general communication system" is much more than he claimed. It is a pattern for producing the modules of progressive transformations of chaos into order, inanimate (order) into living (order), living into agentive, agentive into communicative, and communicative into semiotic. Each step and respective module being more than simple copy-making and duplication. Each implies numerous copy-making multiplied and stored by twinning, folding and spiraling. None of elementary copy being a forthright replica but ambiguous peer ententionally open to interpretation. And interpretation (with interpretant at all) crowns this majestic progression by 'cloning' ententionality into intentionality.

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Knowing how to be: Imitation, the neglected axiom

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The concept of imitation has been around for a very long time, and many conversations have been had about it, from Plato and Aristotle to Piaget and Freud. Yet despite this pervasive acknowledgement of its relevance in areas as diverse as memetics, culture, child development and language, there exists little appreciation of its relevance as a fundamental principle in the semiotic and life sciences. Reframing imitation in the context of *knowing how to be*, within the framework of semiotic theory, can change this, thus providing an interpretation of paradigmatic significance. However, given the difficulty of establishing imitation as a fundamental principle after all these centuries, since Plato, we thus turn the question around and approach it from a different angle. If imitation is to be incorporated into semiotic theory and the Peircean categories as axiomatic, then what pathologies manifest when imitation is disabled or compromised? We begin by reviewing the reasons for regarding imitation as a fundamental principle. We then review the evidence with respect to autism and schizophrenia as imitation deficit. We are thus able to consolidate our position that *imitation* and *knowing how to be* are integral to agency and pragmatism (semiotic theory) and should be embraced within an axiomatic framework for the semiotic and life sciences.

Sebeok revisited: The three-stage model of communication and cognitive systems

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The paper aims to provide a general framework for assessing and categorizing the communication and cognitive systems of humans and animals. Our approach stems from biosemiotic, ethological, and phenomenological investigations into the relations of organisms to one another and to their environment. Building on the analyses of Merleau-Ponty and Portmann, organismal bodies and surfaces are distinguished as the base for sign production and interpretation. Following the concept of modelling systems by Sebeok, we develop a three-stage model of communication and cognition that posits three intertwined levels: corporeity, sociality, and culture. The model explicitly works with the pluralistic perspective that views the communication and cognition of humans as distinct, but not superior to those of various species of animals. From an epistemological perspective, our paper is a contribution to contemporary attempts to link biosemiotics with phenomenological concepts of agency, living bodies, and lifeworld.

In contrast to Lotman's profoundly linguistic approach, Sebeok and Danesi (2000) reclassify language as a secondary and culture as a tertiary modelling system and give them a position above a primary modelling system incidental with Uexküll's use of umwelt (cf. Kull 2010). In this move, they postulate a basal zoosemiotic dimension common to all animals and humans as possessors of individual umwelten. At the same time, setting aside two modelling systems as uniquely human seems to be a heritage of Sebeok's own linguistic education.

Our model will differ from Sebeok's approach in few essential places, and it is a dialogue with this system that justifies the new concept. In its structure, it maintains Sebeok's hierarchical division into three stages, but the categorization of these levels is carried out differently, especially given that each level is at least partially occupied by non-human species. We also pay close attention to the fact that the individual stages have intermediate zones and interact with each other: the model is therefore hierarchical only in the first approximation. The relationship between humans and animals is exposed in two steps: first, we introduce a general zoosemiotic characterization at each stage, which we then complete with a description of human specificities.

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Ur-forms of fettering: How life handles matter

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> – and now he knew for sure
> that flying would be possible
> only with a very special way of fettering –
>
> Ilse Aichinger, *The Fettered Man*

Currently, we are witnessing a major breakthrough in molecular and cellular biology, which stems from the establishment of a novel connection with phenomena at a more fundamental level. It is about how we treat matter that is regarded as the constituent of living organisms. The tradition tells that matter can be in one of its three possible phases: solid, liquid or gas, and that the cell, "the building-block of life", encapsulates within its membrane an aqueous solution packed full of multifarious molecules and further membrane-bound functional entities containing aqueous solutions packed with molecules. However, the simplistic model of matter that only knows its three phases falls short of accounting for the intricate ways how molecules can be organised in the cell. At this point, what we need is a finer resolution, at which "sub-phases" of the liquid phase can be distinguished. Recent work in cell biology reveals the exciting phenomenon of *liquid-liquid phase separation*, a meta-concept that offers a completely new picture of the cell: the membrane now appears as just one of the possible alternatives for intracellular compartmentalisation. Evidently, there exist more sophisticated kinds of constraints that subdivide the cellular medium into domains with distinct dynamics and biological functionality.

In view of the paradigm shift heralded by these new findings and the insufficiency of the theoretical foundations of biology in addressing phenomena at this intersection point of physics and biochemistry, we propose to heed to Simondon's Theory of Individuation, which offers a holistic framework for all types of processes of becoming. Simondon's theory involves an intricately entangled set of key concepts. We want to bring to the fore one of those concepts that we consider most relevant in this context: *dephasing* (fr. *se dephase*).

Biosemiotic origins of spontaneity and autonomy in the living state

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Primary among the aims of research in molecular biology is to understand the biophysics that causes the living state and underpins its various and diverse biofunctions. In the presence of nutrition the living state is observed to be both *spontaneous* and *autonomous*.

There is wide agreement that information is a defining property of living systems. Walker and Davies puts it as follows: "Although it is notoriously hard to identify precisely what makes life so distinctive and remarkable, there is general agreement that its informational aspect is one key property, and perhaps the key property" (Walker, Davies 2013: 2).

To date, how information functions in the life of the living state has not been satisfactorily explained. In physical chemistry the spontaneity of a reaction or transformation must satisfy thermodynamic and kinetic conditions. Biosemiosis is recognised as fulfilling a central role in the function of all living systems. It has been defined in the following terms:

> Biosemiosis is simply sign mediated communication in living organisms resulting in biological function. The heart of all biological sign systems is the central dogma, describing how the DNA code (its signs mediated and processed as mRNA) becomes "translated" by the tRNA ribosome interpreting complex to form polypeptides. (Gryder, Nelson, Shepard 2013: 236)

A biosemiotic molecule is therefore one that has specific and essential significance within the living process of a living system.

The physical constraints inherent in biosemiotic molecules constitute 'information' variously described as sign and/or symbol. The Brillouin negentropy principle of information recognizes that molecular information has the property of thermodynamic negentropy (Brillouin 1953).

The negentropy of biosemiotic molecules functions kinetically by lowering the activation energy of a reaction or transformation. The energy currency of the cell is biosemiotically programmed in the Krebs Cycle and the electron transport chain of mitochondrion. The products of these cycles, such as ATP, *contribute* to the living state by making biosemiotic reactions and transformations thermodynamically allowed.

The primary cause of the living state is the expression of biosemiotic information. The energy currency of the cell functions only to bridge any thermodynamic deficits thereby ensuring the spontaneity of biosemiotically prescribed biofunctions.

The fact of autonomy indicates a programmed state within the boundary conditions of the cell membrane. The code script of DNA constitutes a primary biosemiotic programming language wherein the genome is a vast database of programs that respond dynamically to complex systems of regulation and signalation.

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Why mimicry avoids typicality?

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Since Jakob von Uexküll and Emanuel Rádl, we are aware that the physical objective space is not the same as the biological space in which organisms enjoy and suffer their lives. Our models of biological reality should thus be able to translate between the objective (measurable) and perceived (experienced) spatial patterns. Despite this intuition, the theoretical formalization of a biological space is lacking. To fill the gap, we are taking advantage of the psychological Attractor Field Model (AFM) to explain the evolution of mimicry as a trade-off between optimization of structural similarity and the rate of visual interactions. AFM argues that representations of atypical (as opposed to typical) stimuli have wider 'attractor fields' because they are less densely populated in the peripheral regions of the relevant representational space, and there is less competition between them and other (atypical) stimuli. Mimicry requires coordination in the development, behavior, and evolution of two or more organisms in their environments, and yet the final functionality of mimicry still depends on the perceiver. People form a first impression about an unknown person in just tens of milliseconds. Vertebrate predators, as potential selective agents of mimicry, are in a similar situation. In a multi-species similarity space, it is more difficult to differentiate between individuals of atypical species than between individuals of typical species. This implies that mimicry can evolve more easily among atypical species than among typical ones: atypical species do not need the same level of similarity to their model as typical species do for the mimicry to be successful. Further, AFM may elucidate the existence of imperfect mimicry and explain why imperfect mimicry is functionally perfect. AFM may also shed new light on the existence of parapatric mimics. Eventually, we introduce the mathematical formalization of frequency-dependent perception-driven dynamics of mimicry based on perception-space deformation, which can be narrated in terms of the attractor field model.

The quest for a theory of meaning in biosemiotic research

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The aim of our study is to propose a universal theory of meaning, a theory restricted not simply to a language and culture but one which is able to describe various phenomena underlying the basis of life. To do so, a very rudimentary and operational definition of meaning is introduced. Following the Charles Sanders Peirce's theory of sign, the signal is defined as meaningful if it is recognisable by the system and an effect of the same change of that system.

The main classical theories of meaning popularised in philosophy and linguistics are compared to the Peircean model. The one proposed by the father of pragmatism, the triadic concept of sign (formed of Sign-Representamen-Object), proved to be an advantage over dyadic models, especially in the context of describing processes. Meanwhile, this feature may play a pivotal role in biosemiotic research providing invaluable heuristic tool for further research.

The proposed paradigm is explained by the example of a cell signalling with particular focus on the multiplicity of semiotic processes levels. For example, the membrane receptor by itself could be regarded as a sign (or semiotic machine), yet at the same time it is a part of particular signalling pathways and a participant in a border semiotic process including cellular response to the changes of the environment, etc. All the levels of semiotic processes can be simultaneously modelled with the proposed triadic theory of sign.

In addition, using one of the simplest examples of a system able to perform both signal discrimination and directed changes of its internal environment, which is the cell membrane, the process of semiotic evolution is shown. Gaining semiotic complexity can be obtained on the base of the iteration process that introduces the next levels of membrane building upon the previous one.

This model is a good visualisation of more general phenomena responsible for a gradual increase of life complexity. Frequently, new levels of semiotic processes rely on the previous signs, which are reused and incorporated in the next level of signs manipulation.

Semiosis, simultaneity, anticipation

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I

(1) A remarkable fundamental feature of perception is the simultaneity of the multiple (at least something two) in a single perception. Perception is always a perception of difference, which assumes something two *at the same moment*. Explanation of the mechanism of this phenomenon is crucial for understanding semiosis.

Henri Bergson made a clear distinction between the physical and psychical simultaneity in his commentary to Albert Einstein (Bergson 2020 [1922]). Psychical simultaneity – or rather, *organic simultaneity* – is that of semiosis. By organic simultaneity I mean the instantaneous reciprocal linkage of states in cellular and metabolic systems.

(2) *Affordance* is a result of simultaneous sensing of an object and of an organ of action, or rather reciprocical sensing between these. Any perception requires perception-action cycle. In the same way as something is perceived simultaneously with something else that is next to it, in case of affordance something is perceived simultaneously with the action that can be executed. This means that the perception-action cycle is a perception-action circle, its state is simultaneous (Kull 2020b: 229–231).

(3) The new dimension that emerges with „life itself" – the imaginary space, virtuality, self – *is* the simultaneity, the temporal sameness. Organic simultaneity and being (as the „matter" of mind) are one and the same. Being (mind) is the organic simultaneity as such.

(4) Simultaneity is indescribable with the sequential formalism. Therefore it is beyond the classical physical models. Classical physics which is based on efficient causality (only *causa efficiens*) excludes, on the one hand, quantum phenomena, and on the other hand, the phenomena of organic simultaneity. Quantum phenomena and organic simultaneity have some analogous features, while their nature is different. Quantum entanglement is different from *organic entanglement*.

(5) The process that takes place in the organic simultaneity is semiosis. The aspects of semiosis – representamen, object, and interpretant – are organically simultaneous. Logical incompatibility (optionality) presupposes simultaneity (the present, or now – Kull 2015).

(6) Organic simultaneity, if measured by an external observer, may last from tens of milliseconds to a couple of seconds, however felt by the self as one moment (Pöppel 2010; Wittmann 2011). Time as a sequence presupposes simultaneity in order to be perceived. The organic simultaneity enables perception of potential action.

(7) Semiotic theories describe meaning-making (i.e., semiosis) as primarily either for communication, or for modelling, or for decision-making. Most general of these three is evidently the *decision-making* (i.e., semiosis is always decision-making), however, the concepts of communication and modelling can also be generalised so that they could cover all cases of semiosis. For instance, communication (dialogicity) in a general sense can primarily be autocommunication (heterocommunication being a special case of autocommunication, in this understanding). Also, semiosis can always be a kind of modelling, since it has some relation to (real or imaginary) object. Such view helps to interrelate and integrate otherwise rather separate semiotic theories (Kull 2020a).

(8) Complexity of the organically momentary semiosis can vary. Different depths of meaning-making (or semiotic freedom, in Jesper Hoffmeyer's terms – i.e., different logical complexity of decision-making) is the basis for different types of signs. Among the latter, symbolic sign is the type of sign in which meaning is made using (mediated by) an arbitrary third. The more complex logical operations can be included (embedded) into the moment, the deeper is the comprehension. Structural complexity of the simultaneous can be rather high, as observed in case of perceived complex momentary visual picture or comprehended logical complexity of a sentence or mathematical formula. Obviously, the scope and complexity of the simultaneous is species-specific, and in some extent trainable.

(9) Perceptual microgenesis is a process of sign-formation, thus microgenesis can be seen as the internal dynamics of semiosis. However, paradoxically, there are not many studies that explicitly address the relationship between perceptual microgenesis and semiosis (e.g., Abbey, Valsiner 2005). From the biosemiotic point of view, a particular interest have the studies of microgenesis of iconic and indexical signs.

(10) Processes in the simultaneity are based on semiotic causation. Semiotic causation is logical (i.e., not efficient) causation. In this sense (as C. S. Peirce claimed), semiotics is extended logic.

(11) Organic simultaneity emerges and extends via the coexistence of incompatibles, the latter being at the same time possibilities or options or affordances. Their coexistence is a prerequisite and reason for choice, thus choice being an attribute of semiosis and simultaneity (Kull 2018).

(12) The elementary structure of simultaneity should include a triad as a minimal mechanism enabling choice (e.g. including the states 'yes', 'no', 'yes/no'). The whole interpretive network covered by simultaneity can, however, be rather large, as observed in case of vertebrate sensor-motor systems including a complex neural web in synchrony.

(13) Subjectivity emerges in case of the sensory-motor-sensory temporal calibration or attunement (perception of action in synchrony). This is the state in which cause and effect are not temporally separated – they are aspects of the same present moment, of atemporal semiosis. As including both the cause and the effect, the state of organic simultaneity is anticipatory.

(14) Once the action and its perception are simultaneous, also ententionality emerges. (Ententionality is an extended intentionality – Deacon 2012.)

(15) Whether the organic simultaneity can be intracellular remains to be studied.

II

There has not been much interaction between biosemiotics and artificial intelligence studies in the last decade. However, recent developments in both of these areas call for an exchange of ideas.

Using the distinction Daniel Kahneman (2011) introduced between system 1 and system 2, we can see that biosemiotic studies cover system 1. The divide between system 1 and system 2 coincides with the symbolic threshold as described by Terrence Deacon. System 1 has been characterized as implicit, fast, parallel, and prelinguistic, with system 2 being explicit, slow, sequential and linguistic.

System 1 – which is the field of biosemiotics – has been difficult to study because it is hardly observable:

(i) its workings are largely unconscious, thus inaccessible to introspection;
(ii) its processes are not deducible from physico-chemical laws, because these are code-based;
(iii) it is hard to recognise their mechanisms from morphological and physiological accounts, because without relevant models it is not clear what to search for.

System 2 is to a certain extent accessible via introspection, because this is the conscious part of the mind. However, contemporary solutions of AI can simulate many functions of system 1, while being in diffficulties with mimicking system 2. A possible reason for this can be some inadequacy in the modelling of system 1, since system 2 cannot work without system 1; system 2 in the human brain is calling system 1 all the time. System 1 is responsible for the grounding of meaning. Moreover, the elements of meaning-making and consciousness find their origin in system 1.

Thus it might be interesting to analyse whether some models of contemporary biosemiotic theory can contribute to AI-studies. In particular, the following ideas of biosemiotics can potentially be usable in AI studies:
(a) models of categorization in communication systems (including brainless systems);
(b) the role of code-makers;
(c) conditions for minimal meaning-making (understanding that code is necessary but insufficient for meaning-making);
(d) three levels of learning (imprinting, associating, mimicking);
(e) conditions for the primary mechanism of choice;
(f) descriptions of prelinguistic logic.

It is obvious that biosemiotic models can also benefit from formalization. As an example, we can provide a biosemiotic explanation and reintepretation of some experiments on animal logic. We'll use an example of an experiment that has been interpreted as an evidence that animals can learn equivalence, but not symmetry or transitivity relations. However, such experiments often apply the model of linguistic logic, which assumes the existence of system 2. An alternative hypothetical explanation will be discussed.

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Historical perspectives on hormesis: Bridging experimental models and (semiotic) theory

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In recent years, the need to complement classical reductive and molecular-level accounts of neurobiological functions with broader and more qualitative concepts of cellular responses and behaviors has been increasingly recognized, as is particularly evident in research on hormetic phenomena (Mattson 2008). Defined operationally as dose and intensity dependent effects of stimuli on cells (such as stimulatory or beneficial effects at low doses and inhibitory or adverse effects at high doses), hormetic processes highlight the need for time-course studies of cellular responses, and their dependence on precise modes of stimulation. In this talk, we consider how these recent theoretical works, so far mainly confined to toxicology, may be conceptually relevant also from general and neurobiological viewpoints, where the multi-phasic nature of cellular responses to exogenous or internal agents (e.g., neurotransmitters, hormones, stressors and toxins) have been often underappreciated and ignored (Mattson 2008). At the same time, accounting for this response variability would be critical for any account of context-dependent factors in cellular signaling, such as sought in biosemiotics.

To explore these connections in a theoretical and historical light, we propose to reexamine the approach of the Wedensky–Ukhtomsky physiological tradition, where in terms of "parabiosis" similar response variations have long been analyzed as currently investigated (independently) in hormetic research. Indeed, related historical connections have been highlighted (Agutter 2007) and seen as important avenues for future investigation. This may be particularly important considering the potential ubiquity of hormetic effects in biology and neuroscience (beyond toxicology and pathology), and the need to couch these effects in terms of a broader theoretical framework, as currently sought. Thus, key theoretical concepts from study of the dominant by A. A. Ukhtomsky will be highlighted, as well as the search for a new discipline, "cytoethology," to which related cytophysiological investigations gave rise (Alexandrov 1972). The possible biosemiotic implications of these early approaches will be discussed.

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In search of C space: Umberto Eco between dyadicity and interpretation

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Umberto Eco's approach to non-cultural modes of semiosis was, at the beginning of his career, marked by skepticism. His attitude changed somehow after he started to cooperate with Giorgio Prodi. Eco invented the concept of *natural primary iconism* in order to study the semiotic competence of life forms at the biological level. Even though the concept of natural primary iconism – attributed to the genetic code and immune cells – represented a step towards the recognition of semiosis at the cellular level, Eco still remained very prudent and placed primary iconism below the lower semiotic threshold, defining it as a simple dyadic relation between a stimulus and a response (the dyadic nature of primary iconism is very clearly delineated in Eco 2007). One might see an inconsistency here, in fact, as admitting a certain level of semiosis for life forms while at the same time describing it as dyadic does not solve the problem. Fortunately there is another concept developed by Eco that can aid us in solving the paradox of the lower semiotic threshold: the concept of C Space (Eco 1990), an interpretive space to guarantee thirdness. Eco himself applied this concept to the simplest life forms, even though this passage is not well known because of the fact that it was not translated to English. As is the case of many translations of Eco's books, the translation of *The Limits of Interpretation* contains a different text from the original. The concept of C Space shows good potential in biosemiotic theory. In my presentation, I will stress on its applicability and usefulness for the biosemiotic project.

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Discursive habits: A representationalist rethinking of teleosemiotics

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Enactivism has greatly benefitted contemporary philosophy by showing in detail how the traditional intellectualist 'act-content' model of intentionality is simply insufficient both phenomenologically and naturalistically, and minds are built from 'operative intentionality' – world-involving bodily habits. It has been assumed that this insight must entail non-representationalism concerning at least basic minds. But what if we could show that representation is itself a form of skilled performance? I sketch the beginnings of such an account, drawing on Peirce's pragmatic semiotics, which understands signs as habits whose connections with rich schemas of possible experience render them subject to increasing degrees of self-control. This new framework, I argue, enables us to take a crack at the Information Processing Challenge (Hutto, Myin 2013), and offers the prospect of a new, entirely habit-based epistemology.

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Intertwinings between semiotics and ecology: The current state of the art

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In the current era of species decline and global climate change, working towards a synthesis of ecology and semiotics is both a timely and necessary target. The current presentation will give an overview of the points of co-operation between the two fields and focus on the future perspectives of ecosemiotic studies. The main fields in ecology and environmental studies where semiotics has been recently made use of are: landscape semiotics (Farina 2020); species conservation studies; systems ecology (Nielsen 2007); and environmental communication studies (Low 2008). The semiotic methods and tools prospective to ecology include umwelt analysis (discerning sign-based connections between an organism and its environment, Tønnessen 2014) and ecofield analysis (mapping landscape as a sum of patches based on their meaning and usability to organisms). Although the semiotics of ecological issues has reached to its own disciplinary identity as ecosemiotics (Maran, Kull 2014), there are still challenges to be addressed. These include finding possibilities to include the organism's perspective into the analysis of ecosystems, developing the frame of analysis to cover processes with different semiotic complexities and fostering a shared conceptual framework between ecological science and environmental humanities.

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Deely's object and organism's *innerness*

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John Deely defines an object as a result of semiotic processes patterned from external perceptions as well as from the internal memory and experience (e.g. Deely 2009); consequently, the expression "unknown object" is an oxymoron. The inner dispositions of a living being as immersed in a particular environmental context (including the community of other living beings) will be decisive in defining objects – and the objective reality as its (and its community's) model of the world. I will compare the concept with three models of the living: those by Marcello Barbieri, Adolf Portmann, and Jakob von Uexküll.

From such a comparison, I will present the model of evolution as a semiotic process, as outlined in the recent book by Markoš & Švorcová (2019). Life emerged as a biosphere of cells with established, and universally shared, "rules of the game" (codes) defining genetic processes, metabolism, signaling, etc. Particular organisms will play, improvise, introduce novelties, i.e. develop new living strategies, over such rules, yet (1) when "transgressing the norms" never forgetting basic rules that connect all living being across the biosphere, and (2) preserving a pool of memory and experience based on the history of the lineage, of community, and the individual. Such a potential allows mutual understanding (of various degree, of course) of all inhabitants of biosphere, and negotiating (compromising) – in frames of the community – the ways of living and their trajectories into the immediate future.

The idea will be demonstrated on the examples of tools (epimutations, the "hairball" of interactions, modularity, etc.) as well as of phenomena (morphogenesis, pattern recognition, cooperation mimicry, ecology, holobiotic relations., etc.)

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Discussing episodic memory in non-linguistic animals as a problem of biotranslation

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How can we probe if animals, other than humans, possess a mental record of spatiotemporal events? The aim of this presentation is to explore such question as a semiotic problem of biotranslation (Kull, Torop 2003). This implies presupposing (1) degrees of meaning equivalence between different umwelts, and (2) the possibility of translating different types of awareness in terms of behavior, and vice versa. These assumptions will be framed by the context below.

Episodic Memory (EM) or 'remembering memory' is the main neuro-cognitive subsystem responsible for our capacities of retrospection and prospection. Roughly speaking, it encodes and retrieves information about our past experiences, and is tightly connected with planning and decision-making processes.

EM was first discussed in 1972 by neuroscientist Endel Tulving, alluding to a hypothetical subtype of declarative memory that would account for the fact that reliving an event (as well as pre-living it) is neurologically and phenomenologically different from knowing a fact, or mapping space. The latter two tasks are enabled by Semantic Memory (SM) or 'knowing memory', which is not uniquely human, and is an evolutionary prerequisite for EM.

Nowadays EM is a highly researched system in the transdisciplinary context of Mental Time Travel (MTT) studies. But it is still unclear if its phenomenological traits (chronesthesia and autonoesis) are uniquely human or language-dependent. The underlying epistemological problem, needless to say, lies on the fact that non-human species cannot 'report', in our own linguistic terms, what they actually experience.

Making use of the evidence provided by Panoz-Brown *et al.* (2018) – who argue that rats possess EM – I will further characterize EM in general biosemiotic terms, and ponder to what extent its iconic, indexical and symbolic features may have equivalent non-linguistic counterparts in other species.

According to Clayton and Wilkins chronesthesia and autonoesis "have been impossible to access in non-human animals to date, owing to the lack of agreed behavioral markers of consciousness in non-linguistic creatures" (Clayton, Wilkins 2017: 2). This is not surprising, if we take into account that both features have been mainly characterized with respect to syntax and grammar-centered notions, such as "present", "past" and "future", which could in principle be translated into a non-verbal logic.

The presentation will, thus, explore the arguably less anthropocentric implications of semiosis as a bio-translating framework for probing EM and its relation with SM and other memory subsystems that we share with other species. In order to do so, I will resume semiotic concepts that already deal with umwelt theory and the phenomenology of time (e.g. 'biotemporality', 'virtual habit', 'phenomenal present', 'poneception', etc). The expected outcome is to sketch out a typology of EM concerning the logical relations in the mind between episodic images.

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Analysing umwelt reversion: Communication between local people and the European mink (*Mustela lutreola*)

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European mink (*Mustela lutreola*) is the most endangered small predator in Europe. The island of Hiiumaa is one of the few places in the entire world where this species can be found and has a self-sustaining *in situ* population. However, in order to achieve this self-sustaining population, the mink was reintroduced over the course of almost two decades from Tallinn zoo. Since the animals were taken to the island from a captive environment, they were used to people and the food that humans provided. Thus, during the process of reintroduction, this animal had also a lot of contact with human settlements and the locals of Hiiumaa. This presentation focuses on the European mink's encounters with local people and the stories that they have to share regarding the animal's behaviour. More specifically, we see the information gathered from interviewing local people of Hiiumaa as essential to modelling the umwelt of the given animal and the major changes that have taken place in the animal's umwelt. Based on relevant literature, interviews and information gathered from the reintroduction project managers, we shall argue that the mink population has undergone an umwelt reversion, which is seen as a special case of umwelt transition. Umwelt reversion takes place due to environmental affordances, but also due to humans' activity regarding the reintroduced animals. We will use the examples of how the meanings of "food" and "human" have changed for the European mink population to illustrate the case of umwelt reversion.

Learning the language of life

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What determines how a protein looks, how it works, and where it carries out its function? Within the field of bioinformatics, many methods have been developed to predict the structure, function, and location of proteins based on their amino acid sequences. However, these prediction methods could be much better if we had an understanding of the language of proteins.

In the field of Natural Language Processing (NLP), methods for making machines "understand" human languages are developing rapidly these years. Tasks such as automated translation and text classification are being handled by deep learning methods, e.g. at companies like Google or Facebook. A natural choice would be to apply methods from cutting-edge NLP to the language of proteins, i.e. their amino acid sequences, and indeed, both Google (Bileschi *et al.* 2019) and Facebook (Rives *et al.* 2019) have made initial efforts at protein understanding.

We have also started our own foray into this field, using a recurrent Long Short-Term Memory neural network to build language models for protein sequences, i.e. models that predict an amino acid given its context in the sequence. From this work, we have learned that the language of proteins has *dialects* – the predictability of amino acids depends on the origin (domain of life) of the sequences used for training and testing. As an example, bacterial proteins seem to be generally more predictable than eukaryotic proteins.

Our long-term goal is to use the internal states of trained protein language models as representations of proteins for various prediction tasks, including the structure, function, and location of proteins. In this way, the vast amounts of unannotated protein sequence data could be brought to use in such prediction tasks, which otherwise depend upon severely limited amounts of experimentally annotated sequences. It has already been shown that such a representation is able to improve predictive performance of secondary structure and subcellular location (Heinzinger *et al.* 2019), but that study was, like the Facebook and Google attempts, done without taking dialects into account.

Another way to use a trained protein language model is to ask it to generate novel sequences without homology to any known proteins, but with biological properties similar to those in its training set. By generating novel proteins using our language model and a simple background model, we have e.g. shown that proteins from the language model have a realistic proportion of predicted signal peptides in contrast to the background model, which generates almost no signal peptides. This shows that a neural network representing an understanding of proteins in general can have tangible technological implications.

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Time transfer: Human B-series time as a spin-off from biological E-series time

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Can we say with certainty that our standard human time is empirical and intrinsic? We all know that our clocks tell us time, but we cannot actually observe time or how time behaves even though it is thought to be around all the time. The ticktack of a clock is a rhythmical sound, and the hands display physical movements. They are just sounds and movements, but no more. Time seems impalpable with no substance. There is nothing as intrinsically identifiable as time. If so, empirically speaking, where is time?

The key to solving the mystery is found not in time but in timing, that is, timing in terms of a verb. Timing as a transitive verb is defined as "to set the tempo, speed or duration of," as in the case of "She timed her leap perfectly," according to the Merriam-Webster. Notice that such timing (v.) is observable among living organisms themselves, as well as to the outside observer, for example, in such a case of a hunting owl adjusting timing to fly off to catch its prey, a mouse. Timing adjustments along with time spanning among the participating organisms are at the core of experiential time measurement, where such adjustments necessarily require temporal coordination in relation to one's environment or with other individuals. What we can experience empirically in biological fields – without assuming the existence of time – are these interactive phenomena of timing adjustments.

The present paper is written for the argument that our standard time (ST) in the B-series (i.e., a *mono-metric* time scale constructed by removing the space and interactional variables) is an indexical system derived from the E-series (i.e., a *dia-metric* time frame of local synchronization, in which time and space are intact). *B-series time being the decisive and necessary tool for human social existence may be an "artifact" or an abstracted derivative* *from the relational code used in timing adjustments in biology, which are observable to the internal participants as well as to the external third-person.* Our non-empirical global time (ST) in the B-series is therefore considered an offshoot from the empirical local time in the E-series.

The concept of *time transfer* refers to the shift from one time-series to another or its shift back, that is, E-series time being replaced by the *monometric* measurement of global synchrony in the B-series, or the other way around. For example, the E-series time frozen in the finished record may be taken as the B-series time. Alternatively, the acting-out of this record may be equated to a *back time transfer* from the B-series to the E-series. However, this in-bound route is beyond the scope of the present paper involving the non-empirical notion of "internal models," which is considered the C-series, although this acting-out is often observed among humans in playing the instrument from the music score (in the C-series) or in performing the stage along the script (in the C-series). The act-out of such static time maps in the C-series represent re-emergences of the E-series time.

Using the data from the mother-infant interaction, circadian rhythms of *Cyanobacteria* and social behaviors of fruit flies, we explain how the intersubjective time of a second-person dialogue in the E-series is transferred to the objective time of a third-person monologue in the B-series.

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Integrating biosemiotics and multimodality: A criticism of double articulation

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This paper advocates for the bridging of biosemiotics and the recent *multimodality* framework. The resulting theory construes culture from the perspective of embodiment, arguably a long-standing aim of biosemiotics, first explored by Cobley (2010; 2016), but not fully developed. Towards this end, a semiotic notion of the body (Stjernfelt 2006; Hoffmeyer 2008) is not yet integrated, as a mandatory part and parcel, in what should be a cognitive semiotic theory.

While coming from contrasting traditions of semiotic scholarship, biosemiotics and multimodality theories share a criticism of (the several versions of) the *double articulation* hypothesis in linguistics. While occasionally remarked, the opposition to the view of meaning as the double articulation of form and content, in both of these areas of scholarship, has not been explored. Biosemiotics has a latent interest for explicating meaning as multiply articulated, implied by the construal of umwelt as relying on the variety of sense perception channels and semiotic systems that a species has at its disposal. The multimodal approach to meaning and communication has a latent interest for embodiment, by starting from the other end, from the consideration of the modal heterogeneity of messages. Thus, integrating these theories in light of their rejection of *double articulation* can constitute a remarkable step towards overcoming the polemic in linguistics between, simplifying, cognitive universalism and cultural relativism.

Perpetuated in various incarnations in, for instance, phonology, (post) structuralism, anthropology and sociolinguistics, the double articulation hypothesis fundamentally relies on de Saussure's notion of the sign as an articulation between signifier and signified, where the latter are understood as opposing entities. Brandt (2011) claims that this this opposition, which he terms a "wall", gives semiotic terminology its functionality, while also explaining that the work of signs breaks down the wall. He concludes by suggesting that the signifier/signified divide is (one of) the last strongholds of Cartesian dualism which prevents a proper understanding of the body as semiotic. An account of the body as semiotic, following Brandt, is necessary because it explains the possibility of sharing meaning as signifying that which originally is intimately introspected.

Further, by relying on the cognitive semiotic notions of *polysemiotic communication* (Zlatev 2019), as complementary to, rather than alternative for *multimodality*, and *exbodied mind* (Mittelberg 2013), I expose the possibility of integrating the multimodality theory and biosemiotics around a shared criticism of double articulation. My main argument is that this opens the possibility of a construal of the body as fully semiotic, as the shared direction that recent developments in cognitive and bio-semiotics and multimodality indicate.

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8D model of discourse viewed as a functional transforming system and a living holistic sign: Causal-Genetic Approach (CGA) as a current trend of discourse linguistics

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CGA (Oukhvanova 2017: 8–19) models discourse as a *meaning-representation* sign open to multileveled function-following transformations which are systemically and structurally recurrent. As such, discourse represents itself via a set of codes (dimensions of its replication) subordinated to natural conventions, which regulate and are regulated by the general and particular, e.g. via social and individual representations on all levels of its functioning. Each discourse-produced code is responsible for its own (homeostatic) control within the body of a discourse system.

In accord with CGA, the main codes of discourse are grouped into those producing ideational and phenomenological types of content (macrolevel discourse research) or meaning (microlevel discourse research). While the ideational content is built on the axes of mental processing (epistemic – syntagmatic, axiological – paradigmatic), which is the prerogative of the semiosphere, the phenomenological content is built on the axes of phenomenon-based activity ('referential – sign-referential' (R – R') and 'cortege – sign-cortege' (C – C')), which is the prerogative of the biosphere.

Natural intercrossing (marriage) of ideational and phenomenological content reproduces offspring, that is, an 8D discourse and thus 8 codes of discourse representation. Their functional representation can be found in such scientific schools as CGA (Oukhvanova 2015), which follows a deductive tradition of discourse modeling, and the French school of discourse analysis (Maingueneau 2002), which follows an inductive tradition of representing elements of discourse organisation. We can consider the CGA model presentation here in the context of its verification. Thus discourse represents itself via the following codes:

(a) referential code of discourse reveals its referential layer of content production and replication, e.g. referents (R) as socially evaluated and individually structured *(Le discours est contextualisé et pris en charge)*;
(b) sign-referential code of discourse reveals its virtual referential layer of content production and replication, e.g. sign-represented referents (R')

as individually textualized and extracted from socially formed language paradigms *(Le discours est une form d'action et suppose une organisation transphrastique)*;

(c) cortege code, in turn, reveals discourse's cortege layer of content production and replication, e.g. corteges (C) as individually assessed (corteges with actualized attitudes) and normatively textualized/addressee's targeted (*Le discours est interactif et orienté)*;

(d) sign-cortege code, finally, reveals discourse's sign-represented cortege layer of content production and replication, e.g. sign-represented corteges (C') in accord with formats as time-depended virtual (agreed) space organisation of communication, and genres as cortegetype varied communicative space non-time dependent (*Le discours est régi par des norms et pris dans un interdiscourse*).

Such a dynamic (structural/functional) view on discourse modeling supports describing discourse as a universal *content-minded* communication-bounded system of content-produced codes, which makes it open for applying to different domains of knowledge focused on meaningful processes and products.

The approach of 8D discourse modelling introduced in the European context and presented in the given abstract meets both Eastern and Western traditions as it applies a discourse type of thinking (going to and fro) enriched by Peirce's logical circle ('-inductive-abductive-deductive-abductive-' type of thinking). The aim of our approach is to keep a holistic functional type of thinking, however complex the research object is from its structural perspective. The approach in its applied perspective joins the tradition of exploring the world of living subjects.

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Semiotics of (linguistic) fingerprints: Perspectives of individuality

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We usually ask what people – humankind as one species – have in common, what we share, what makes us alike. Here we want to ask the opposite question: what makes us unique beings, distinct individuals - the one and only among the rest?

Fingerprints are subtle patterns on the top of each finger – dactyloscopy, the discipline of fingerprint identification, distinguishes several types of archs, loops and whorls: every person has fingerprints with a unique combination of these patterns. It is their singularity what makes them the most convenient proof for identification of their author; they are perfect and undeniable indexes.

The question is: is it possible to find an identification tool with the very same attributes and indexical character as biological fingerprints? Of course, we can talk about genetic fingerprints based on the uniqueness of DNA minisatellites. But let's look at the case when we need leads rooted in the human mind without needing any type of tissue to recognize them. We want to present "linguistic fingerprints", subconscious language idiosyncrasies each person uses in their speech and text structures. Even in this place it is appropriate to speak about a combination of patterns. We can actually find them on all language levels and areas: lexicology (vocabulary, word order, parts of speech, word length), morphology, syntax, typography, etc.

We would like to introduce some basic qualitative and quantitative approaches from the field of forensic linguistics, whose object of interest is to distinguish language patterns and attribute them to their author. Our aim is to show that biological fingerprints in general, including all genetic leads, and linguistic fingerprints in particular, have essentially the same nature: they serve as unique indexical markers and can be used to identify individuals.

From Incomplete Nature to Incomplete Society: Sense, absence, and mass media communications

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Inspired by Terrence Deacon's claim that biologists need to change their view of complex living systems to include "specific absences" (Deacon 2011) with real effects, this essay analyzes how Japanese TV is structured and constrained by ententional factors at a variety of levels. From helping to explain everyday work practices observed inside a major Osaka television station (for example, how TV producers avoid being caught on camera at all costs) to framing deeper systemic questions (how TV creates a quasi-intimacy with its amorphous viewers), the absential perspective is both flexible and productive. At the same time, a wider socio-theoretical framework is needed to more fully conceptualize the complex operations and functions of the mass media today. Here, Niklas Luhmann's pioneering writings on the functional differentiation of social systems, and especially his ideas about the mass media as the sine qua non of modern culture and communication, can help us begin to build such a model. While there are significant differences between biosemiotic and Luhmannian approaches to conceptualizing signs and meaning in complex systems, I believe that Deacon's focus on an incomplete nature and Luhmann's insistence on an incomplete society (incomplete in that it can never match the complexity of its own environment) together open up new spaces for observing and understanding our dynamic, evolving world.

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Conceptual blending in animal cognition: A biosemiotic account

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The theory of conceptual blending (CBT) from cognitive linguistics attempts to account for memory-based networks of compressed relationships that are shared between patterned clusters of experience known as "frames" or "mental spaces" (Fauconnier, Turner 2002). The cognitive processes CBT is designed to model have traditionally been discussed as "analogy" – a classical yet vital function often equated with thought in general, or even the human language faculty. The CBT account improves on traditional treatments of analogy by proposing a typology of conceptual integration networks in four layers: (1) simplex, (2) mirror, (3) single-scope, and (4) double-scope integration. Notably, this typology is not only gradient but also evolutionary, with the fourth level being said to represent the emergence of language out of animal communication (Fauconnier, Turner 2002: 119–135). But in spite its promise for clarifying fraught distinctions of key importance to ethology, evolutionary linguistics, anthropology, and semiotics, this aspect of CBT theory has received scant attention in the literature. This is a problem well suited for biosemiotic intervention. In response, I apply ideas from Charles S. Peirce, Thomas Sebeok, John Deely, and other semioticians to two sets of data in an attempt to further clarify the theory, establishing in the process foundations for a working database of examples suitable for testing and refining CBT's evolutionary typology of animal communication. The first set of data is drawn from contrasting observations of interspecific and intraspecific baboon communication reported by Robert Sapolsky (2001) in *A Primate's Memoir*. A supplementary collection of data is drawn from a wide range of a published findings and reports on animal communication. In the process of categorizing examples to test and refine the CBT typology, the importance of semiotic insight for distinguishing and relating concepts becomes focal. Prominently included are semiotic consciousness and the human language capacity – the former being a reflexive awakening to signs as signs (Deely 2010), the latter being the creative modeling of possible worlds.

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Co-taming, co-domestication, and our nearest and dearest

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People and the other creatures most fascinating to them, especially mammals, and among them, dogs, have been linked throughout their common coevolutionary history or, "prehistory". History is written; prehistory is inferred. Previous to that coevolutionary past, of course, human animals share a phylogenetic genealogy with other closely related creatures in the order of primates, with other orders in the class of mammals, and with other classes in the subphylum of vertebrates. All living things share common structures, as in genes, and common functional processes, as in biochemical pathways, which have all been relatively conserved throughout the otherwise kinky diversification of species throughout time and across space. We also share our habits of relations amongst living things and our hardly inert immediate landscapes and remote firmaments. What we don't share are the cumulative traces of individual experiences, sometimes epigenes, which themselves mutually embed with their umwelten. Along these paths we now realize the evolutionary story is not represented by an inverted tree diagram.

It should therefore be no surprise that we humans also relate behaviorally, cognitively, socially, and culturally to the livingness around us, and that the most salient of these relationships are to a degree interdependencies, even actively reciprocal. We recognize the mutuality or complementarity in, for instance: hunting, tracking, omen-reading, surrogating, imitation, recreation, pet-making, dreaming, parasitism, protection, herding, husbanding, path-making. That humans and other creatures exist as mutual constructions of each other can only be understood as the outcome of: (1) long-term phylogenetic evolution (and co-evolution); (2) blatant or latent domestication (or, more appropriately, co-domestication); (3) sometimes shorter-term shared ontogenetic development (hence co-development), even leading to (4) mutual habituation (hence co-taming).

Certain alloanimals have entered into co-domestication with humans such as dogs and cats, horses and cows, sheep and goats. Notice how more of these animals trip off our tongues paired in litanies, as do some less cognitively significant undomesticated creatures, such as flies and mosquitoes, birds and bees, and even some plants, such as mushrooms and toadstools, peas and beans. We now know that humans have not unilaterally shaped, through artificial selection our so-called domesticated animals. Rather, humans were also transformed in the process, which in some instances was not initiated by the human at all.

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The thirdness of clinical medicine: A life story narrative

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Semiotic approaches to clinical medicine are well evidenced in the literature and take various forms. One of these forms is to frame clinical diagnosis in contemporary medicine within semiotic approaches such as that of Peirce and de Saussure. This body of work relating clinical signs (firstnesses) and disease (secondnesses) privileges these two categories over thirdness. This concern with signs and their diseases also reflects an instrumentalism with regards to the goals of medicine that sustains a fruitless impasse between subjectivism and objectivism.

The interpretation above however treats the interpretation of the signs as disease as the central concern. This is however contrary to the observations of non-human animals – particularly in chimpanzees – caring for injured and sick co-specifics – in that they do not construct ideas of disease and diagnoses in linguistic terms as medicine does. The importance of this observation lies in the fact that they are not, seemingly concerned with the disease as such but with the distress caused by the physical and emotional states of the co-specific and the interpretation of that distress in terms of their own bodily, emotional and social lives. This may displace the centrality of the diagnosis of disease in clinical care and bring to the fore a thirdness of care or empathy. The discovery of mirror neuron systems in monkeys as well as behavioural and imaging studies of humans have given insight into link between perception and action and its links to memory and emotion both neuroanatomically and behaviourally. Through qualitative methodology I seek to provide a description of kind of thirdness in clinical medicine.

In this paper I present a life story narrative of a neurodevelopmental paediatrician in South Africa. His account of his experience in clinical practice is rich in metaphor, imagery and memory and draws attention to experience of the thirdness and allows us to consider the practice of clinical medicine within the evolutionary biology and neuroscience of empathy.

This account of the thirdness in clinical medicine presents the interpretive importance of empathy in clinical medicine as the recognition of the co-specifics distress in relation to the interpreters own physical body, memory, creativity and life experience and proposes potential neurological origins of these interpretations. By seating thirdness in clinical medicine in the biology of empathy, it is possible to accommodate both the signification of discrete clinical entities as well as lived experiences of suffering, distress and healing.

Semioticum Mondi

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The Semiotic Worlds can be considered as a common space between beings – both human and non-human – its construction is filled with interpretable objects, translations and actions that will eventually lead to memory. This constitutes an intermediate point between what perception is and the possibility of the representation of what has been previously interpreted. Following the theories of Jakob von Uexküll and Ernst Cassirer, we are also confabulating nature and culture. Both provide a way to decipher the semiotic reality that encircles each world. For interpretation to take place we must acknowledge those who share our space and that cause interpretation and translation; culture as nature is composed of these worlds, the soap bubbles of Uexküll. There is a double interpretation effort, since the contents and stimuli provided by nature sooner or later will find their place in culture. Here is where semiotic reality takes place: all these processes must lead us from the signifying sphere to the signified world, through the sign vehicle that initiated the process in the first place. It is in this line of thought that we should consider all living beings as capable of interpreting their space. Everyone lives in a world that surrounds them and reacts accordingly, and in each world objects are charged with meaning, which is given by the subject immersed in it. Intersubjective and relational fluxes play an important role by implying that we share an umwelt. Considering that we are capable of interpreting and of being subjects of interpretation by others, we are affected and affect each other.

Umwelt, extinction, and the return of the disappeared

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Extinction studies is a relatively new avenue of research in the humanities. Biosemiotics could contribute by studying the extinction of nonhuman forms of meaning making – of semiocide – in the living world. In an era of human-induced sixth mass extinction event, there is a need, as part of attempts at mitigating the present crisis, to bring this disappearance more clearly to cultural awareness. When it comes to capturing the imagination about the consequences of species extinction, whether that extinction amounts to cultural forgetfulness or the perpetual disappearance of biological species, comparative umwelt studies could prove to be a useful tool.

Cultural imaginaries about the ends of the world abound. This presentation attempts to describe the consequences of the activities of *homo destructor* on nonhuman modes of semiosis, what we can learn from it, and what consequences there may be from their loss. For, as Vinciane Despret has put it, "Each time an existence disappears, it is a piece of the universe of sensations that fades away" (Despret 2017: 220).

Of particular interest are what could be termed "dark umwelts" (Maran 2017), the life-worlds of species fundamentally different from humans, the understanding of which is particularly challenging. More often, the cultural imaginary circles around charismatic megafauna of various sorts; meanwhile, understanding the full diversity of meaning-making should require us to examine fundamentally "alien" species as well. In addition, human beliefs and ideas are dependent on human species-specificity. A comparative analysis of nonhuman umwelts could then also show the possibilities of thinking more deeply about semiotic and philosophical concepts by considering the embodiment and cognition – the umwelts – of nonhuman animals. This would then amount to an increased diversity and thoroughness in the realm of ideas and concepts.

The presentation will describe certain unusual umwelts and relate them to human modes of thought and cultural imaginary, in an attempt to show how a comparison between the umwelt and embodiment of nonhumans and humans can deepen but also dislocate certain philosophical thought patterns. What if the philosophical animals themselves were to look at humans and assess their thinking, instead? And what consequences are there when the famous "good to think-with" animals were to disappear forever?

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Where is the place of aesthetic?
Hypotheses for a non-art-centered aesthetics

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This paper aims to explore how biosemiotics can aid in formulating a new and more inclusive definition of aesthetics and its goals. Specifically, the current trend is to consider aesthetic – or the object of the field of study of aesthetics' – as exclusively related to one of its possible products: the work of art. It is precisely this limiting idea of aesthetics that I would like to move away from. With the purpose of better defining aesthetic as a model-making instrument, I believe it is worthwhile to adopt the tools provided by biosemiotics.

The idea of aesthetics as a modeling system, however, is not completely new. One of the most interesting definitions has been formulated by one of the precursors to biosemiotics, Gregory Bateson, who in *Mind and Nature* described aesthetic as "responsive to the pattern which connects" (Bateson 1979: 8). Other attempts have been carried out by the two semioticians Charles Morris and Juri Lotman. In particular, Morris claimed that aesthetics has to be defined as "the science of esthetic sign" or "the science of esthetic perception" (Morris 1939: 132) and Loman argued that art is an important modelling system among secondary modelling systems, because it allows to store and increase in a very economical way a large amount of complex information (Lotman 2011).

These theories lay the foundations for a modelling theory of aesthetic. However, as far as Bateson's description is concerned, it lacks a further detailed study and regarding Morris' and Lotman's definitions, they remain circumscribed to human semiosis. In order to further develop these theories and try to extend the concept of aesthetics so that all phenomena of living beings are included – thereby formulating a non-anthropocentric perspective – it can be useful to follow the Modeling System Theory offered by Thomas Sebeok and Marcel Danesi (Sebeok, Danesi 2000). Here, compared to Lotman, the main modeling systems are three, among which the Primary Modeling System – essentially iconic – is also shared by other non-human animals.

In conclusion, in this presentation I will argue that a type of aesthetic behaviour can already be observed in the Primary Modeling System and, more specifically, in the ability to select meaningful connective similarities and differences from the surroundings, whereas the work of art finds its collocation only in the Tertiary Modeling System.

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Tracking and classifying objects: Solving a conundrum for simple semiotic systems

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Biological semiotic systems require a certain number of capabilities to be considered semiotic as such. However, when dealing with the boundaries comprising the lower semiotic threshold, semiotic features become scarcer as requirements for semioticity stand more or less fixed. I will argue that tracking and classifying objects are central requirements for semioticity altogether, and while this presents an important problem for simple organisms, there may be ways to develop theoretical solutions to the conundrum.

In order to develop a potential solution, I will explore how rigid our concept of object must be for the purpose of a sign and the limits of internal and relational capabilities of a model organism. By doing this, we can formulate a kind of object classification that is flexible enough to account for semiosic activity at the lower threshold while also being robust enough to use as an indicator of minimal semiosic capabilities. While the criterion itself could not account for a full threshold theory, this theoretical approach aims at grounding sign usage as a biological function on object classification, the latter taken as a crucial part of semiosic capabilities at all biological levels.

From perceptron to semiotron: A (bio)semiotic approach to artificial intelligence

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After nearly three decades of a "winter", artificial intelligence based on neural networks (NN) has been warmed up by Big Data and now seems in a spring mood. There are great expectations that an all-purpose general machine based on multi-layered NN will be capable not only of "deep learning", but also of emulating most – if not all – characteristics of a complex living being, including expression of emotions, action based on moral choices and even aesthetic judgments that would allow it to create art. The definition of intelligence is critical when such claims are made. In the early 60's of last century, Rosenblatt, Minsky and their followers took the biological functioning of the brain as the prototype for building artificial neurons and emulating intelligence. The culminating point wast AlphaGo and similar algorithms that can not only "learn" and master any board game, but also solve many difficult problems in chemical, medical and pharmaceutical fields, such as diagnosis and the synthesis of new molecules. But this is not the final proof of intelligence as envisioned by Alan Turing. Turing was adamant in putting human communication as the highest possible bar in the pursuit of artificial intelligence. We are far from this yet. One mocking dictum among philosophers of mind is that "intelligence is and always will be whatever a computer cannot do – yet", which exposes the everlasting difficulty between what C. P. Snow once called the "two scientific cultures": hard and soft, hard being mathematically minded and soft being humanistic in its nature. Maybe biosemiotics, understood here as the general logic underlying the behavior of living beings, could be of some help in solving this aporia. Biosemiotics is much more about the mind than the brain, meaning that it is much more concerned about the general logic of perception, representation, and communication than the activation threshold of neuron networks and their convergence to a final state. We will propose here a shift from Rosenblatt's perceptron (1957) as the basis for artificial intelligence to the semiotron – a processing unit based on the semiosis of communication. The semiotron was introduced by ourselves (2010) as a hypothetical machine based on the solenoid of semiosis, a logical structure connecting all the minute aspects that compose a sign in Peirce's definition of it. We think that the time has come to develop and implement such an approach. Our hypothesis is that (bio)semiosis can help us explain much of what is not understood in "deep learning" algorithms. In fact, the undeniable success of machine learning based on NN comes with a baffling admission that no one really understands why they work. Since artificial intelligence is taken to be the next turning point in the evolution of human culture, we find it critical that we might be developing something that we do not really understand. It is not an overstatement to say that this might be a real threat to our civilization. We hope that biosemiotics can contribute to the debate.

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Mimesis, body plasticity and the evolutionary emergence of language

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This paper develops the notion that a global semiotic lens spanning nature and culture (thus encompassing phenomenal and emergent processes of life generally) is a particularly vital frame for inquiry into the evolutionary emergence of language. It is further suggested that such inquiry, in its turn, might reveal itself to be the single most important area of study to the difficult work of moving beyond long-standing dichotomies between biological and cultural studies, and of affirming the perspectival salience of a semiotic theory of life. This accords with Thomas Sebeok's prognostication that the "strategic anthroposemiotics/zoosemiotics dichotomy will stand, just as long as the riddle of the origin of human language remains unsolved" (Deacon 2004). It is from this wide lens semiotic perspective that I approach the object of the origin of language, locating it within a coevolutionary complex whereby:

(1) physiological impulse (bio-/zoo-semiotic), operating through certain
(2) biophysical systems of constraint (corporeal, kinesio-semiotic), embedded and enacted within a
(3) dynamic local ecological niche or umwelt (ecosemiotic) could give rise to
(4) symbolical insight (anthroposemiotic).

It is argued that evolutionary semiotic processes hinge, crucially, on mimesis – as the primary (iconic) mode of information transmission (Donald 2013) – in its social imitative sense and in its biological replicative and adaptive senses. A faculty for mimesis is explored as a requisite preadaptation underlying a capacity for symbolic reference in language (Innis 1985). The primary locus wherein these processes are explored consists in the physiological and potentially coevolutionary interrelation between the brain (prefrontal cortex) and the extra-encephalic constituent parts of the greater corporeal whole (i.e. – the human/hominin body) with specific regard to those parts that have exhibited a higher articulative/communicative competence for perceiving, navigating and manipulating the environs in which the organism is embedded. These would include the semiotically dexterous features of the anatomical periphery (rooted in internal neurological

systems) such as eyes, ears, arms, hands and fingers, facial muscles, lips, and, crucial to the eventuality of linguo-centric human language, tongue – the muscular little stylus that I argue would be sufficiently equipped to mimetically "underwrite" a very particular kind of coevolutionary process, one that might culminate in the reified corporeity of mind by virtue of an underlying isomorphism of articulatory potentials shared between (phono)lingual and pan-corporeal domains.

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Non-physicality, symbolic reference, and science

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This presentation is a follow-up to the one I presented at the Gatherings in Biosemiotics 2019. The basic issue is that at some point in its evolution the human brain became capable of producing and processing nonphysical symbolic concepts (e.g. freedom, law, democracy, love, hope, motivation, emotion, peace, politics, obstruction). As a result, humans now live in a world that is both physical and nonphysical, and the nonphysical part of the world is made up of precisely those concepts whose labels have no physical referent in the world. But in symbolic reference, as conceived in Peircean sign theory, symbols (words) can get their meaning from other words, not from things. This makes symbols nonphysical/nonmaterial and their reference is grounded in interpretation and imputation, not in physical entities. The position seems dualistic. We have a physical world and then we have nonphysical entities in that world. The question becomes how they interact. This difficulty is one of the major reasons for rejecting dualism. I will suggest that if the physical brain produces nonphysical entities, and then the nonphysical entities become part of the human environment and have influence on the physical brain just as the physical environment does, the interaction between the brain and the nonphysical world is not problematic. The link is the fact that material human brains (often acting in interaction with other brains) are the generators of the nonphysical world, and the question of how the brain and the mind interact is not problematic.

The other issue I will address is whether the nonphysical aspects of the human world can be studied scientifically. From the time of Galileo, science has been consistently restricted to that which is observable, objective, mathematically describable. However, nonphysical entities are unobservable, subjective, and not amenable to mathematical description. If this is the case, then our nonphysical conceptual world is outside the domain of science (Goff 2019).

If the nonmaterial world comes out of the physical brain, then there is an ontological continuity between the physical and the nonphysical, but there may be an epistemic gap between the two. In other words, we can't know the nonphysical world in the same way and by the same methods as we know the physical world. Observation and experimentation may not be enough.

What is involved then is interpretation, imputation, inference, all of which lead to understandings but not facts – no final solutions. This places the nonphysical aspects of humanity and the human mind smack in the humanities, the arts, and the "social" sciences (anthropology, sociology, psychology, linguistics, and biosemiotics.

Whether nonmaterial/nonphysical entities are outside the domain of sciences has implications for biosemiotics because this field is concerned with sign interaction among physical biological entities and with nonphysical entities at the level of symbolic reference

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Translation in biology

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Translation means a semiotic process in which meanings are transferred or transformed between different sign systems. This term is similar to 'interpretation', but it is more relevant for lower-level or automated processes that preserve most of the incipient meanings. Following the project of Kobus Marais (2019), aimed at expanding the notion of translation beyond linguistics, here I present an overview of translation processes in living organisms. Translation is a function of organisms, and as such, it is more than a mechanism and should be considered in the evolutionary context. At the molecular level it is represented by two sequential steps of processing of the hereditary information: transcription – copying of DNA sequence to RNA, and translation – synthesis of proteins programmed by the RNA sequence. Protein synthesis is, however, not the end of the biological translation chain. Extended steps of translation include protein folding, transport, and functional activities of proteins. Proteins become agents that perform translation/interpretation functions on their own. In contrast to Peirce's semiotics, molecular-scale interpretation (protosemiosis) does not include objects (Sharov, Vehkavaara 2015), and the interpretants function not only as signs but also as agents at the following interpretation steps. The difference between agents and signs is that agents act, whereas signs signify. These roles can be combined; however, in this case, the role of interpreting agency is active and, in this respect, more important than signification. Signs are grounded in agency because agents use signs as information-carrying tools (Sharov 2018). Biological agents are multi-level – they include organisms, their subagents (organs, cells, organelles, molecular complexes), and multi-organism systems (e.g., colonies and symbiotic consortia). Translation of signs and messages is performed by agents of each level, and it is aimed at regulating all living functions, such as construction, repair, recruiting, or reprogramming of themselves, their subagents, and/or external agents. Thus, biological translation is a goal-directed process targeted at maintaining the identity of living agents at all levels.

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A game of… senses and signs: cross-modality between nature and languages

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Synaesthesia is a perceptive-sensorial phenomenon which represents an important research topic in neurology and psychology as well as in literary studies and linguistics. Sounds, colours, images convey information and can explain some elements of the source text that otherwise may not be visible or clear to the recipient, especially if they belong to a different cultural space. According to specialistic studies on synaesthesia, even vowels and consonants have an associated meaning. Therefore front vowels, high tone, and voiceless consonants are connected to brightness, sharpness, freshness, thinness, pleasant smells, intensive colour, while back vowels, low tone, long vowels, and voiced consonants are rather related to largeness, fatness, unpleasant smell, lack of taste, and awkwardness etc. (Cuskley, Kirby 2013). Similarly, colours are commonly known to convey a precise (and conventional) meaning, which might differ depending on the culture. Additionally, the simultaneous exposure to different sensorial stimuli enhances our receptive capacity of text and communication and may therefore result in a more complete and effective reception of the message.

The paper will present how senses at a neurological level stimulate the creation of signs and meaning and contribute to their interpretation through synaesthesia. It will also illustrate how cross-modality through a cross-coding and decoding process of senses and signs belonging to different language-codes work and generate meanings in multimodal text.

It will also refer to some researches carried out in the field of cognitive neuroscience and psychology in order to point out the strict connection between the sensorial and semiotic spheres. For instance, as explained by a pool of researchers in Cognitive neuroscience from CUNY and University of Texas, "[p]hysiologically, the similarity between auditory and somatosensory processing begins in the structure and function of the receptor organs." Similarly, "neuroanatomically, the organization of the cerebral cortex is well suited for integrating sound and touch information" (Ro *et al*. 2013).

The role of multimodal translation will also be discussed as sounds and images are usually more "understandable" also to those who have to interpret the message contained in the text, especially when it has been expressed in a different language and culture.

The final aim will be to prove once more the strong link and interaction existing between our naturally provided capacities on one side and the semiotic and semiosic character of signs in different language codes on the other.

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Biosemiotics and the evolution of scientific theories

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Charles Peirce, one of the founders of semiotics, had a strong interest in science. Indeed, he related science to the method of inquiry, which he considered one of the best ways to overcome doubt and fix belief (Peirce 1992 [1877]). However, although his *pragmaticism* (together with the works of other proponents of classical pragmatism, such as J. Dewey and W. James) has certainly influenced the development of the philosophy of science, his *semeotics*, on the other hand, has not been thoroughly examined from the perspective of its relationship to the central issues in philosophy of science, such as theory change, realism, and scientific progress. While biosemiotics' main interest has revolved around a better understanding of life based on the insight that life and meaning are coextensive, another insightful observation – which has guided research in fields like evolutionary epistemology – has been that knowledge and life are also very closely related. In this talk, a comparison will be made between two interpretations of Peircean semiotics that are relevant for current debates in the philosophy of science: the first of them has been advanced by T. L. Short (2007) and hinges on a detailed analysis of the relationship between Peirce's faneroscopy and his system of categories; the second one is based on a reconstruction of N. R. Hanson's views on observation, the nature and interpretation of scientific theories, and the logic of discovery – which has strong links to Peirce's philosophy –, that employs both Peirce's system of categories and J. von Uexküll's insights into the relationship between organism and environment, particularly his notions of functional circle and *Innenwelt*. It will be argued that the second account, which is based on the relationship between Hanson and Uexküll, solves some of the problems that Short finds in biosemiotic interpretations of Peirce's writings while also producing valuable insights for contemporary concerns in the philosophy of science.

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Monkey business or what is money talking about? An introduction to economical biosemiotics

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Besides language, economical means, relationships and values for centuries considered by scholars as uniquely human, the founder of classical economics, Adam Smith, believed that monetary exchange and the idea of private property belonged solely to humankind. "Nobody ever saw a dog make a fair and deliberate exchange of one bone for another with another dog. Nobody ever saw one animal by its gestures and natural cries signify to another, this is mine, that yours" (Smith 2007: 41). However, recent studies in behavioral economics involving rats, pigeons and monkeys have shown that animals present economical behavior and rational economic choices similar to humans. The basic concept of (self-)property ('this is mine, that is yours') was found in bacteria and plants that could recognize self and non-self signals (changes) and activate defense mechanisms. The marking of territory by social animals is also a routine and ubiquitous business in nature. Agricultural 'business activities' with their elaborate labor division, distributed cognition and advanced communicative skills have also been discovered in ant colonies. For example, fungus-growing ants culture fungus, yellow meadow ants practice animal husbandry by keeping root aphids as a source of food and supply for honeydew secreted by aphids. Another unexplored and underestimated topic in biosemiotics is the biological nature and evolutionary preconditions of money. There are several researches in the semiotics of money, but no works on the biosemiotics of money. Fortunately, several studies in behavioral economics have been conducted about the usage of fiat currency in a colony of capuchin monkeys. It has been shown that monkeys are able to understand and use money as an abstract concept/values and have economical biases similar to humans (Dubner, Levitt 2005). Capuchin monkeys recognize the symbolic nature of fiat currency and do not reduce money as a concept to objects used for coins (in experiments they tried to use other objects with a similar shape as that of money). In Peirce's terminology, they understood money not just as the particular object ('sinsign') or general type embodiment ('qualisign') but as a 'legisign'. Being a sign, money has a paradoxical nature. It 'makes sense' and has value if it stands for something else, it is abstract and concrete and its value is both autonomous and relational. Studies of capuchin monkeys have also shown that they are not capable of saving money. However, the ability for saving for the future is common in nature and shows the ability of animals for 'mental time travel' and anticipation (mental representation) of the future (Roberts 2007). For example, squirrels and birds (scrub jay) can anticipate a future need for a specific food and store it for proper time. Studies of squirrel monkeys also have shown that monkeys can ignore immediate profit in the name of bigger, anticipated profit. Finally, in the framework of studies of isomorphism between biological and social systems, a firm analogy between money and energy can be drawn. Money is like a nutrient that supplies with energy the development and growth of the economy. Heraclitus once said: "All things are an exchange for fire, and fire for all things, as goods for gold and gold for goods". Adenosine triphosphate (ATP) is metaphorically considered by scientists as the universal 'molecular unit of currency' of intracellular energy transfer (Roberts 2007). In light of the 'Mathematical Universe Hypothesis' it is also interesting to theoretically reevaluate the evolution of money from a barter economy to a digital economy.

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The trouble with mechanicism and why does it always win?

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Living beings, their parts, behavior, and functioning have been compared to machines since the time of Descartes and the machine they were likened to have always depended on the state of scientific progress: in the 17th century, organisms were compared to clocks, in the 18th century to steam engines, in the 19th century to factories, and since the 20th century, organisms have been compared to computers. Such analogies permeate all areas of science from molecular biology to linguistics. They are usually accepted with no philosophical reflection as the basic ontology for living beings and related phenomena such as development, instinctive behavior, or language.

My paper focuses on contemporary biology and one core question: Is there a way out of mechanicism? Are there any theories or approaches that grasp the character of living beings without viewing them as machines and are not vitalistic? In what respect are these theories better suited to describing the agency of living beings? And what are their methodological weaknesses and flaws?

In my contribution, I discuss various approaches to biological systems and organismal agency, such as organicism, process philosophy of biology, biosemitotics, and others, and compare them with the prevailing mechanistic view. I briefly review their historical and philosophical background, possible methodological advantages and implications with respect to a description of agency of living beings. Using specific examples, it is shown in what ways organisms cannot be considered to be machines. The paper also offers an overview of the advantages and implications of mechanicism and a discussion of why mechanicism tends to be so heavily favored as a more scientific approach – in other words, why it always wins.

Dermatosemiotics: Skin as embodied mind

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Skin – the body's largest organ system – is a complex adaptive system connecting us biologically and psychosocially to each other. Its function as an interactive boundary due to its location at the interface with the external environment makes it the primary organ for communication and perception. This view of skin as an adaptive interface is the essence of the "system" view of life, which perceives everything as being interconnected and interdependent. The presence of such a living boundary – the skin – as a mereological structure is the precondition that makes perceptual difference possible, with the potential for differentiation creating a dynamic interplay between presence and absence, signifier and signified. Skin connects the self to the other, the human being as a living system to the environment. There is a semiotic aspect to the skin, connecting signified to signers, the whole to different parts. Skin as a semiotic boundary makes us function as a *holon*, whole and part of a whole, system and subsystem, identity and difference. This is the origin of semiosis and the complexity of life that makes the cycle of action-potential and action, intentionality and fulfillment meditated by the skin as an adaptive semiotic interface. The function of skin as an adaptive boundary and haptic system is fundamental to the genesis of life as a complex adaptive system. Dermatosemiotic, which is grounded in biosemiotics, neurophenomenology and complexity science, is a relational stance that bridges the gap of the inside and the outside, subjectivity and objectivity.

In this paper I will use biosemiotics and complexity science as the theoretical framework to ground the emergence of dermatosemiotic as an essential and reliable tool for doing qualitative research, grounded in lifeworld phenomenology as a research paradigm.

The origins of the crisis in modern science and medicine is a result from wearing the skin as formulated by positivism, solid and permeable to only one kind of data. This kind of insensitive skin creates an "autistic" culture that can't view things as signs, as part of a context. The skin of modern science is an indexical skin that can only touch physical reality. The paradigm shift from modern science to complexity requires a *reskinning*, that is, a change at the level of the skin. Complexity science wears a semiotic skin that allows a response to all types of signs (indexical, iconic and symbolic).

Dermatosemiotics is a tool that can facilitate such reskinning and reframing of the discourse of science by creating a space for biosemiotics and qualitative research .

Dermatosemiotics can be a solid ground to help restoring the primacy of touch, which is essential for the emergence of meaning as connection and relation. The discourse of modern science gives primacy to eyes in order to ensure objectivity and distance. Umwelt or lifeworld is a tactile semiotic world that makes us whole and part of a whole, singular and particular. Using biological skin as a metaphor standing for semiotics and semiosphere is a precondition for leading a transformative reform in education, medicine and political systems grounded in the umwelt/lifeworld rather than a mechanistic view of the world. The lifeworld is accessed through empathy and touch rather than through observation and detachment. Skin as a semiotic boundary/interface is an essential ground for the emergence of meaning, difference and the irreducibility of living systems/human beings to neither inside subjectivity nor outside objectivity, putting us inside liminal semiotic space.

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Introducing a three-dimensional interactive semiotic model of environmental change

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In this paper I present a three-dimensional interactive semiotic model of environmental change which incorporates some elements from my previous work and introduces new, related elements. The paper draws directly on work from my recently published article "What can be known about future umwelten?" (Tønnessen 2019).

This model is *interactive* because it demonstrates the constant interplay between different forms of causation and signals. It is *three-dimensional* because it takes three dimensions of living nature into consideration (see Table below; taken from Tønnessen 2019: 419), namely the *Innenwelt*, the *Umwelt* and the *Umgebung* of a creature endowed with an umwelt (typically an animal, a human being or a microorganism) (Uexküll 1921). By applying a subjective perspective focused on the inner world (*Innenwelt*) and outer world (*Umwelt*) of animals and humans, and the subjective worlds' relation to relevant aspects of the physical environment (*Umgebung*), the model builds directly on Jakob von Uexküll's umwelt theory.

Table. Three dimensions of living nature.

Dimension	**The dimension in which the organism relates to . . .**	**Processes**
Innenwelt	Its body; itself (via signification)	Endosemiotic sign processes
Umwelt	Other organisms; the physical environment (via signification)	Exosemiotic sign processes
Umgebung	The physical environment (via efficient causation)	Physio-chemical processes

The organism relates to its physical environment in two fundamentally different ways, namely by way of signification and by way of efficient causation, and it is thus involved in both semiotic and physio-chemical processes, with the former being endosemiotic in the *Innenwelt* and exosemiotic in the *Umwelt*.

The complex interplay between the three dimensions of living nature is illustrated in Figure below (taken from Tønnessen 2019: 420). The interplay between the various dimensions involve *environmental signals* (originating from the *Umgebung*) which triggers *Umwelt signals* (originating from the *Umwelt*) which triggers *Innenwelt signals* (originating from the *Innenwelt*) which in turn triggers action and thus *semiotic causation*, or in other words "the bringing about of changes [in the *Umgebung*] under the guidance of interpretation" (Hoffmeyer 2008: 149).

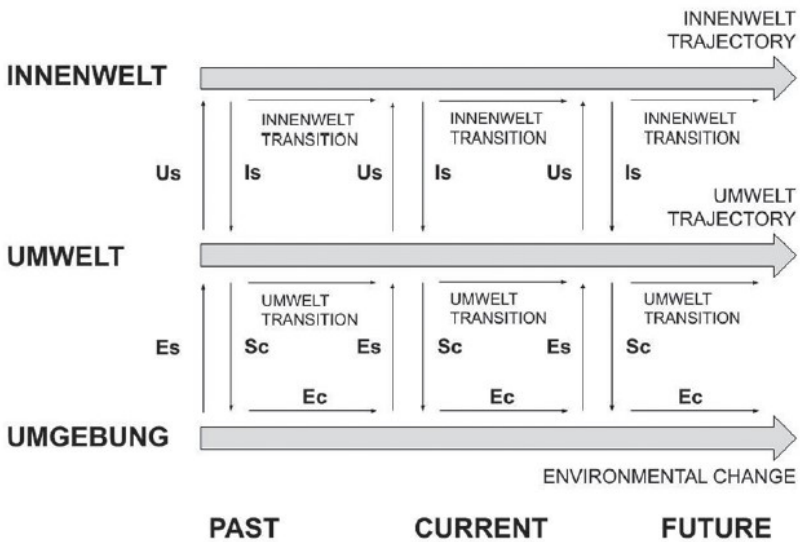

Figure. Three-dimensional interactive semiotic model of environmental change. Abbreviations: Ec = Efficient causation; Es = Environmental signals; Is = Innenwelt signals; Sc = Semiotic causation; Us = Umwelt signals.

The change from one interplay cycle to another can be understood as an *Umwelt transition*, and seen in context, several umwelt transitions can be understood as constituting an *Umwelt trajectory*. Change from one interplay cycle to another also constitutes an *Innenwelt transition*, and seen in context, several *Innenwelt* transitions constitute an *Innenwelt trajectory*: i.e., the course through time taken by the *Innenwelt* of a creature as defined by its changing relation to itself and its own body.

As we see in this complex, dynamic model of environmental change, changes in, e.g., identity, experience, and the physical environment are interrelated, and change in one dimension can be triggered by changes in the other two dimensions. While the physical environment is constantly affected by living creatures (via semiotic causation), it also changes irrespective of the actions of umwelt creatures – via efficient causation. This in turn affects environmental signals that again, in ever new cycles, trigger new umwelt signals, which trigger new *Innenwelt* signals, which trigger new actions and thus new forms of semiotic causation, and so on.

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Biosemiotics in the service of animal ethics: How semiotic knowledge improves farm animal welfare

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Farm animal welfare is a major concern for our food and clothing industry. To more accurately evaluate animal farming in general and to avoid exposing livestock to cruel treatment, it is necessary to understand not only their behavioral but also their cognitive needs, semiotic capacities and communicated content (Bradbury; Vehrencamp 1998). General knowledge of how farm animals perceive and interact with their environment is of major importance for consumers, zootechnicians and scientists. This presentation aims to outline the current state of farm animal cognition research and focuses on two ungulate livestock species: cows (*Bos taurus*) and domestic pigs (*Sus scrofa*). My work reflects upon a defined set of cognitive capacities, such as categorization, reasoning and social cognition, particularly individual discrimination and recognition, communication with humans and social learning (Howery *et al*. 2000).

There is a noticeable lack of information on certain aspects of semio-cognitive capacities in most farm animal species. This leads to further questions on how pigs and cows comprehend their physical environment and understand causal relationships. Increasing our knowledge on the area of biosemiotics should facilitate efforts to adjust husbandry systems to meet the needs and preferences of these ungulate species.

Research in the semio-cognitive area indicates cows and pigs possess sophisticated mental capacities, such as the discrimination between, and recognition of, conspecifics as well as humans (Mendl *et al*. 2002). The aforementioned farm animals also react to very subtle behavioral cues from conspecifics and humans. These semio-cognitive capacities can impact human-animal interactions during management practices and introduce ethical considerations on how to treat livestock in general. There is a need to emphasize the importance of understanding how pigs and cows interact or communicate with their physical and social environments, as this information can improve housing conditions and can be used to evaluate the use and treatment of animals during exploitation.

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Meaningfulness and applicability of semiotic concepts in biosemiotics

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The fourth of the so-called Saka-theses (Kull *et al.* 2009) proclaims "the aim of biosemiotics to make explicit those assumptions that are imported into biology by such unanalysed teleological concepts as 'function', 'information', 'code', 'signal', and 'cue' and to provide a theoretical grounding for these concepts". The sixth one declares that "(b)iosemiotics does not take for granted the wide variety of concepts of the sign, sign action, and so on […] but undogmatically sees these as a resource for the construction of an up-to-date, refined, and better-grounded […] version of a general semiotics" (p. 170). The question is how to ground and legitimate the use of semiotic kind of concepts in the study of biological phenomena. One of the many difficulties in this is the integration of conceptual and empirical studies. Often in empirical studies, the phenomena are dealt with standard biological manners, and the semiotic concepts either play rather thin and decorative role, or are referred only in some vague intuitive senses. Theoretical studies, in turn, easily stuck into debates between competing abstract definitions without criteria specific enough to control their applicability. Some of the theoreticians start from a kind of foundational and universalistic semiotic metaphysics or transcendental philosophy (seemingly e.g. Søren Brier, John Deely, and Thure von Uexküll) that is supposed to replace more standard non-semiotic naturalism. Others take the opposite strategy and start from standard physical theory but aim to end up showing how semiotic concepts emerge or become possible as the complexity of physico-chemical systems increases (e.g. Deacon 2013, Short 2007, Bickhard 1998, and to some extent Hoffmeyer 1993). Although I take the certain kind of naturalism as preferable (Vehkavaara 2002), this last strategy may be too consuming for more concrete studies.

It would be accurate in all these types of biosemiotic approaches to consider on which grounds and how the theoretical starting points are chosen? In empirical studies, the choice appears often as rather random, but it is implicitly present even in the naturalistic strategy of Deacon and others, because some preliminary idea about signhood or meaningfulness is after all required. Be the starting points some already developed semiotic conceptions or merely intuitive ideas, we should pay attention to the semiotic phenomena that we use as exemplary prototypes for the used or constructed concepts of sign, meaning, etc. Of the already established semiotic theories and conceptions applied in biosemiotic studies, several motivating problems and starting point intuitions can be listed: (1) subjectively meaningful perception (e.g. Uexküll, Husserl, and Sonesson), (2) socially shared mental ideas (e.g. Saussure and structuralists, Lotman, and later Wittgenstein), (3) representational cognition of rational inquiry (Peirce and Dewey), (4) mechanical action or correspondence (e.g. Barbieri's cry "meaning is a molecule!", protosign of Sharov 2015, and perhaps Morris), (5) intentional or teleological action (e.g. Alexander 2013, constructive representation of Vehkavaara 2003, and minimal ontological representation of Bickhard 1998). These differing starting points produce the differently structured and functioning concepts of sign or meaning. I would take it unlikely that any single concept of sign or *semiosis* could be sufficient to describe all biosemiotic processes and be somehow self-evidently universally applicable. Moreover, I would assume that in many cases there are more than one differently structured signs functioning together, e.g. when a bird is gathering truthful information through perception in order to successfully construct a nest.

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On the biosemiotics of "language, mind and body"

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It has been brought to our attention that in certain recently published works discussing the problems related to key biological concepts (the body, the brain, etc.) the word *(bio)semiotics* may not be mentioned despite the possible initial expectations of some readers. It is in light of this that we will analyze, in the following presentation, John Joseph's recent book *Language, Mind and Body: A Conceptual History* (2018), which opens with the following description:

> Where is language? Answers to this have attempted to 'incorporate' language in an 'extended mind', through cognition that is 'embodied', 'distributed', 'situated' or 'ecological'. Behind these concepts is a long history that this book is the first to trace. Extending across linguistics, philosophy, psychology and medicine, as well as literary and religious dimensions of the question of what language is, and where it is located, this book challenges mainstream, mind-based accounts of language. Looking at research from the Middle Ages to the present day, and exploring the work of a range of scholars from Aristotle and Galen to Merleau-Ponty and Chomsky, it assesses raging debates about whether mind and language are centred in heart or brain, brain or nervous-muscular system, and whether they are innate or learned, individual or social. This book will appeal to scholars and advanced students in general linguistics, cognitive linguistics, language evolution and the philosophy of language.

Does a "(bio)semiotic" reading of this book allow us to discover some new facets of the work, bringing something new to the understanding of both biosemiotics in general and its history in particular? Our presentation offers an answer to this question.

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What it is like to be a postdisciplinary scientist: The semantic approach in code biology and biosemiotics

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Conceptual vagueness is a common feature of the contemporary post-disciplinary group of knowledge. Stephen Kellert pointed this out in the now classic *Borrowed Knowledge* by suggesting a typology of conceptual borrowings and providing a manual for their appropriate use. His examples concentrated on conceptual borrowings from dynamic systems theory. However, the procedure that he chose is of a universal nature.

Kellert conceived three steps of conceptual borrowing: of individual terms, of precise concepts, and of concepts with their commitments, i.e. of whole inference schemes (Kellert 2008: 42). This paper will illustrate individual examples of successful and unsuccessful conceptual borrowings of whole inference schemes of source disciplines or theories. A central example will concentrate on biosemiotics and code biology. The goal of code biology seems to be primarily to save biology of physicalist patronate, whereas biosemioticians are trying to express that the concept of code is not enough of an explanation for the specificity and originality of life.

We strive to use our conceptual analysis to clarify the main differences of semantic approaches to biology as present in code biology and biosemiotics. The main difference seems to be the variant of paradigm shift which is necessary to do in biological sciences. The majority of biosemioticians borrow for this purpose the Peircean concept of sign (Rodríguez Higuera 2020), whereas in code biology there seems to be new place only for coding rules, i.e. organic meaning (Barbieri 2015: 15).

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Functional relevance of triplet positions[1]

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It has been stated that both genes and non-coding areas of DNA molecules are constructed from the same four nucleotides (Ratner 2000: 23); therefore, the differences between these sequences are not determined by their physical nature, but by their order of appearance and configuration. In respect to genes, different configurations of the same set of nucleotides are connected with different amino acids. Thus, it is logical to assume that positions within triplets have their own relevance and can be compared with syntactic categories within a sentence (predicate, subject, modifier, according to López García 2005) or morphological segments of a word (prefix, root, ending, following Rumer 1968 and Ratner 1993). However, instead of these analogies, it is possible to identify the proper semiotic and formative functions of positions, as well as supra-segmental functions, which characterize not a single position, but a configuration of them.

We sort out the following functions, which may be performed by a single position:

(a) *distinctive*: the order of appearance of nucleotides (first, second and third positions) distinguishes the semantics of one sequence from another; the second position determines some class of amino acids, while the first one identifies the specific amino acid within this group (for example, all codons with cytosine in the second positions related to certain class of 4 amino acids, the first position associated them with concrete amino acid CC_ – proline; AC_ – threonine; UC_ – serine; GC_ – alanine).

(b) *delimitative:* the third position marks the end of a three-element sequence of nucleotides correlated with a certain amino acid; for half of the triplets, the third position plays only a delimitative role, for the other half, it works in both the delimitative and the distinctive roles;

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(c) *structural:* it relates particularly to the third position if it has no distinctive value; in half of the cases, the third position is redundant from the semantic point of view, but it is necessary as a structural unit since it complements the doublet to the required triplet structure;
(d) selective-syntagmatic function: it is performed by all three positions when, in the next stage, a complementary pair ("codon-anticodon") is formed; in the so-called "wobbling" situation, the third position may lose selective characteristics: the third position of the codon does not determine which nucleotide of the anticodon will be attached to it.

It is also possible to sort out supra-segmental characteristics:

(e) coding (semantic) function: in the canonical genetic code, a triplet (except for stop codons) corresponds to one and only one amino acid;
(f) textual function: some triplets (so-called nonsenses) serve as a signal of the beginning and the end of operations for the creation of cistrons. In a few contextually-dependent cases, codons correspond to either a specific amino acid or perform a textual function.

The distinction between vocabulary (nucleotides) and categories of grammar (positions within triplet) allows to identify the formation rules for the significant units of the genetic code (doublets and triplets) and explicate their compositional semantics (correspondence rules between codons and amino acids). The principle of context-sensitivity allows us to move on to the next level: describing cases when biochemically the same sequence of nucleotides, depending on their location, acquires a different meaning and performs a different function.

The evolutionary perspective reverses the functional relationship between the first and second positions, but this does not affect the main principle: one of the positions determines a class of encoded amino acids, the other specifies a member of the class. The complexifying of life forms leads to the appearance of new amino acids and new principles for their structuring. The doublet code is transformed into the triplet code. The functional inequality of the third position correlates with its late emergence.

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Name index

The page numbers in **bold** refer to the author's text and in *italics* to the person on photo.

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Biosemiotics is the study of semiosis in the biological realm. Or, as it was written in the introduction to the 17th Gatherings in Biosemiotics in Lausanne, “biosemiotics is [...] the study of meaning-making and its consequences in living systems, and much of its focus is on investigating and understanding pre-linguistic sign processes in both humans and other organisms”.

Biology, on the one hand, has an important and impressive history of studying the systematicity of *nature*, as it is exhibited in the analyses of the genetic, physiological and morphogenetic processes of living systems. Yet biology, at the same time, must also certainly recognize that it is likewise the study of the systematicity of *freedom*, in as much as its object of study is the phenomenon of life itself. And so biology, understood as biosemiotics, studies life’s capacity for aboutness, for establishing mediated and arbitrary relationships that result in the creation of novelty, for making choices, and for the ongoing exploration of possibility.

The world meetings on biosemiotics – *Gatherings in Biosemiotics* – have been taking place annually since 2001. The first twelve years of these conferences was described in a volume of 2012, while the current volume covers the meetings from 2012 to 2020. In addition to the accounts and programs of these events, and including over sixty contributions to the twentieth meeting, the current volume includes review articles, evaluating the work done thus far, and predicting future developments. The history and philosophy of Czech biosemiotics, in particular, receives a detailed account, and many other new ideas in biosemiotics are also discussed in this book.

Tartu Semiotics Library 20

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