The Eleventh Annual International Gathering in Biosemiotics

June 21 to June 26, 2011

Hosted by the Dactyl Foundation
& the International Society for Biosemiotic Studies

at the Rockefeller University for Biomedical Research
Weiss Research Building, Room 305
1230 York Avenue (at East 66th Street) NY, NY USA

PROGRAM

The Program at a Glance

21 June, Tuesday – Arrival day, Registration
22 June, Wednesday – First full Conference Day
23 June, Thursday – Second full Conference Day and Dinner Party
24 June, Friday – Third full Conference Day
25 June, Saturday – Fourth full Conference Day
26 June, Sunday – Departure Day

	Wednesday 22	Thursday 23	Friday 24	Saturday 25
09.00 – 09.30	Don Favareau	Paul Cobley	Stephen Cowley	Jonathan Beever
09.30 – 10.00	Jesper Hoffmeyer	Dennis Goerlich et al.	Prisca Augustyn	Gary Shrank
10.00 – 10.30	Kalevi Kull	Liz Stillwaggon-Swan	Susan Petrilli, et al.	Morten Tønnessen
10.30 – 11.00	Coffee	Coffee	Coffee	Break
11.00 – 11.30	Vinicius Romanini	Marcello Barbieri	Søren Brier	Gerald Ostdjek
11.30 – 12.00	Eugene Halton	Jan-Hendrik Hofmeyer	Eliseo Fernandez	Jerry Chandler
12.00 – 12.30	Natalia Abieva	Joachim De Beule	Franco Giorgi et al.	Thomas Long
12.30 – 15.00	Lunch	Lunch	Lunch	Lunch
15.00 – 15.30	Victoria Alexander	Mark Reybrouck	Pierre-Louis Patoine	John Collier
15.30 – 16.00	Jeffrey Goldstein	David Rothenberg	H. Tanya Gilham et al.	Hidetaka Yakura
16.00 – 16.30	Alexei Sharov	Tina Roeske et al	Dorion Sagan	Anna Arango
16.30 – 17.00	Coffee	Coffee	Coffee	Break
17.00 – 17.30	Almo Farina	Tim Higgins	Daniel Mayer	Tim Ireland
17.30 – 18.00	Louis Goldberg	Peter Harries-Jones	Sara Cannizzaro	Luciana Garbayo
18.00 – 18.30	Dolores Steinman et al.	João Queiroz	Astrid Thome (film)	
19.30 – 21.30		Dinner Party		
	Chair	Chair	Chair	Chair
Morning	Don Favareau	Natalia Abieva	Paul Cobley	Victoria Alexander
Afternoon	Victoria Alexander	Myrdene Anderson	Kalevi Kull	Don Favareau

Thursday Dinner, June 23 @ 7:30 PM

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Abstracts

in alphabetical order
by first-author's
last name

Ambiguity in Iconic and Indexical Relations

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The generally accepted typology of signs is based on the trichotomy of Peircean categorical classification – *icons* (similarity), *indexes* (association) and *symbols* (convention). Language *symbols* are of primary concern to linguistics and semiotics because they permeate human cultures. Verbal units are purely abstract and mediate relations between objects and concepts conventionally. On that ground they are looked upon as the domain of truly human cognition and communication while *icons* and *indexes* (usually described as analog signs because they have direct isomorphic reference in their form to objects of reality) are believed to be simpler both in semantics and form and for that reason not so actively used in information exchange by humans. Having applied the principles of semiotic analysis to the forms of interaction in the biological world biosemiotics has successfully shown that external forms of communication between conspecifics (interpersonal communication) and species (trans-species communication) (Witzany 2005) are effectively performed in the absence of *symbols* (Hoffmeyer 2008; Kull et al. 2010). T. Deacon (1997) was one of those who noticed that human language having no counterpart in the rest of the biological world must be either some anomaly, or, as many cognitive anthropologists believe, a later invention in human evolution (e.g., Donald 1991). In both cases it means that language symbols are an extra acquisition and humans being a biological species certainly possess abilities to communicate via analog signs similarly to the rest of the biological world plus the newly acquired *symbols*.

T. Deacon (1997) showed that language symbols as higher-order forms are decomposable into lower-order forms and described the hierarchic relationships between iconic, indexical and symbolic types of reference – for him symbolic relationships consist of indexical relationships, and indexical relationships consist of iconic relationships, the construction of meaning being a bottom-up process (Deacon 1997, 2010: 553). According to Deacon and Hoffmeyer, iconic relations must be the initial point of semiosis as icons are 'a kind of Firstness' and possess a 'pure quality': “That a sign is *iconic*, then, just means that quality as such is prevailing in the sign process, while Secondness (association) and Thirdness (convention) only play minimal role” (Hoffmeyer 2008: 285). Though Peirce's notions of Firstness, Secondness and Thirdness are interpreted differently (see, e.g. Favareau 2010: 40), it seems that the former two are particularly special because, being direct representations of the environmental objects, they are loaded with natural semantics. Undoubtedly, *icons* are semantically the richest of the three signs as they preserve the isomorphic parameters of real objects in their forms.

The problem is that it is not that simple to separate an *icon* from an *index* as both can be described either way. All the cases of *indexes* mentioned in scientific literature have that double status, e.g. the repeatedly described example with a smoke being an *index* of the fire is not quite correct as a smoke ***may*** be an *index* of the fire for some observer and ***may not***, but it is always an *icon* of the smoke *per se*. Footprints on the sand ***may*** be an *index* of some-one who has passed and ***may not***, but they are definitely *icons* of some-one's soles. That makes the relationship between *icons* and *indices* rather ambiguous and not very well described in research papers.

The paper deals with this ambiguity. Semantic and pragmatic characteristics of both signs are described in terms of the cognitive psychology of perception (Kosslyn 1978) and communicative intentionality (Millikan 2004, Markos 2010) of the observer.

Mysterious Objects:
Integrating Biosemiotics with Complex Systems Science

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Biosemiotics is to me primarily a tool for studying purpose/intentionality. I also think biosemiotics can be a tool for studying emergence, which, like the idea of purpose in nature, is not well-understood.

In previous work, I've extended Tom Short's argument that the goal/object of purposeful action is always general, never particular. I argue likewise that all objects of signs are *types,* general sets of conditions that constrain but do not determine directly. Everything true of *purpose* in Short's theory, I say, is true of *semiosis*. Some may disagree saying that, for instance, a cell receptor doesn't respond to a ligand as a sign of a *type* of organized, constraining conditions, and thus Short's purpose-loaded theories have no place in biosemiotics at the level of the cell or below. Short himself does not apply his theory below the level of the organism. But I argue that Short makes the mistake of not incorporating a theory of emergence, which would make the purposeful individual an emergent whole, whose type is preserved or enhanced by purposeful actions. Although the parts of a whole don't act purposefully, their actions within a context give rise to purpose. Insofar as biosemioticians understand semiotic agents as emergent wholes, they can argue that while a single cell itself is not a semiotic agent per se, because it is a part in an organ, its activity leads to semiotic action in the organized and functional whole of the organ. And going further, while a part within a cell is not a semiotic agent per se, its activity leads to semiotic action in the functional whole of the cell. Any part-whole relationship is necessarily semiotic. Definitely locating the semiotic act – *here* – is not possible, precisely because it is an emergent phenomenon, involving whole-part relations. As I have tried to argue with Short, you can no more locate the semiotic act in human interpretation than you can in cellular processes. Actions can only be considered semiotic / purposeful within a context (whole) that is being preserved or enhanced, and it is that context that constrains the actions such that they are semiotic / purposeful.

The whole-part self-reference may be unavoidable but it doesn't have to be quite so endlessly dizzying. Hoffmeyer has suggested that negation is an important aspect of semiotic self-reference. I believe this is similar to some things Jeff Goldstein has suggested about negation in emergent processes. In an effort to address this now-you-see-it-now-you-don't problem with purpose/emergence/semiosis, I am now attempting to extend Jeff Goldstein's analysis of emergence, applying it to Short's theory of purpose/signification. Goldstein argues that emergence involves what is "not explicitly programmed in plus behavior that confers additional functionality." Emergence comes about through processes that "alter relations between wholes and parts [and] take advantage of randomness" and that "intensify under some kind of containment combination," and that "include some element of negation operations that open a space for radical novelty." He notes that once a new level of organization emerges, the lower level components no "longer exist as they did before but have a new existence entangled with the new level."

In my talk I will take a quintessential example of purposeful/semiotic behavior – an animal searching for food – and analyze it as an example of emergence, using a formula developed by Goldstein. The formula captures some aspects of creativity through negation, which are as important to purpose and semiosis as to emergence. The results will, I hope, provide further conceptual tools for integrating biosemiotics with complex systems science.

The Marriage of Psychoanalytic Methodology with the Biosemiotic Agenda

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Few are aware that Freud was a research biologist before entering medical neurology and uncovering the workings of the human 'Unconscious'. His prodigious observational powers led him to publish a whole series of new hypotheses in rapid succession; in1895, collaborating with Breuer, came the first etiological theory of unconscious determinants in hysteria and the value of 'abreaction', releasing suppressed emotion while "talking" to another. In 1900 he had uncovered the latent/manifest structure of the Dream, deciphering the primary process grammar of its pictorial-meaning representations, and proposed a 'technique' of dream interpretation within his first 'topographical' theory of mind.

By 1915, he had established 'Metapsychology', a scientific framework for his psycho-analytic method which was now three things in one; a mode of therapy; a theory of mind; and a research methodology. But neither the status of knowledge of early development, neurology, emotions, linguistics, or semiotics, nor the general scientific *Weltanshaung* of his era, could provide explanatory principles for a science of signals, signs, symbols, and symptoms that pointed to meanings invisible to the naked eye. The transformations taking place as the "unconscious becomes conscious" remained a mystery, temporarily couched in the concepts of force, mass, and energy of Newtonian physics.

Most psychoanalysts today are clinicians, practicing a therapeutic technique that interprets the personal unconscious. But some, very few, such as myself, are theoreticians interested in revising, updating, and redefining the epistemological scope and scientific basis of a methodology that evolved a now vastly expanded interpretive purview. The deep unconscious *is* the biological substrate of the human mind.

With the help of a broad interdisciplinary base spanning current neuroscience, early cognitive development, paleoneurobiology, semiotics, linguistics, group processes and anthropological studies, the marriage of Psychoanalytic methodology with the Biosemiotic agenda, opens immense new possibilities for understanding the *natural* basis for many hitherto inexplicable interactive and communicative phenomena.

Meaning in Nature and Semiotic Modeling

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How do we construct nature? How do we see ourselves and other organisms in it? Will a *revolution of the life sciences* (Weber 2008) change the way we see nature and ourselves as part of it in the future? This paper analyzes the role of language as a secondary modeling system (Sebeok 1991, Sebeok & Danesi 2000) in the human construction of nature. Using Bruno Latour's (1991) notion of *hybrid* as a starting point, this paper examines recent interdisciplinary research projects revolving around the forest (Hecht et al. 2006, Hecht et al. 2007) in *political ecology* and the backyard (Robbins & Sharp 2003) in *economic geography.* While language plays an important role in constructing a new model of nature and the role humans play in it, this paper argues that new cognitive habits and changes of belief in the long run will primarily come from face-to-face and non-verbal communication pertaining to our interaction with other organisms, human and non-human. This paper also offers a cautious analysis of the biosemiotic movement as a network of *hybrids* (Latour 1991) and the role it may play in *a revolution of the life sciences*.

Key words: biosemiotics, Umwelt, philosophy of nature, semiotics of nature, creative ecology, cognitive linguistics, semioethics

Names and Nominable Entities

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Science is always expressed in words and we need therefore to give '*names*' to the objects and the processes that we observe in Nature. Names (including those that we call 'numbers') are a necessary component of physical theory, but, unlike laws and constraints, they change from one language to another. This is because names (or *nominal entities*, to use a classical term) in general have nothing to do with the intrinsic features of the named objects, and are therefore mere labels that we attach to them.

The deep divide that exists between 'names' and 'objects' has been at the centre of many controversies in the past, in particular of the celebrated medieval dispute over 'nominal entities' and 'real entities'. It has also had a long history in the philosophy of mathematics, where some have argued that numbers are inventions of the human mind, whereas others have maintained that they have an existence of their own.

The relationship between names and objects is also a crucial issue in science, but here it has taken on a new form. Let us underline that all names are sequences of characters (alphabetic, numerical or alpha-numerical) and that each sequence is unique. Names, in other words, have *specificity*. In general, the specificity of a name has nothing to do with the characteristics of the named object, and in these cases we can truly say that names are mere labels. Science, however, has invented a new type of names where the sequence of characters does represent an order that is objectively present in the named objects.

The chemical formula of a molecule, for example, describes an objective sequence of atoms, and any atom can be described by the objective sequence of its quantum numbers. In these cases, the names are no longer arbitrary labels but true '*observables*' because they describe characteristics that we observe in Nature. This shows that there are two distinct types of names in science: labels and observables.

In the case of the observables, furthermore, there is another distinction that must be made. The sequence of quantum numbers in an atom, or the sequence of atoms in a molecule, are completely determined by internal forces, whereas the sequence of amino acids in a protein is not determined by internal factors but by an external template. In the first case, the sequence is a *computable* entity, in the sense that it is the automatic result of physical forces, whereas in the second case it can only be described by 'naming' its components, and is therefore a *nominable* entity (this term should not be confused with the classical concept of *nominal* entity, which applies to all names. A *nominable* entity is not a label but an observable, and more precisely a *non-computable* observable).

All names, in conclusion, are specific sequences of characters, and in science they can be divided into two great classes: labels and observables. The observables, in turn, can be divided into *computable* entities and *nominable* entities. The important point is that physics and chemistry deal exclusively with computable entities (physical quantities), whereas nominable entities (information and coding rules) exist only in living systems. We need therefore to pay a special attention to these new observables, because they represent the key features that divide life from inanimate matter.

Toward a Biosemiotic Approach to Environmental Ethics

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Peirce's semiotic, the theoretical foundation of contemporary biosemiotics, provides an ontological foundation for a naturalistic moral value theory. Within a Peircean framework, environmental ethics is the study of the moral relationships humans should have toward the environment, or the study of the moral status of their ecological relationships. Our ecological relationships are a matter of empirical research in ecology and biosemiotics and, as such, are becoming more and more well-defined. Thus, the central problem in environmental ethics has been determining and defining the status, scope of, and justification for our moral relationships with the environment and the organisms that make up that environment. This involves questioning how and why should we consider individual organisms morally valuable. Is the common hare worthy of our moral consideration? What is the moral difference between the hare and the fox? Between the fox and the tick? Between the tick and the tree?

If the central problem in environmental ethics is determining and defining the moral value of environmental entities, our normative ethical theories must be able to explain on what basis and to what extent those entities have value. The naturalistic foundation of contemporary biosemiotic theory grounds a theory of moral value capable of addressing this problem. Namely, it suggests that what is morally relevant is the semiotic relationship: things either are morally significant because they signify or become significant because they are signified. On this account, things that signify have inherent value and things that are signified have instrumental value. Within this framework, semiosis is a morally relevant property of all living things thereby offering us an ecological, as opposed to merely environmental, ethic.

A consequence of this semiotic theory is that living things are accorded inherent moral value based on their natural relational properties – their ability to signify. This consequence establishes a hierarchy of inherent moral value based on the scope of signification: the larger the Umwelten, the greater the value. I will argue that a robust semiotic moral theory can take into account a much wider scope of inherent value. A complex but conceivable calculus, totaling the inherent and instrumental value of the entity in question, would then provide an account of the total moral value of that entity. These consequences have positive ramifications for environmental ethics in their recognition of the natural ecological networks in which each organism is bound. A reevaluation of the basic problem of the moral value of environmental entities based on the theory and methodology of biosemiotic analysis directs us toward an ecological ethic, founded on signification, the intentional sign or semiotic relationships between environmental entities. This presentation of a biosemiotic model of value offers an account of our contemporary moral intuitions concerning the representation of our semiotic/moral relationship with animals while also pushing our normative ethical boundaries.

How Biosemiotics can Produce an Evolutionary Theory of Conscious Experience and Intersubjective Meaning Production in Communication

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As biosemiotics is trying to finish building its disciplinary matrix it becomes clear that there are disagreements about what it takes to produce signification. There seems to be differences in philosophical frameworks especially in the stipulation on ontology and epistemology and their relational interdependence. A crucial question is, if it is possible to develop a transdisciplinary framework where a scientific theory of nature and a phenomenological-hermeneutic theory of interpretation and meaning can be integrated with an evolutionary theory of levels of semiosis. Others want to stay clear of interpretation as necessary conditions for semiosis in animals without nervous system in showing that information and meaning exists independent of interpretation on the level of cells and organs as well as organisms on that level of complexity. Information and meaning can then be naturalized by operative definitions using the concept of code. Code biosemiotics is a school of thought where meaning is defined by coding, not by interpretation. Thus non-peircean code-semiosis first came into existence with the genetic code, at the very origin of life. The point then being that interpretation requires internal representations of the world and probably only animals evolved the ability to build them. The paradigm does not say how and in my view miss a theory of the experiential aspects of life: How it is that living systems as the only ones on our planet have an experiential feeling life world with qualia. Opposite this view there are the Peircean biosemioticians that have to face Peirce's three categories, his hylozoic view of matter and mind and his Agapistic integrative view of science and religion. The major problem for many scientists is that Peirce brings mind and consciousness into his basic metaphysics as the pure feeling of Firstness, as it leads to serious clashes with the received view of mechanistic natural science. Some biosemioticians have developed a combination of organicism and complex adaptive systems as a modern substitute for Peirce's unbearable ontology. The problem is that first person consciousness does not seem possible to explain from these non-Peircean paradigms in my view.

My suggestion. Instead of wanting to explain meaning and consciousness from a fixed scientific is that instead of having an ontology starting with energy, matter and information, we might, so to say, start in the middle from what we know. From being here with other conscious embodied beings in conversation, we know that the world can produce more or less stable embodied consciousnesses that can exchange and construct conceptual meanings through embodied conversations and actions that last over time and exist in space-time and mind all correlated to our embodied practices. We can also see that our communication works not only language based on a grammar, but also through signs for all living systems in structured and progressively developed system of communication. For semiosis to happen we have to assume the reality of – at least – four different worlds: our bodies, the combination of society, culture and language, our consciousness, and physic-chemical nature. The viable reality of any of them cannot be denied without self-refuting paradoxes. This forces us to start with semiosis from the middle of embodied real conversation instead of with energy, information and codes in a bottom up project from a scientific produced past. C.S. Peirce's biosemiotic philosophy offers a solution to this problem of connectedness between the four worlds through his view of "synechism." It places the process of meaningful semiosis as a fundamental and central aspect of reality that is a connection between nature, consciousness and culture.

Cybernetics, Soviet Semiotics and the Quest for Homology: The Interdisciplinary Past of Thomas Sebeok's Biosemiotics

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Biosemiotics has been referred to by Jesper Hoffmeyer as "an interdisciplinary scientific project" (2008: 3). The nature of such interdisciplinarity as explicit in the *bio* prefix of biosemiotics seems to suggest that biosemiotics consists in the interdisciplinary *borrowing* and *integration* of semiotic models into biological studies. However this paper argues that when borrowing from semiotics one needs to take into account the various intellectual currents that converged in semiotics in the first place. Particularly one has to remember that semiotics became rather popular at the turn of the 1970s, which incidentally was an époque marked by educational reforms and student protests against the rigidity of educational systems. What happened in this period, a fact that is also central to biosemiotics, is that interdisciplinary studies established themselves at educational and research level. It is at this stage that synthetic theories such as General Systems Theory, structuralism and Marxism started to function as unified sciences and "provided an integrative methodology or theory for cluster of disciplines." (Miller 1981: 29) It is also in this context that, as this paper argues, biosemiotics consolidates in its contemporary form and establishes itself.

In fact, the scholar who brought biosemiotics to the forefront of contemporary semiotics research, that is, Thomas A. Sebeok, was clearly a interdisciplinary scholar who was interested in semiotics, biology, and as this paper argues, in cybernetics. In fact by operating a re-configuration of Juri Lotman's notion of "modelling system" (1967) in terms of Primary, Secondary and Tertiary modelling systems (Sebeok and Danesi 2000), Sebeok irreversibly linked the history, and thus the future, of biosemiotics to that of cybernetics. In fact Lotman's models of 'modelling systems', 'dialogue', and his view that "the minimum working semiotic organization consists of two differently constructed and aligned structures" can be read through the cybernetics lens as, respectively, 'isomorphic models', 'informational disequilibrium' and "structural coupling". Indeed Lotman belonged to the Soviet-Tartu school of semiotics which was in fact "distinguished for the importance it attributed to cybernetics" and whose clearly interdisciplinary interests included "machine translation, automatic information processing, and mathematical linguistics" (Lucid 1977: 7). Thus since Soviet semiotics serves as one of the best examples of interdisciplinary project emerged following the 1968s' educational reforms, any discipline which draws on it draws simultaneously from the aggregation of different disciplinary currents that influenced it in the first place. Thus, this paper argues that when one is borrowing from semiotics, particularly in the context of Sebeok's biosemiotics, one is simultaneously drawing from Soviet Semiotics, and thus from cybernetics, systems theory and, to a degree structuralism. Ultimately these three perspectives are united under the investigation of form, or to be more precise, homology. A distinction will be made here in respect to the fact that biosemiotics focuses on 'qualitative diversity' (Kull 2010: 49) and 'semiotic freedom' (Hoffmeyer 2008) whereas cybernetics is more rooted on formal similarity and 'isomorphic models (Bertalanffy 1968). As this paper claims, an awareness of the interdisciplinary past of biosemiotics, and an acknowledgement of its cybernetic heritage constitutes a step towards the epistemological clarity of the interdisciplinary biosemiotic project and will pave the way for future trans-disciplinary application.

Keywords: homology, soviet semiotics, Lotman, cybernetics, modelling system.

A Reflexive Theory of Biosemiotics

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A reflexive theory of biosemiotics is developed from a neo-Aristotelian philosophy of science, Dalton's relational notation and Charles Saunders Peirce's concept of "formal rhetoric". As a general systematic theory of communicative relations, a formal biosemiotics combines formal material causality and formal efficient causality to generate coducive relations within and among organisms. Formal material causality is developed as synductive logic, a formalization of Dalton's 1803 chemical notation. Abstractions from the atomic numbers create the basis of the perplex number system, a graph-based formalism that represents both regular and irregular natural structures and processes. A living organism is symbolized as a dynamically poised system with discrete two-way communications between the internal dynamics and the external dynamics of the situation, the embedding ecosis. The natural communicative capacities of living systems are generated internally by the synductive linkages between the informative messages received as exo-information, and the exformative messages sent, generating expressions as exo-information. The capacities for encoding and decoding of messages are a function of the perplex architectures created from the comparable developments of genetic inheritances. Simple organisms communicate, internally and externally, with exact codes within "augmentable trees" of the graphs of the perplex number system. For example, the capacities of external lactose to induce the lactose operon in E. coli by a concatenation of synductive operations illustrates a primitive stage of symbolic communication in the perplex codes at the base of the tree of life. Higher-order biological architectures with elaborated sensory capacities communicate with multiple perplex codes, informative and exformative messages linked by the synductively-encoded central nervous systems. Within the perplex number system, the network of molecular cognition is extendable indefinitely.

Intrinsic to such a theory of communication is the concept of selfhood, the concept of individuality of each living organism and the concepts of communicating messages between individuals. The concept of selfhood includes the uniqueness of the symbolic inheritance as well as the relative loci of matter in space and time. The concept of individuality specifies the particularity of matter, space and time with the Daltonian presupposition of indivisibility of matter. A message is a relation between a pair. A formal message may take various forms, each form a particular system of encoding and decoding of information. A message between a pair may be either symmetric or asymmetric, although both members of the pair must know the symbols that encode the message itself. Thus, the essence of this reflexive theory of biosemiotics is to relate five distinctive concepts, identity, individuality, matter, space and time. The purpose of the theory is to describe the communication of natural and artificial messages among natural organisms and artificial organizations. The principle abstract grounds of the theory include Aristotelian causality, biochemical physiology, Dalton's "ratio of small whole numbers", C. S. Peirce's reflexive logic, and perplex number system.

For purposes of exact representation of reflexivity, a series of ur-symbols was developed to separate the various logics of correspondence relations between various sorts of marks, analogous to Dalton's innovative methods. Each ur-symbol is a circle. A diameter of the circle separates a pair of concepts. The angle of the diagonal with respect to the horizontal or vertical specifies an abstract conceptual symbolic reflexive category - number, matter, space, or time. The rhetoric, grammar, and logic of each ur-symbol are restricted to the vocabulary of marks appropriate to the ur-symbol. An ur-symbol with two or more diagonals infers that two or more scientific vocabularies are permissible in communications with that ur-symbol. (Because of the high degree of redundancy among the distinctive marks used in scientific communication, this specification is necessary to ensure biosemiotic coherency of grammars with logical diagrams.) For example, a circle with two diagonals is necessary to represent the equilibrium point of a chemical reaction and a circle with three diagonals for representation of the law of mass action.

Codes, Communication and Interpretation

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The concept of code has a long and varied history across the sciences, the social sciences and the humanities. It has been central in information sciences as a kind of 'rule' for transforming one piece of information into another one. It has also been crucial in specifically cultural fields where it is has generally been taken as the systematization of the way in which meanings are exchanged by way of signs. Yet, in semiotics the relations between signs and objects has never been as stable or straightforward as the systematization inherent in 'code' implies. This is acknowledged in biosemiotics' engagement with the process of *interpretation*, although this interdisciplinary field has made 'code' foundational, especially through the idea of code duality (Hoffmeyer and Emmeche 2007) and has subsequently not been free from controversy and questions of definition (see, for example, Barbieri 2010). One reason why code has been so central to modern semiotics is not simply a matter of the linguistic heritage of semiology and the work of Jakobson who straddled both semiology and semiotics. Rather, it has been the programmatic reconceptualization of code which is woven through the work of modern semiotics' founder, the father of both biosemiotics and zoosemiotics, Thomas A. Sebeok. A biologist *manqué*, a communication theorist influenced by cybernetics and a semiotician deriving from the 'major tradition' of Peirce, arguably Sebeok's most systematic considerations of code were offered in his essays on zoosemiotics from 1963 onwards. This paper revisits the notion of code promulgated in Sebeok's work and discusses this within the frame of the vast number of definitions of 'code' to be found across the humanities and the sciences. The paper aims to ameliorate (or even further problematise) current divisions in biosemiotics by suggesting that biosemiotic approaches are based on insufficient theorisation and even acknowledgment of Sebeok's synthesis of zoosemiotics and communication theory from the 1950s upon which biosemiotics is based.

Immediate Interpretants in the Immune System

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Last year I described in general terms the nature of immediate and final interpretants in the learned immune system (distinct from the innate immune system). Although the innate immune system is arguably not symbolic in its operation in any way that need s the resources of semiotics, the learning aspect as well as certain features of the learned immune system strongly suggest that semiotic analysis of its functioning will be useful. I argued that there is a chain of interpretants leading to a final interpretant within the immune system itself, based on the distinction between self and non-self. Further, I argued that there is another final interpretant external to the immune system that explains its functioning: biological autonomy and survival. I argued (following a very general argument I gave three years ago) that there is a chain of interpretants of any biosemiotic element going back to autonomy. In this case the immune system has a certain degree of autonomy, but it also works within the overall functioning of the organism. Its relative autonomy implies that immune system elements must adapt by integrating into the immune system as a whole, and cannot adapt independently (this is not necessarily true of the innate immune system).

This year I will look in more detail at the local functioning of parts of the learned immune system to try to find immediate interpretants of various elements in order to understand in more detail how they function as signs. I will make some suggestions of how they might also function as a code, and give some arguments against this view. However, when we look at the large scale functioning of the immune systems there are some facts that tend to undermine these arguments. The overall aim of the presentation is to clarify notions of interpretation, code and function.

Languaging, Writing Systems and Codes

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Languaging can be defined as *activity in which words play a part*. Using Maturana's (1988) work, this view can be contrasted with that of 20th century linguists (including Saussure, Skinner, Chomsky and Sebeok). This becomes a monological tradition based on 'written language bias' (Linell, 2005). Seen thus, one can contrast how humans engage dialogically in real-time – human activity in which words play a part – with both the units of writing systems and products of their use (texts). Languaging thus contrasts with processing by automatised systems that draw on, for example, Morse, C++ or data-mining. By highlighting contrasts with man-made codes, one can revisit Barbieri's (2007) concept of *organic coding*. In relevant processes (e.g. protein synthesis), *internal* control parameters shape irreversible activities that draw on a system's organic memory. Using Hoffmeyer and Emmeche (1991), Cowley (2007) and Markoš and Švorcová (2009), analogue and indexical /iconic aspects of languaging thus link semantic biology with the workings of organic memory. However, the verbal aspects of language that are captured by the use of writing systems (viz. grammar, phonology and reference) cannot be captured by such models. This is because biological coding contrasts with man-made 'processing'. As a result to speak and hear while using verbal patterns –in contrast to languaging – also depends on *orienting* to what is said and heard (in the cultural setting). Human activities can therefore extend organic memory by virtue of how we use symbolic constraints and a community's other *external* control parameters. Far from being biological or designed, linguistic symbols become their own designers –the products of an unfolding cultural history. We inherit collective resources that are manifest in our artefacts, institutions, traditions and languages. In its verbal aspect language belongs to, not biology, but a common world.

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Agency and the Creation of Meaning

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At the heart of our work lies the concept of `meaning'. `Meaning' and `function' are integral parts of semiotics and biology. Nevertheless, they remain elusive concepts in many respects, and a naturalistic theory of meaning is as yet unavailable. Such a theory requires a marriage between physics and biology, and can only be achieved by extending naturalistic principles with mechanisms for coding and measures for meaning. Thermodynamics is an ideal candidate for this. Two out of three pillars of neo-Darwinian biology are more or less implied by the first and second laws of thermodynamics, namely the need for reproduction (or regeneration, to go against the second law), and the inevitability of selection (since regeneration requires work, and hence free energy, which is not infinitely available according to the first law). The relation between entropy and Shannon information is another clue. The third pillar, variation (e.g.in the form of heredity with mutation), and the concept of meaning, are still missing from thermodynamics and information theory. They are both related to coding.

I therefore propose to include the notion of agency, defined as the capacity to code, as a fundamental and irreducible concept of Biosemiotics. Shannon noticed that meaning has to do with "references or correlations [of signals] according to some system with certain physical or conceptual entities" [1]. Barbieri defines a code as an arbitrary mapping (i.e. a system of correlations) between meanings and signs, mediated by adaptors and produced by a codemaker [2]. Shannon furthermore defined signals as units of information, measured in bits per second. A reasonable description of life is that it has the capacity to locally go against the second law of thermodynamics, that is, that it locally turns available free energy (information) into useful work while releasing heat (entropy). This is all compatible with a definition of agency as the capacity to code, if codes are arbitrary mappings between meanings and signs and if both meanings and signs are measured in units of information. Agency is therefore the capacity to maintain, through work, arbitrary mappings (or functions) and produces units of (arbitrary) mutual information.

The implications of the capacity to maintain a code are possibly vast but not yet fully understood. In cybernetics, the law of requisite variety (as first proposed by Ashby and later extended by Aulin, [3,4]), states that units of mutual (or conditional) information are essential for control, i.e. for reducing variety and the influence of the environment on one's goals (e.g. regeneration). Apart from some marginal exceptions, agent based modeling in artificial intelligence also involves agency, for example in the form of learning if-then rules. A particularly illustrative example is Hebbian learning in artificial neural networks. In Hebbian learning, the synaptic connection between simultaneously firing neurons is strengthened. It allows to capture correlations between patterns in the sensory-motor channels (i.e. between meanings and signs) and is known to take place in the brain. In this paper, formal and analytic models are presented of cellular agents, that is, of cells that have the capacity to code. It is shown that such agents are conveniently described at the level of signs, meanings and adaptors and, when placed in a community and when interacting with other agents, can induce conventionalization mechanisms that are best described with measures of information and mutual information that supersede the level of individual agents.

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Soundtope: The acoustic *Consortium* of bird communities

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Passerine birds, like many others animals, use extensively acoustic signals especially during the breeding season, producing a dense network of communicational bonds. Ecologically, behaviorally and cognitively-oriented investigations have described patterns and assigned significance to such activity, as confirmed by a rich bibliography, but when individual vocalizations are considered merely components of an aggregated context or *Consortium* (*sensu* Reinke), great incertitude emerges concerning the functional meaning of this biophony. We define soundtope the temporary coordinated aggregation of multi-species vocalization that is expected to be positioned in a way to perform at the best the collective symphony. An uneven distribution in space and time is observed for this acoustic aggregation.

To verify the soundtope hypothesis, a field collection of sound files, obtained from a bird community living in a Mediterranean scrubland (Tyrrhenian coast, Ligurian Region, Italy) during the breeding season (April-July 2010), was processed by applying the Index of Acoustic Complexity (ACI) to sound data converted by the Fast Fourier Transform (FFT) algorithm.

The results indicate that after the dawn chorus of not aggregated and neither coordinated bird vocalizations (individuals are singing contemporarily and immediately close to the roosting sites), as sun light increases in intensity vocalizations coalesce in distinct soundtopes.

Soundtopes have been found to change characters along the hours of the day with a maximum of intensity and repertoire diversity during early morning. Seasonal variation in space and time of soundtope characters has been observed as well, according to the phenological rhythm of every participant species.

Soundtope location seems independent by other niche components like food location, nesting places and refugees that are expected more constant along the breeding season. Probably the acoustic quality (Hi-Fi) of geographical site coupled to the necessity to increase the intra and inter-specific communication bonds are important proxies of soundtope distribution. Analogous patterns found in the study area have been observed in a bird community living in a beech mountain forest, investigated during the breeding season 2007.

Definitively, collective communication is expected to have an active role in the community structuring, but further researches are requested to better fix the importance of soundtopes as biosemiotic mechanism that should contribute to community and ecosystem stability.

Biosemiotics: What it Is, What It Isn't, and Why We're Here

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2011 marks the tenth anniversary of the first Annual International Gatherings in Bioseimiotics, and sees the still largely European-based international biosemiotics community meeting in America for the first time. Having been part of this conference series' history from its beginning, I would like to take the opportunity this year to briefly review some of the developments that have occurred under the aegis of *biosemiotics* since the convention of that first Gatherings ten years ago, and to address some of the many misconceptions about their research project that they find themselves often having to clarify both to fellow scientists, as well as to fellow semioticians.

At a time when strictly materialist reductionist explanations of life and its evolution have become increasingly incompatible with what biologists are now conceding is the complex, adaptive and non-linear nature of organization and interaction in the natural world, the conceptual work now taking place under the aegis of the "biosemiotic perspective" is grounded in the conviction that the organization and interaction of living organisms must be understood not only in their naturally-occurring material regularity and evolution, but in their naturally-occurring semiotic regularity and evolution as well. Committed to an utterly natural and non-mysterian understanding of organisms' relations of sign-based interaction and organization that is in full accord with empirical findings and principles of science, biosemiotics does *not* entail – and, in fact, it unequivocally rejects – any form of "supernatural" (e.g. spiritual, vitalistic or anthropomorphic) causation and explanation.

The project remains in a rather difficult position disciplinarily, however, as the operative methodologies and informing paradigms of the majority of the natural sciences limit themselves exclusively to the investigation of purely physico-chemical relations, preempting any serious discussion of how those relations themselves constitute meanings to a living system – while the investigation of "sign relations" as undertaken by the humanities and the social sciences limit themselves exclusively to examination of the symbolic relations of human culture, having little need or interest in the science underlying the more basal sign relations upon which such higher-order symbol systems must be built.

Accordingly, the *rapprochement* that biosemiotics is trying to effect between the sign sciences and the life sciences is one wherein the semiotic aspects of the biological world are not reduced to their material components, and in which the semiotic aspects of the cultural world are firmly rooted in the systemic laws of biological interaction and organization out of which the symbol-building human animal has arisen.

One practical question that those involved in advancing the biosemiotic project continually find themselves having to confront, then, is this: How does one even begin *talking* about such a synthesis without being pre-dismissed as a "mystic" within science circles and a "reductionist" in the humanities? The focus of this talk will be on just those issues of terminology and overcoding that biosemioticians find themselves having to negotiate, sublimate, negate and (occasionally) perpetuate in order to attempt a "scientific" discussion about "signs" and a "semiotic" discussion about "nature."

Energy, Semiosis and Emergence: The Place of Biosemiotics in an Evolutionary Conception of Nature

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Autonomy, i.e., self-ruling or self-regulation, is a distinctive mark of organisms and living systems generally. Organisms are parts of the world that segregate themselves from the rest of it (their environment) through structures (membranes) that allow selective passage of various forms of matter and energy in and out of their constituted interior. Processes within such interiors obey the same laws of physics that govern events in the environment, but are additionally constrained by further restrictions arising from the conjunction of those laws and the peculiar boundary conditions that characterize the internal dynamics of autonomous systems. Paradoxically, by submitting to more exacting constraints organisms enjoy new forms of spontaneity and freedom of action not to be found among inert objects. In contrast to them they act as autonomous agents pursuing their individual purposes.

There are different orientations in biosemiotics, but those moved by Peircean ideas tend to agree that this organization of inert parts into autonomous agents cannot be made intelligible without supplementing the traditional resources of the physical sciences with novel kinds of causation, in particular that form which Peirce called semiosis—the influence by which signs mediate the determination of interpretants by their objects. In this view the promise of biosemiotics far exceeds its role as a biological sub-discipline in charge of the semiotic aspects of living processes (cellular signaling, organic codes, etc.). Important as that task is, it does not exhaust biosemiotics' project which should include two other important endeavors. First, if semiosis is essential to the constitution of the objects of biological science, biosemiotic ideas must have foundational and integrative roles comparable to those of evolutionary conceptions. Second, these roles should promote a wholesale redefinition of the place of biology within the sciences.

This paper addresses the latter two points by contrasting the logic and heuristics of causal explanations in physics and chemistry with those operating in biology. This examination clarifies the relations between semiosis and ordinary physical causation. It also proposes a new perspective on the evolutionary nature of emergence by taking into account the increasing importance of evolutionary explanations in some branches of contemporary physics.

Keywords: Semiosis, Causation, Emergence, Biosemiotics, Evolution, Peirce.

On Signaling Games of Adaptive Morality: Biosemiotic Considerations

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This paper focuses at large on the contribution of biosemiotics to the understanding of communication for cooperation among animals (including humans), while specifically modeling cooperation itself in terms of signaling games constitutive of adaptive morality. Such modeling is in overall agreement with William Harms evolutionary game-theoretical account of morality (2004), and with Ruth Millikan's *teleosemantics* work on biosemantics (1989, 1994, 2004, 2005). They favor a naturalistic, objective picture of morality, compatible with moral realism and an adaptionist theory of meaning, which supports the hypothesis that there are objective species-specific truth conditions for signals. Signals thus might be said to be true or false relative to the contexts of cooperative animal games. Described in this way, cooperative signaling games, such as the paradigmatic vervet monkey warning calls (Cheney & Seyfarth, 1992), can be seen as emerging moral signaling activities in themselves, as they focus primarily on the survival of others in detriment of themselves: to be moral in an adaptive sense may be taken to mean to be able to endure the consequences and costs of signaling in repeated cooperative games, even if by doing so, one endangers oneself. This is what makes animal communication semantically true in the world for some particular kinds of interactions. Those interactions seems to favor the endlessly semiosis and interpretation of signals processes in the context of cooperative settings, thereby crucially contributing to the development of morality, starting by fusing meaning construction and moral acts in many various settings.

Lastly, I address the special case of biosemiotics communication in the human species, where reason appears as an adaptive control system, allowing for creative solutions to emerge from its own adaptive internal rules, thus informing our semiotic exploration and also allowing for the semiosis of self-inquiry and interpretive investigation, this time, previous to action. Accordingly, a higher level of signaling games for discussing norms and for further understanding other people is generated. Such games are dependent both on the mutual clarification of language use and of meaning construction by moral agents, as well as on the awareness of the truth conditions assumed in animal communication – naturally extensive to humans.

Making Sense out of "Sustainability"

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Humans in various times and places have tended to view *Homo sapiens* as a success story. The narrative moreover assumes that the species as a whole has improved in quality ("intelligence") as well as in quantity ("population") over whatever period taken to be criterial—whether 200 thousand or two million years, roughly bracketing the Pleistocene. Any semiotic evidence for "intelligence" may weaken when population trends are taken into account. While more and more Pleistocene mammalian, avian, and reptilian megafauna surviving to contemporary times are facing extinction—often due to the direct and indirect impact of humans—humans themselves resist assessing their own futures on the planet in a systematic manner. Humans do proudly assume credit for technology and, equally proudly, assume blame for their deleterious effects on biota and climate, asserting that attention to "sustainability" via technology will counter the overarching demographic issues. "Sustainability" covers a multitude of sins—derived as it is from that most Roman of all the hairy irregular Latin verbs—"tenere", to hold, to keep. Relying on technology (in whatever form, including the ability to dispose of persons, places, and things) to "sustain" conveniently bypasses questions of what to keep, while concentrating on how to hold it. But there are some things, (like dragons, as Tolkien noted) that it does not do to leave out of the calculations. The argument, posit, and calculations of sustainability leave out a very large dragon indeed. The ecological footprint discourse of the past 20 years fails to emphasize human population as basic multipliers of all resource use. Indeed, population might be termed the "whalephant" in the room. We will place human population in the larger ecological framework suitable for semiotic treatment, and trace some of the more dramatic moments in prehistory, history, and the immediate future.

Semiotic Selection of Misfolded Oligomeric Receptor Proteins in Bacteria and Germ Cells

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Receptor oligomerization plays a key role in maintaining genome stability and restrict protein mutagenesis. When properly folded, protein monomers assemble as oligomeric receptors and interact with environmental ligands. In a gene-centered view, the ligand specificity expressed by these receptors is assumed to be causally predetermined by the cell genome. However, this mechanism does not fully explain how differentiated cells have come to express specific receptor repertoires and which combinatorial codes have they explored to activate their associated signaling pathways. To fully appreciate how cell-to-cell and cell-to-environment interactions have been modified during evolution, the role played by the plasma membrane needs to be taken into account. It is our contention that plasma membranes act as semiotic thresholds instantiating the context dependency of their receptor expression. The occurrence of protein misfolding makes it impossible for receptor monomers to assemble along the membrane and to sustain meaningful relationships with environmental ligands. How could a cell deal with these loss-of-function mutations and restrain gene redundancy accordingly? Cells may behave differently depending on their prokaryotic or eukaryotic nature, or on their somatic or germinal origin. In this paper, we will be arguing that the easiest way for bacteria clones to accomplish this goal is by getting rid of cells expressing mutated receptor proteins. Due to their incapability to undergo membrane oligomerization, misfolded receptor proteins may accumulate intracellularly and cause the engulfed cells to be eliminated by programmed cell death. The mechanism sustaining this Darwinian cell selection has been shown to occur in many somatic tissues and its function is currently believed to counteract *in vivo* protein mutagenesis. Impediment of receptor oligomerization, as due to protein misfolding, may also affect germ cells. However, due to the need to maintain unaltered their totipotency throughout development, germ cells may not be selected as cell lineage, but as carriers of a multicellular heritability. Because of this essential role, several mechanisms are known to restrict gene expression in germ cells, thus ensuring their proper migration and survival in the developing embryo. To appreciate the overall significance of these processes, several examples of tissue dynamics and germ cell development will be examined in this paper. Our discussion will be mainly focused on the significance and semiotic nature of the interplay between membrane receptors and the epigenetic control of gene expression. Besides being interpreted semiotically as a key process for genome stability, the present study on receptor oligomerization may also serve as a research project to be tested experimentally and eventually to be validated scientifically.

Analysis of a Simian Semiosphere

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Biosemiotic theory, as elaborated by Hoffmeyer (Hoffmeyer 2008), hypothesizes that big-brained animals should exhibit a high *interpretance* level, meaning that they are able to "read" a great variety of complex cues in their environment, including "individual behavior patterns of conspecifics". Big-brained animals should also demonstrate a high degree of *semiotic freedom*, which indicates that their behavior as it unfolds on a moment-to-moment, real time basis should be, in the main, "unencumbered by the lawlike necessities of genetic determinism." According to Hoffmeyer, big-brained animals that demonstrate a high degree of semiotic freedom can be thought of as "living systems with an extreme semiogenic capacity". Such animals have the ability "to take advantage of any regularities they might come upon signifying vehicles, or signs."

Primates are a group of big-brained animals whose individual members should, therefore, exhibit a high degree of semiotic freedom and an extensive semiogenic capacity. We will examine such capabilities in monkeys by focusing on the results of an intensive study of stable, social groups of two congeneric primate species in a laboratory setting. The initial goal of the study was to develop a detailed understanding of the moment-to-moment interactions of all members of the group over years of continuous observation. The investigators stated that, "In order to formulate theories for ordering behavior into motivational or functional schemata it is first necessary to describe empirically the units of behavior themselves and the contexts in which they arise."

In biosemiotic terms, the investigators set out to describe the structure of the semiotic niche in which the members of the monkey groups were embedded and to delineate the specific semiotic units that maintained the inter-monkey communication flows upon which the existence of such a niche depends. The initial result of this work, "A behavioral taxonomy for Macaca nemestrina and Macaca radiata: based on longitudinal observation of family groups in the laboratory" (Kaufman and Rosenblum 1966) was further elaborated upon in a paper entitled, "Monkeys in time and space" (Rosenblum 1979). In our view, these papers remain the most thorough and detailed longitudinal examination of the dynamic interactions that occur in monkey social groups.

We characterize a functioning monkey social group as: a) a set of constantly changing, b) overlapping individual Umwelts, c) held by each of its members, d) with each member, in its constant flow of effector patterns (in response to it own Umwelt), e) constantly changing the social Umwelt set. It is this *never-constant, individually unique, continuously interacting constellation of Umwelts, that is the social semiosphere*. We use the results of the behavioral taxonomy study to demonstrate the high semiogenic capacity of monkeys, their ability to read complex cues supplied by individual behavior patterns of conspecifics, to interpret those cues and to respond with behaviors that demonstrate the high degree of semiotic freedom exhibited within the monkey group social semiosphere.

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Generalizing from the Potency of Linguistic Context for Biosemiotic Theory

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This paper aims is to aid in the further development of rudimentary elements required for a theory of biosemiotics by focusing on and then generalizing from the crucial role played by context in the emergence of linguistic meaning. Examples are offered demonstrating how context can serve to bring out what is to be considered a linguistic sign plus how the meanings of sign can change. In particular, the focus is on syntactical, semantical, and grammatical linguistic contexts ("grammatical" will be used in a unique sense differing than the usual syntactical sense). Next, a formalism highlighting the potency of context in linguistic settings is developed for the purpose of generalizing to the process of signification in biosemiotics. This formalism will be tied-in to the complexity science constructs of nonlinear dynamical systems theory and research into emergence in complex systems. In the former case, the function of context can be understood in terms of parameters on dynamical equations while, in the latter case, context will be seen as linked to constraints operative in complex systems that determine the nature of the novel order that comes about during emergence.
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Cells as Semantic Systems

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Cells are biological systems that process information by means of molecular codes. Many studies analyze cellular information processing in syntactic terms and neglect completely the semantic aspects that are related to the meaning of molecular information. The generation of meaning is important for cells to efficiently use and process information. We will here focus on the semantic dimension which is governed and organized by molecular codes. Therefore, we will present a general conceptual framework for describing molecular information processing, exemplified by biological examples. The conceptual framework is extended by a mathematical approach for the formalization of molecular codes. Emerging from the mathematical formalization we developed suitable algorithms for estimating the capacity of reaction networks to implement such codes. Since molecular codes can be used to generate meaning in system, the capacity of networks to implement such codes can be referred to as semantic capacity. First results show that biological systems may have a high semantic capacity, while non-biological networks, e.g., combustion chemistries, have no semantic capacity. Our formalization approach is accompanied by a game-theoretical framework, which leads to general statements about system parameters with respect to code usage in cells. These formal definitions not only allow for the description of one particular code, but also for the description of the relations between codes, e.g., one code may regulate the dynamics of another code. Thus, we will conclude by giving a description of a cell as system of interrelated codes and point out how different concepts of semiosis work together and assemble in a highly complex system we call cell. By this we also tackle the pragmatic level of molecular information. The combination of a systematic conceptual framework for describing molecular information and mathematical approaches to identify and analyze molecular codes makes it possible to give a formally consistent and empirically adequate model of the code-based semantics of molecular information in cells. Describing cells as semantic systems, i.e., as systems of interrelated codes, may trigger new experiments and insights into the fundamental processes of cellular information processing.

Virtuality, Effacement, and Symboling

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Virtuality is deeply implied in the alienating dynamics of our techno-consumptive world. But it would be too easy to make virtuality the culprit for contemporary dehumanization, because virtuality is also implied in our transformation from primate to human.

The symbol, a communicative achievement worked out to its wider possibilities in the course of human evolution, is nothing less than the energizing into being of the realm of virtuality. It is not a transcendence of or escape from nature, but an emergent development of evolution, an opening up of new habitat with new ecological and ecosophical niches that ultimately engendered anatomically modern humans.

Human symboling is a way of virtualizing communication through signs relating to their objects by natural or conventional habit, whether inborn or acquired, and whether through linguistic utterance, artistic expression, or mathematical calculation. But the development of symboling practices arose through specific kinds of attunements, in which emergent virtuality became another player in what Paul Shepard termed "the sacred game." The change from foraging lifestyles to settled agriculture and civilization changed the basic rules of these attunements, raising questions that go to the heart of symboling.

Virtual space raises important questions about dematerialized human interaction. Do virtualizing devices and modes of experience serve today as means to the good life or do they tend to become ends in themselves? What is the value of face-to-face communication and immediate circumstance in everyday life?

Face-to-face interaction has been basic to human communication, even older than humans. Yet virtuality today, the enscreening of experience, presents dangers of literal effacement, the loss of direct face-to-face encounter, of what Charles Horton Cooley termed primary relations, and I will discuss its place in symbolic and virtual communication, and through considering the life of the self.

Meaning Rationalism and an Algebra of Aesthetics

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The most distinguishing difference in approach between Biosemiotics and cognitive ethnology, our cousins in probing biocommunication is that Biosemiotics centres its discussion on signs and cognitive ethnology on consciousness and 'linguistic competence.' The Biosemiotics approach has thus avoided the worst excesses of "meaning rationalism." Or has it? For ten years Vekhavaara has warned us that any approach to semiotics based on C.S. Peirce inevitably enfolds Peirce own embedding of rationality and logic in his approach to signification. Winfried Nöth also warned us that if our interest was to develop an ecosemiotics then the Peircian requirements for triangulated 'interpretants' would have to be set so low that 'interpreters' would almost disappear. Does this mean that Biosemiotics should slip the collar of Peirce entirely and take on the wildly popular but totally abject notion of 'virtual' communication advocated by postmodernists such as Deleuze and Guttari? This paper will argue that the bases for a bio-semiotic should a) be limited strictly to perception which is widespread if not a universal feature of living systems and b) that the elaboration of perception be described in the dynamics of ecosystems and not in the phenomenology of a particular organism. Perceptual processes are unknowable to consciousness, which was Gregory Bateson's point, but the effects of perception are tractable, including strong evidence for the relation between communication and intentionality in the non-human animal world (Ruth G. Millikan). As for relating perceptual processes to the dynamics of ecosystems Bateson asked would-be percipients to frame their enquiry in terms of aesthetic appreciation, and not in terms of pain and pleasure, nor utility and resource use, nor survival techniques, nor natural selection nor National Geographic's reproductive lust. And he promised an 'algebra' of aesthetics, which, unfortunately he did not complete. His 'algebra' related to its original meaning in Arabic as balance, comparison and transposition. It would be an algebra for a composite whole which is irreducible through its very organization to fragmentation of its parts. Recursive loops, the feedback loops of cybernetics and otherwise provide a mix of interaction both informational and material which occurs at an interface. Thus the leaf of a plant is an interface for photosynthesis and transpiration; the flowers of a plant are interfaces for reproduction (communication and material); and changes in resulting in interface with other species are sense specific changes to the sensing and the responding to pheromones (communication). A 'union' of complements through constraints is a natural dynamic throughout any ecosystem; the integration of the whole occurs through a variety of recursive loops with different reference points widely dispersed in any particular range of interaction. 'The Book of Restoration and Balancing' is an apt metaphor for an ecological aesthetics. The aesthetic interest lies in the patterns of their connectivity, their entanglement or knots in the whole fabric or tapestry. The patterns which connect are not only first-order pathways of recursion but second order; thus a curling of a curling is a vortex, and a circular folding of a folding, a torus. The shift of perceptual focus is to an ecosemiotics of this sort is itself a radical break from the conventions of energy budgets and morphological stasis in biology to conventions of morphogenesis plus topologies of complementarity.

The Semiotics of Chemistry

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The properties of biomolecules make possible their organisation into the cellular and higher levels of organisation that constitute the living systems that are studied in biosemiotics. The discipline of chemistry concerns itself with investigating the properties of molecules, their interactions and relations and yet chemistry has received little attention from semioticians beyond the use of a subset of molecules as content for biology and descriptions, at a physiochemical level of explanation, that conflate chemistry with physics. Perhaps it is not surprising that there is such a clear epistemic cut in a biosemiotics that is based on biology and physics. The inclusion of missing chemistry might muddy the neat separation of knower from known.

Chemistry as a discipline utilises a sophisticated language, symbolism, and sets of models and signs, that separate it from other disciplines and that are intrinsic to its development, suggesting a rich territory for semiotic study. Explanations in chemistry involve multilevel descriptions that can be enriched using semiotic concepts. All of this suggests that the properties, interactions and relations of molecules that constitute chemistry may form systems that involve semiosis or proto-semiosis.

The molecules utilised and synthesised in living systems are only a fraction of the natural and synthetic molecular systems available to the chemist. Differences in the patterning of sign and proto-sign operation in biotic and abiotic molecular systems may shed light on the nature of the boundaries between living and non-living, organic and inorganic, and sign and non-sign systems.

This paper will explore the research practices and narratives used in chemistry for the implicit use of semiotic ideas and concepts and will compare the sign potential of biotic molecular systems with those available in abiotic molecular systems. The paper will explore the boundary between the biotic and abiotic in terms of types of semiosis and suggest candidate proto-semiosic abiotic molecular systems.

The Great Chain of Semiosis

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Much confusion surrounds the relation between the twin concepts of perception and semiosis. The failure to see perception as a higher order phenomenon based on the co-occurrence or interaction of multiple semiotic processes in the whole organism has often resulted in accusations of biosemiotics to imply panpsychism. To counter this misunderstanding it is important to underline the evolutionary perspective, that semiotic freedom is itself an evolved property and that proper psychological phenomena did only appear in late stages of evolution and in relatively few big brained species of animals, mostly mammals, whereas semiosis - the more parsimonious concept relative to perception - is taken to be coextensive with life.

The presentation will suggest a graded terminology to characterize a series of stages in the evolution of semiotic freedom from the single celled organisms to big brained mammals and humans. The general evolutionary trend towards the appearance of semiotically more and more sophisticated species is consistent with the emergence of new types of efficient semiotic scaffolding serving to stabilize niche structures. The over-all effect of this is the gradual replacement of genetic scaffolding mechanisms by semiotic scaffolding systems in the later stages of evolution.

Specifically concerning the appearance of human animals the presentation questions the usual dualistic outsourcing of the mental processes into a distinct disembodied field, the mind, to be studied by a separate science, psychology. This dubious step, admittedly, was necessary as a compensation for the asemiotic conception of the body that has prevailed in medicine and biology for centuries, and still does. A resemiotization of our understanding of the body would allow us to see mental processes as an interface connecting our bodily life to our social life and *vice versa*.

Fragile, Yet Persistent: Biosemiotics and Self-fabrication

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The entire molecular apparatus in which each of the myriad of organic codes is implemented consist of molecules that are fragile, in the sense that their lifetimes are shorter than the lifetime of the system of which they form a part. In order for a living system to persist it must therefore be able to fabricate all of these molecular agents from simpler molecules, either manufactured by its own metabolic processes or obtained from the environment—as Barbieri [1] aptly stated: life is "artifact-making". However, it goes further than this: the artifact that a living cell must ultimately make is itself: in order to persist as a living entity the cell must be able to autonomously fabricate *all* of its own components. In the words of Rosen [2], the cell must be 'open to material causation, but closed to efficient causation'. In biosemiotic terms this means that if the whole genome is regarded as the sign and the cell as the interpretant, then the object or meaning of the sign is the interpretant itself. The aim of this contribution is to elucidate the logic of the functional organization that underlies this self-reflexive, self-productive nature of the cell as biosemiotic triad [3].

The concept of autonomous self-fabrication of systems has a distinguished history. Although Maturana and Varela's [4] concept of autopoietic systems is perhaps most prominent in this history, I find that for the purpose of formalisation it less useful than either Rosen's theory of replicative metabolism-repair systems or Von Neumann's [5] theory of self-reproducing automata based on the concept of a universal constructor. Rosen in particular has shown, using category theory, how to describe such organisations in terms of relational models, although he never realised his metabolism-repair systems in terms of biochemistry as we know it. I shall show how it is possible to combine these two strands of thought into a relational model that commutes with our current knowledge of cellular biochemical processes. This model also makes explicit its biosemiotic nature and its relation to Barbieri's ribotype theory [6], and identifies unassisted self-assembly as the process that ultimately makes the system self-fabricating.

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Space as a Creative Phenomenon: A Biosemiotic Approach to Spatial Configuration.

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Natural systems and living processes are enabled by spatiality making space one of the basic underlying organisational properties of all living things. Space is structural, not in terms of a machine, but dynamic more akin to an organism. It is a condition which emerges resulting from the dynamic organisational property of habits. An organism embedded its environment is a spatially salient condition, in which patterns of space are created. This is perhaps most easily envisaged in a flock of birds or the food foraging trails created by a swarm of ants.

A swarm exhibits collective intelligence. Stigmergy is a form of self-organisation in which environmental cues create signs establishing decentralised coordination between autonomous agents. Behaviour is directed and patterns of spatial configuration emerge. This is perceptible from the viewpoint of an external observer and in the artefacts which systems such as ant colonies produce. Jacob von Uexküll's functional cycle explains this creative condition as feedback between (1) internal processes and (2) the organism's interaction with its environment. Adaptation is the coupling of organism and environment. A process of 'trial-and-error', which Gregory Bateson states is enabled by the capacity to distinguish differences. William Mitchell refers to architecture as 'an art of distinctions': between solid and void, internal and external, and so on determining boundaries between categories around which differences are recognised. The amorphous is thereby transformed into an organisation of distinct parts. In architecture the matter of spatial configuration has two very different issues to contend with: built form (actual, static and physical) has bona fide boundaries and lived space (abstract, temporal, and dynamic) has fiat boundaries. Qualitative spatial representation and reasoning is a way to describe real world spatial conditions, used to establish and describe spatial relations to be modelled. The hierarchical interplay between systems creating a pattern of space is translated such that this interaction is replicated computationally into a mechanism which can be used as a pattern-maker.

Henri Lefebvre argued that space is something which is both produced and productive. His spatial code forms a triad describing the relation between space as something which is perceived (physical), conceived (mental) and lived. Lefebvre's triad was based on dialectical analysis, whereas his argument (and later work on rhythms, circularity and time) insinuates a generative condition. Pentti Määttänen has shown that the semiotics of Charles S. Peirce offers a key to reinterpret Lefebvre's spatial triad, and how the mutuality of the perceived and conceived unfolds in action. Habitation as a tendency towards a pattern of behaviour, perceived as spatial configuration is a result of the dynamic organisational property of the habit of doing something; that something being activity towards some purpose. This is analogous to Peirce's notion that 'things' have a tendency to take habits, which Hoffmeyer extends biosemiotically to explain semiotic emergence. Habits are creative spatial manifestations. Space is therefore a product of the habits of an organism embedded in its environment.

A systemic view of space renders space as a phenomenon established as organisational. It therefore has form. This form is established through information, which is communicated through a matrix of relationships. Biosemiotics is a field in which many of the interrelating notions of this study are ingrained. The semiotics of Charles S. Pierce, Uexküll's umwelt theory and the bio-cybernetic view of Bateson defined through the framework of biosemiotics determines the theoretical underpinning of this study. The biosemiotic understanding of biological processes as semiosis establishes the approach in which properties defining lived space may be interpreted and in an architectural context replicated towards generating patterns of spatial configuration.

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Biotranslation

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In the article "Biotranslation: Translation between umwelten" (Kull, Torop 2003) we gave a generalised definition of translation, which would allow to use the concept in the cases of interspecies exchange of messages, i.e. for the cases in which the sign systems involved may even not include any language. (Language is defined as a sign system that includes symbols.) The formulation, in its short form, defines translation as (a code related) exchange between umwelten. Translation can also be defined as a conveyance of knowing from one sign system to another sign system. As different from communication in general in which the codes in encoding and decoding can be shared, in case of translation, among the codes used in the encoding and decoding, at least some have to be different. Accordingly, „translation semiotics itself can be regarded as a discipline that deals with mediation processes between various sign systems, and, on the macro level, with culture as a translation mechanism" (Torop 2008: 256).

Translation in this general sense, then, was divided into two major types — biotranslation (or protranslation), and logotranslation (or eutranslation) (Kull, Torop 2003: 316). Eutranslation being a transmission between languages, leaves all those cases where at least one of the (bio)texts is not language, under the concept of biotranslation.

The process of code-based protein synthesis on the basis of mRNAs that takes place in ribosomes and is called ‚translation' in molecular biology, strictly speaking, is not biotranslation, and consequently not translation at all in the general sense as defined above. This is because building of proteins on the basis of RNAs as ‚translation' includes only coding, but coding (as well as decoding) by itself is only a necessary and not sufficient component of translation.

Thus, in addition to intralanguage and interlanguage translation (both human), intermodal translation (the translation between sign systems of different modalities, often called oxymoronically ‚intersemiotic', usually meant as human), there exists interspecies translation which does not assume the language capacity of one of the participant.

The main task for biotranslation studies is to work out the ways for translation the expressions in animal or vegetative sign systems into a language. This also requires that the *sign systems* on the animal and vegetative levels will be specified.

A common example of biotranslation is the translation of feelings into words and words into feelings in human body. In order to identify these processes as translation processes we need to assume that feelings form a (animal) sign system.

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Pain as Sign and Symptom: A Semiotic Analysis of Nursing Clinical Practice and Research

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Physical pain, far from being a monolithic sensation, is a complex and varied somatic response to trauma or pathophysiology. In nursing clinical practice, where symptom assessment and management are essential to the scope of practice, reading pain as sign (empirical observation) or symptom (an experience reported by the patient) entails complex interpretation of the body's manifestations. As a result, nursing research into pain and pain management implicitly entails forms of semiotic analysis. This paper will make explicit the semiotic dimensions of pain research in two cases: Xiaomei Cong's research into procedural pain in infants in neonatal intensive care units (NICU) and Deborah McDonald's research into pain communication between older adults with osteoarthritis (OA) and their healthcare providers.

Neonates in a NICU experience procedural heel sticks several times day to draw blood for testing, causing trauma pain. Because infants are unable to express their symptoms verbally, the nurse clinician and nurse researcher are required to read empirical signs, including behavioral responses (crying, facial activity, and movement) and physiological responses (heart rate, respiratory rate, oxygen saturation). Rubrics for reading these signs have been codified in the Premature Infant Pain Profile (PIPP), the Neo-natal Infant Pain Scale (NIPS), the Neo-natal Facial Coding System (NFCS), the Behavioral Pain Score (BPS), and the Pain Assessment Tool (PAT). Cong's research, which entails a low-tech intervention in which the infant is placed skin-to-skin on the bare chest of the parent or other caregiver (called "kangaroo care") requires a relatively precise ability to read and interpret these signs in order to evaluate the effectiveness of the intervention.

At the other end of the life span are older adults, half of whom experience persistent pain from chronic OA, reported by the patients as symptoms of this pathophysiology. Here the semiotic challenge is two-fold: refusing to take at face value the apparent accuracy of verbal communication by the patient, and preparing both the patient and healthcare provider to move beyond the semiotic systems of social desirability bias. Rather than a lack of verbal communication (as in the case of infants) requiring a reliance on the reading of signs rather than symptoms, misleading verbal communication of the adult patient's symptoms affects the semiotic system of adult patient and healthcare provider. Deborah McDonald's pain research among older adults with OA reports on the limited utility of widely used pain scales ("Describe your pain on a scale from 0 to 10, 0 being no pain, 10 being unbearable pain"). Her research also indicates that a healthcare provider's phrasing of a pain question (a question with social desirability bias; close ended or open ended questions) will inhibit or facilitate the patient's communication of pain information. McDonald has also found that the word "pain" itself is not sufficient in this semiotic exchange, with more useful results elicited by the phrase "pain, soreness, aches, discomfort."

Assessing and managing the body's system of signs and symptoms requires a semiotic sophistication by the nurse clinician. Developing and testing symptom management interventions requires an equally sophisticated analysis of biosemiotics and the semiotics of inter-human communication.

Semiosis and Anticipation

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What does it take for a system to be able to anticipate? How can anticipation be formally defined? And how does anticipation pertain to living forms, and thereby to semiosis?

This paper examines the web of relations between form, distinction, anticipation, time, causality, agency, and semiosis. Showing that distinctional processes are ubiquitous throughout the concrete world, it is claimed that living forms carry out a specific kind of such process, namely the anticipatory kind. That is, living forms distinguish.

The notion that function follows form has been discredited in biology since Darwin's theory, in which, to the contrary, small random variations in form may bring about new functions through reproductive success. This is the context in which the question has been asked: What is the minimal possible living form? Or, in other words: What is the minimal possible form that can sustain the functions of living? It is proposed here that anticipation, which is at the heart of semiosis, is the function that is at the heart of life. So, one may ask: What is the minimal possible form required to anticipate? And once this function has emerged, how and why do forms follow from it?

If the living arises from the non-living through anticipation, it is also how hard physical causality gives way to semiosis. This is how agency emerges and unfolds as manifested in myriad living forms.

The Objective Artifice: Social Performance and the Pragmatic Semiotics of Constantin Stanislavski

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Never is it enough, for any philosophy or science, merely to catalog the so-called objects of the discipline – at some point, for it to survive as a discipline, it must provide some graspable, practicable import to some aspect of human life. Of course, such practical applications commonly develop independent of the theory itself: only rarely does some heritable informational structure knowingly emerge. With all this in mind, Biosemiotic theory, which seeks functioning generalities competent to cross multiple scales of living experience, is well served by informed synthesis with Stanislavski's theatrical technique. For not only do we catalog the experience of signage by studying the consequences of their function, we also seek tools with which to generate signs *knowingly*. This implies more than the strategic use of signs, which all complex living things do, and of which our many subjective selves emerge. It calls for an objective artifice of signs, that is, some set of techniques competent to produce subjective objects and capable of being objectified, such that it can enter into a curriculum and become a knowable standard. This is precisely what Stanislavski offers: techniques to knowingly create novel, actual, believably generative, signs – within the realm of human action and on the scale of human knowing. Though the man displayed little concern for philosophy or science, his focus on given circumstances, psychological adaptivity, 'objectives', 'through-lines' of action and the function of belief, positively exemplifies a practicable application of semiotic theory.

I argue that these techniques can serve across a broad range of human experience – from the origination and development of knowing beings, to that of the cultures that makes such beings possible. This essay focuses on Stanislavski's use of the pragmatic a priori that is implicit within the work of Chauncey Wright, that is, the motivation living beings experience to answer specific needs within specific situations (which includes the need to breath, but also to use one's existing epistemic structures competently, and thus adapt one's self to one's circumstances – and vice versa). There is a strong parallel between Stanislavski's practicable artifice of signaling pathways and social emergence, and Wright's argument that science is necessarily never 'objective', but best served by the rendering of an objective motivation into semiotic action, a notion he derived from his study of 'psycho-zoology', and which grounds his proto-semiotic epistemology. This use of Wright links Peirce's ontogenetic semiotics and Dewey's aesthetic pedagogy to Charles Tilly's approach to society as ongoing performance. Back-tracing this heritage through Stanislavski generates a potential entrée to the hermeneutic circle of the living 'text', and set of tools for opening such potential at will.

Organic Life in Fictional Environments : A Biosemiotic Approach to Immersive Video Gaming

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For many of us, living at the beginning of the XXIst century typically implies pursuing ends which would have seemed ludicrous only a few decades ago : defeating zombies, exploring forests full of elves or saving humanity from evil aliens are activities that can occupy a significant amount of our time... Such activities, rendered possible by the advent of video games as a dominant cultural form, a medium offering highly immersive and sensorimotorily demanding digital narratives, transform our experience as organisms immersed both in biosphere and semiosphere (as defined by Yuri Lotman).

If, as MIT researcher Henry Jenkins suggests, "game designers don't simply tell stories; they design worlds and sculpt space" (2004, 121), we can ask ourselves : how do we inhabit those worlds and spaces? Are those fictional environments becoming a fundamental part of our Umwelt? In what ways do immersive video gaming contributes to what semiotician John Deely describes as the " 'loosening up' of the objective world as naturally determined (by biological heredity on one side and physical environment on the other) whereby reality itself becomes in some measure 'freely chosen' " (1990, 69) ?

I propose to use Uexküll's Umwelt theory in conjunction with recent neurological researches on embodied cognition and general principles of Peirce's relational, triadic semiotic to explore such questions, using the critically acclaimed video game *Dragon Age : Origins* (BioWare 2009) as a case study. I believe we can productively discuss immersion in fictional environments through neuropsychological models of cognition as rooted in the feeling, imitative body and more specifically in activations of sensorimotor and affective-motivational neuronal networks. Such models allow us to understand video gaming as a simulative performance, a practice which fully involves the bodymind. By carefully combining elements from semiotic theory with cognitive neurosciences, my aim is to go beyond the hype often associated with the latest neuroimagery study and to avoid the naive or deterministic use of neurological data. On the contrary, we will see that cognitive neurosciences can provide useful and accurate insights on the complex relationships between symbolic practices and biological life.

Key words: Biosemiotics, Ludology, Immersion, Embodied Cognition

Communication, Modeling and Dialogism in the Biosemiotic Sphere

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Communication, modeling and dialogism are closely interrelated. More precisely, modeling and dialogism subtend all communication processes verbal and nonverbal within and beyond the sphere of anthroposemiosis. This means to say that the concept of dialogism can also be traced in the larger biosphere beyond the human and is applicable to all communication processes human and nonhuman. Dialogism understood in biosemiotic terms overlaps with the concepts of interconnectivity, interrelation, intercorporeity and presupposes the otherness relation.

There is a close implication of Uexküll's biosemiosic 'functional cycle' for the problem of the relation between dialogue and communication. It is possible to show how biological models, which describe communication as a self-referential autopoietic and semiotically closed system (such as the models proposed by Maturana, Varela, and Thure von Uexküll), are radically opposed to both the linear (Shannon and Weaver) and the circular (Saussure) paradigms. Jakob von Uexküll's 'functional cycle' is a model for semiosic processes. In the 'functional cycle,' the interpretandum produced by the 'objective connecting structure' becomes an interpretatum and (represented in the organism by a signaling disposition) is translated by the interpretant into a behavioural disposition which triggers a behaviour into the 'connecting structure.' Uexküll does not use a dialogic model. All the same, the point we wish to make is that in the 'functional cycle' thus described, a dialogic relation is established between an interpreted (interpretandum) and an interpretant (interpreted by another interpretant, and so forth). Nor does the interpretant limit itself to identifying the interpreted, but rather establishes an interactive relationship with it. Vice versa, not only does the 'functional cycle' have a dialogic structure, but dialogue in communication understood in a strict sense may also be analyzed in the light of the 'functional cycle.' In other words, the dialogic communicative relationship between a sender who intends to communicate something about an object and a receiver may be considered, in turn, on the basis of the 'functional cycle' model. The theory of autopoietic systems is incompatible with dialogism only if one subscribes to a trivial conception of dialogue based on a communication model that describes communication as a linear causal process. This is a process moving from source to destination. Similarly, there is incompatibility between autopoietic systems and dialogism, if dialogue is conceived as based on the conversation model governed by the turning around together rule. Also, the autopoietic system calls for a new notion of creativity. Furthermore, there remains the question of how the principle of autonomous closure is compatible with dialogue conceived as the inner structure of the individual, therefore with creativity and learning.

Communication occurs within the limits of the world as it is modeled by a given species. Communication in the human world is the most complex form of communication traceable in the biosphere given that the human animal is capable of modeling an indefinite number of possible worlds. Dialogism is a necessary condition for life, and to recognize the structural necessity of dialogism for life is a step towards improving the qualify of life over the entire planet. Given the threats menacing life in global communication today such recognition is now urgent. Charles Peirce, Mikhail Bakhtin and Thomas Sebeok all develop original research itineraries around the sign and despite important differences are easily related in light of the concept of dialogism.

New Criteria for Conceptual Notion of Semiotic Complexity

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The evolution of semiotic complexity is a central theme for the evolution of language research and biosemiotics. By consensus, complexity has increased in living information systems, giving rise to symbolicity, grammar, synthetic recursiveness, and semiotic social systems of higher complexity. However, the processes behind the complexification of semiotic processes and their relation to evolution are not well understood. Moreover, evolution of semiotic complexity can mean different things in different contexts and domains (linguistics, cognitive science, general semiotics). To make matters worse, there is no agreement regarding the most appropriate criteria for measuring levels of semiotic complexity in biological systems. Concretely, many open questions related to the evolution of semiotic complexity can be asked. 1. How can semiotic complexity growth be measured in natural living (and artificial) systems? 2. How can existing data from nature be brought to bear on the study of this issue? 3. What are the main hypotheses about semiotic complexity growth that can actually be tested today? 4. Are the principles of natural selection sufficient to explain the evolution of semiotic complexity in biological systems? 5. What is the role of developmental mechanisms in the evolution of semiotic complexity in living systems? 6. What models are most appropriate for understanding the evolution of complexity in living systems?

Here I summarize what I consider the most problematic (blurred and obscure) aspect of the notion of "semiotic complexity", in view of the tentative modeling of "evolution of information systems" (as proposed by Maynard Smith & Szathmary) a new perspective based on Jesper Hoffmeyer's notion of "semiotic freedom" and on Peirce's extended theory of signs (developed after 1903).

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Musical Sense-making between Nature and Nurture: An Ecosemiotic and Psychobiological Approach

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Music possesses common attributes across cultures which exploit the human capacity to entrain to external stimuli. As such, it has inductive power for sense-making and for reactive behavior. There is, however, a tension between wired-in reactions that are universal to a great extent and those that stress the differences between listeners and that involve a learning history. This holds true especially for the aesthetic enjoyment and emotional power of music, but also for the attribution of value and meaning. Much is to be expected here from the neurobiological approach to music processing which has stressed the existence of evolutionary low-level centers in the brain together with a genetic evolution for the existence of sophisticated cognitive faculties which are located in the higher levels of the human brain.

The aim of this contribution is to stress the major role of relatively unchanging biological processes of aural perception in discovering patterns of sound. Taking full advantage of current developments in Darwinian anthropology, evolutionary psychology and gene-culture co-evolutionary theory, it is shown that at least some mechanisms of musical sense-making rely on genetics rather than on culture. It is possible, however, to go beyond these innate mechanisms of quasi-causal reactivity and to consider also the role of cognitive penetration and the listener's learning history with a major focus on his/her previous and actual epistemic interactions with the sounds.

As such, this paper elaborates on the axiom of psychobiological equivalence between percepts, experience and thought and the possible lawfulness in the co-ordinations between sounding stimuli and the responses of listeners in general. It further deals with mechanisms of sense-making which rely on evolutionary older levels of coping with the sounds as well as higher-level functions of the brain. Revolving around the nature/nurture dichotomy—what is innate (nature) and what is acquired (nurture)?—, it considers the role of the music listener and his/her dispositional machinery to respond to sounding music.

Starting form the classical trichotomy of a sensory-transformational-response mechanism—and the related notion of S-O-R (stimulus-organism-response)—, it addresses the functions of music both from an ecosemiotic and evolutionary perspective. It provides evidence for an ongoing process of sense-making that is grounded in our biology and possibilities for adaptive control, involving the realisation of systemic cognition in the context of interactions with a sounding environment. This is, in fact, the hallmark of the ecological approach to perception which studies the human cognitive and perceptual apparatus in the service of survival and orientation in the environment. Central in this approach is the concept of coping with the environment, or, in musical terms, to perceive the sounding music in terms of what it affords for the consummation of musical behavior. It brings us to some basic questions such as the origins of music and the related question of the adaptive significance of music. Can music be considered as a genetic adaptation? And is musical adaptation to be distinguished from evolutionary adaptation in general? The questions have been an elusive target until now, but they are actually becoming active topics of empirical research with contributions from several fields. This paper gives an overview as well as attempt to provide an operational definition of the concept of musical affordances.

Melody and Rhythm in Nightingale Song

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Nightingales are skilled singers with large repertoires of about 200 song types. After returning to European breeding grounds from wintering grounds in Africa, males engage in elaborate nocturnal song performances. Some studies have focused on counting song patterns or investigating single performance traits (like trills), but little is known about higher-order factors of structural organization that characterize individual song performances, and can hence be of relevance to the receivers. We recorded nocturnal song of male nightingales in South France. Through statistical analysis, we started assessing global melodic and rhythmic parameters such as progression of pitch over the course of the song, and rhythmic exactness as measured by syllable onset-onset intervals. Most songs of an individual shared common rhythm elements, and each individual bird had a unique rhythm signature, suggesting either production constraints (perhaps in song nucleus HVC) or stylistic variances that relate to the receivers of the song. We found such individual differences only in the rhythmic, not in the melodic domain of the songs. In nightingale melodies of all individuals, small pitch intervals were mostly descending, a phenomenon that is also found in human melodies. However, in contrast to human melodies, nightingale song showed no step inertia – the tendency of a small pitch interval being followed by another interval in the same direction, resulting in melodic lines. Nightingales' melodies rather tend to switch pitch interval direction frequently.

Perception grounds communication

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During his mature studies, Peirce was searching for an architectonic design for his philosophical system in which Metaphysics, Phenomenology, Philosophy of Mind and Semeiotic would converge harmonically. After 1905, the sign is described by him as a medium for the communication of a form – or information. We claim here that this form is the outcome of what Peirce calls collateral experience and directly linked to perception. The sign does not create *ab novo* the information communicated to its interpretant. On the contrary, such information must be previously shared by the minds (or quasi-minds) involved in semeiosis. Co-minds, or commens, are real and active as they share information about the world, in such a way that there is no sharp line dividing and isolating individuals that participate in a community of interpretants. Better than that, a certain degree of mentality is pervasive in the Universe, in the same measure that signs are so. As Peirce says, we are in signs, and not the opposite. We will show that such form of the sign, basis of every logical predication, is brought into the phaneron during perceptual judgements. This form is the measure of the familiarity with the dynamic object of the sign and, for this reason, is linked to the memory of the minds involved in semeiosis. Besides that, such form has the nature of a conditional future, or "would be". We claim that such semeiosic processes are ubiquitous in nature and become more intense in living systems, producing what we call ontological diagrams: semeiotically active structures, at the same time always vague and general, that allow mind and world to modelize each other reciprocally in a kind of causation that embodies teleological purposes.

Animal Music, Animal Aesthetics

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Music may be a better model for understanding the complex animal communication of songbirds, whales, and insects, because the most complex of the utterances of these creatures is not related to difference and complexity in the message, but more in the form of the performance. Thus a complex bird song, say that of a nightingale, is supposed to 'mean' the same thing as the simple song of the chaffinch: both are sung by male birds to defend their territory and attract mates during breeding season. Then why must one sing for hours throughout the night and the other be content with a simple 'sis sis sis siseeyou?' The difference is one of musical style, or of species aesthetic. Each species has evolved a specific aesthetic sense, and this is what defines the details of their evolved music. If one thinks of such performative animal communication as something closer to music than to language, whole new avenues of inquiry are opened up.

The musical aspect of animal communication is often overlooked, because scientists believe aesthetics is too subjective a category to apply to species other than our own. But some scientists are starting to take the aesthetic approach seriously. I will present the work I am doing with Ofer Tchernichovski and Tina Roeske at CUNY, where we are using musical approaches to complement the statistical analysis trying to make sense of the deep structure of complex bird songs, such as nightingales and mockingbirds. We are hoping to be able to quantify the specifically musical qualities of the sounds of these birds.

I will discuss the larger implications of this work, as it relates to the efforts of ecologist/ornithologist Richard Prum to bring aesthetics back into biology, which was a key part of the original idea of sexual selection as introduced by Darwin in *The Descent of Man*. Prum believes animal aeshetic traits in males evolve together with their appreciation by females, so a natural "artworld" is evolved. This is why nature is beautiful, and why music can be an appropriate model for undertstanding the songs of birds, whales, insects,
and maybe even humans.

Thermosemiosis: the Thermodynamic Background of Meaning-Making in an Energetic Cosmos

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Bracketing the role of consciousness and free will, this paper develops the idea that the evolutionary roots of "human-mindedness" extend beyond the animal and living realm into the natural telic inclinations of nonliving complex systems. Thermodynamics and its second law are distinguished from communications theory, and Frank L. Lambert's heuristic simplification of the second law and the meaning of entropy are discussed, as is life's root structure as an implicitly semiotic energy-spreading system, stabilized but not defined by its genetics. It is argued that the great semiotic processes on Earth do not exist on their own, but always already in a thermodarwinian context. Science fiction and a postneodarwinian interpretation of caloric restriction as unconscious ecosystem-based semiosis are also discussed.

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The Semiotics of PS 101

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Kull, Deacon, Emmeche, Hoffmeyer, and Stjernfelt (2008), in their prolegomena for the role and nature of biosemiotics, lay out eight key theses for the grounding of biosemiotics within a theoretical model of biology. In this paper, I would like to show how these theses can be used to address key issues in the field of education in general, and most especially the American public education system in particular.

Like traditional biology, the American public education system is a product of modernist thinking. As a result, this system has focused on such issues as standards, assessment of learning, benchmarking, and teacher evaluation, to mention just a few areas. The irony of this "scientific" and "progressive" approach is that the American public education system keeps falling farther and farther behind other systems worldwide. That is, no other educational system has adopted anywhere near the modernist and mechanistic approach that has been virtually sacrosanct in American educational thought. But as the American system falls farther behind, its answer has been to tighten up its modernist approach even more.

As an alternative approach, this paper will offer three key directions. First of all, it will argue the need for the American educational system to rethink its basic definition of education. Education, from the American perspective, is viewed as an institution for credentialing expertise and developing a basic workforce. Therefore, unless there is an institutional agency in charge, there is virtually no education. In this paper, we will build upon Shank and Brown's (2007) assertion that education is a basic human process -- as basic as eating, sleeping, seeking shelter and companionship, and the like. When education is seen in this more basic way, its institutional role is greatly de-emphasized. As a result of this de-emphasis, education becomes less a prisoner of institutional needs and more a part of everyday life.

The second key point focuses on re-thinking the functioning of public education. If we accept the notion that education is a basic human activity, then like any other such activity it is organic in nature. But the fundamental strategy of the modernist American public educational system is mechanical in nature. Therefore, this paper will call for the wholesale discarding of most of the mechanical aspects of American public education, including standards per se, assessment, bechmarking of goals, and the like.

The third, and most important point in this paper deals with the replacement of mechanical thoughts with organic thoughts. This is where the eight biosemiotic theses of Kull et al. (2008) come into play. In particular, key theoretical ideas like semiosis and umwelten can be used to help ground a model of education that is more in tune with the lifeworld and less an agent of institutional instrumentality. In addition, such key issues as organization, signification, and the autonomous self can be fruitfully translated from their general biosemiotic grounding to a more specific educational context. As a result, a whole new sets of defining concepts can be put into place to help the American pubic educational system come to grips with an understanding of education that goes beyond schools as institutions to schools as sites for authentic learning. Furthermore, taking a lead from Kull (2009), the study of education can be moved from a phi-science with its positivistic and mechanical approaches to research and assessment, to a sigma-science taking advantage of the use and power of explicit semiotic methodologies.

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Evolution of Natural Agents: Preservation, Development, and Emergence of Functional Information

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Biological evolution is often viewed at syntax level as a change of gene frequency in a population. In contrast to this narrow approach I consider evolution as preservation, development, and emergence of functional information (FI) in natural agents at various levels including phylogenetic lineages, ecosystems, individuals, cells, and even molecules. FI is a set of signs (e.g., memory, transient messengers, and natural signs) that encode and control functions of agents, which are reproducible sequences of actions that are beneficial for the agent. I use the notion of FI to emphasize the semantic (functions) and pragmatic (benefits) aspects of evolution. Agents use signs to preserve and organize their functions as well as to disseminate them to other agents vertically and horizontally. The confusing notion of natural selection (nature is not an agent and cannot select) should be replaced by a model where agents select their actions based on FI, and the benefits from selected actions determine the success of dissemination of FI. Agents are not passive tokens sorted by nature, but active organisms capable of interpreting FI and making choices in their development and behavior. But signs are not universal: they carry information only in relation to specific kinds of agents that can interpret them. Thus, meaningful exchange of signs is usually restricted to the members of a communication system which is a set of agents with compatible interpretation modules. Communication systems are often organized hierarchically, representing various levels of individuation. The integrity of animal mind is based on neural self-communication (memory), and the integrity of a species is based on the propagation of the genetic information which is a long-term self-communication. Preservation of this integrity is an essential component of evolution although it does not produce novelty. FI is preserved actively via continuous transformations, which are pre-determined changes that do not require learning (e.g., cell division). Novel FI appears via development, and emergence. Development of FI is based on the improvement and modification of already existing functions. These modifications are controlled by the logic of agent behavior and development, which makes evolution and learning more efficient in the long term. Modifications also include a random component because otherwise no novelty and no improvement of functions would be possible. Logic and utility are two independent factors of evolution in the short term, but they are linked at longer time scales because logic evolves slowly towards higher adaptability. Emergence is based on re-interpretation of already existing signs; for example, when old tools and algorithms are adopted for a novel function. It often leads to a rapid change in evolutionary directions. Principles of human semiotics are not fully relevant to the study of biological evolution because FI often includes primitive signs that do not have many properties of human signs. Thus, I distinguish two levels of semiosis: protosemiosis, which is roughly equivalent to vegetative semiosis by Kull, and eusemiosis, which matches to animal and social levels of semiosis. Protosemiosis differs substantially from eusemiosis, because proto-signs are detected rather than recognized and interpreted via direct code-based matching rather than being associated with ideal representations of objects. Eusemiosis is based on classification and modeling of objects, which represent the knowledge of agents about their body (Innenwelt) and environment (Umwelt).

Computer Biosimulations as Tool of Translation and Communication

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In the current medical culture, implants (some bioactive) and grafts have become common place and human bodies as well as their constituting systems, organs and tissues have proven the ability to accept these synthetic counterparts and adapt their communication means and methods at macro, micro and nano levels. Furthermore, technology did penetrate the ways in which this communication is translated, represented and interpreted. Never before have man-made devices played such a role in the communication between and within biological systems and questions about computational means of communication regarding the effect that interference between sign and signifier - as mediated by binary code - as well as the new practices of observation fostering new tensions between objectivity and subjectivity have reached a new stage.

Our research projects involve both representations of anatomical structures (i.e. blood vessels) as well as simulations of physiological phenomena (i.e. mechanical forces exerted by blood flow) however we shall refer to the new tools of communications and translation rather than addressing the biological systems themselves. Computational representations allow a slow move into intervention thus bringing new and unique insights into complex biological processes and systems as well as a new paradigm of communication.

By the same token, computational equivalents have taken the place of the traditional sign and the implicit challenge is that of misinterpreting, misconstruing and misreading the signifier. As part of its mandate, the computational apparatus is rendering visible and implicitly mediating, shaping or constituting what we see and generating novel relationships between object and sign.

The research we conduct in the Biomedical Simulation Laboratory allows us direct insight into this area since we are the apparatus that re-writes, models and controls the vocabulary and code of communication between the component elements, as we observe and anticipate them. In the process, we need to make choices and ascertain our path though trial and error since we are advancing in uncharted territory, from vocabulary, to idiom, to language.

The words and drawings familiar to the natural scientist and the anatomist are replaced by binary code, and computer-generated simulations try to mimic nature in its ways of functioning and communicating. In our simulations of blood flow we are rethinking, reconstructing or challenging notions of verisimilitude as we strive to equal traditional relationships between sign and signifier or amending them.

We would like to put across issues that we face daily in our practice and discuss how these newly emerging technologies and techniques of truth production through computational models affect the cognitive domain and the collective perceptual life.

The Search for Meaning in Biosymbols and Computer Codes

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We employ Marcello Barbieri's code model of semiosis to shed light on a long-standing conceptual confusion in the philosophy of mind concerning what it means to conceptualize the human mind as a physical symbol system. In 1980, philosopher John Searle published his now-famous "Chinese Room Argument" which cast doubt on the then mainstream computationalist theories of mind, according to which minds are symbol processing systems that can be instantiated in silicon or brain matter. Inside Searle's hypothetical Chinese Room is a man who understands only English but uses a code that tells him which Chinese characters to spit out in response to which ones come in, making it seem to the person outside that he does in fact understand Chinese. The significant conclusion of the Chinese Room thought experiment is that processing symbols is insufficient to generate understanding because even though the man manipulated the Chinese symbols effectively, we would not say that he did so with any understanding, i.e., that the symbols had any *meaning* for him.

Barbieri's code model of semiosis holds that signs, meaning, and code are all produced internally to the semiotic system by the same agent, the codemaker. For this reason, Barbieri concludes, "a computer contains codes but is *not* a semiotic system because its codes come from a codemaker which is *outside* the system" (Barbieri 2010, italics added). Searle and Barbieri are in agreement on this point insofar as meaning could be found in the Chinese Room scenario only if we include the man on the outside who is reading the responses in Chinese; without him, all we have is signs (the Chinese characters) and code (for how to rearrange them into answers), but no meaning.

But a curiosity remains. According to Searle, meaning requires more than symbol processing, and according to Barbieri, symbol processing (signs with codes) is sufficient to generate meaning. Which view is right? Do symbols intrinsically enable meaning-making or not? We argue that the answer to this question depends on the context. Symbols cannot ground meaning in non-semiotic systems such as computers where meaning-making would necessarily include what is external to the system; yet symbols do ground meaning in semiotic systems, as depicted in Barbieri's code model, because their meaning is generated internally, organically. The bottom line is this: computers and human minds can both be conceptualized as physical symbol systems, but the kinds of symbols processed by each render them, as symbol systems, so intrinsically different that an entirely different ontology is required for each. Specifically, we know that the human mind processes symbols, but we also know that for us, meaning is inherent in this kind of symbol processing; once we learn to read, we cannot see the string of symbols in the word "season" without automatically assigning meaning to it, whereas this string of symbols has no meaning for a computer, but only for its user. We conclude that we need a different starting point than computer models of mind in order to understand how humans, as biosemiotic systems, process symbols meaningfully, and insights from Biosemiotics can help philosophers of mind do this.

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Interview with Friedrich Salomon Rothschild
August 11 and 12, 1991
Film, 20 minutes, dvd

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The film shows selected parts of an interview with the almost 92 years old Rothschild in his apartment in Jerusalem, which has been taken by the German psychoanalyst Gabriele von Bülow in August 1991. Rothschild was psychoanalyst, neurologist and brain scientist who tried to explain holistically the brain and its evolution as a psycho-physiological organ of human communication with the environment. 1962 he used for the first time the term "Biosemiotik" for his research and findings. The interview provides some of his central ideas. The interview originally spoken in German language will be subtitled in English.

Integrated Biological Individualism and the Primacy of the Individual Level of Biological Organization

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In 'Umwelt Transitions: Uexküll and Environmental Change' (*Biosemiotics* 2.2) I introduced the notion of *integrated biological individualism*, according to which the individual, or more precisely organismic, level should occupy the centre—the middle ground—of methodology in the life sciences, at the crossroad where the somatic realm encounters the ecological one. The term was then included in a broader programmatic treatment in 'Steps to a Semiotics of Being' (*Biosemiotics* 3.3). From the standpoint of the individual, or organism, we can describe how an individual organism is constituted as a biological body, as well as how nature as a global ecological system is constituted by individual organisms and their interrelations. Nature, then, is a body of bodies (the ultimate superorganism); and any individual self is by its nature a social self – through its interrelation with others, a self is always bigger than itself.

In this paper I will expand upon the notion of integrated biological individualism by relating it more explicitly to the suggested primacy of the individual level of biological organization. As Anton Markoš remarks (*Readers of the Book of Life: Contextualizing Developmental Evolutionary Biology* (2002): 29), life "proceeds synchronously on innumerable space, time, and organizational levels. Nothing on any single level can reveal its essence". Yet, it remains that a biological science with no concern for, or interest in, the living themselves (qua living beings – at the level of the individual) would be deeply problematic. There is no doubt that the 'genetic turn' in biology has been successful in terms of scientific understanding, but the new microscopic realm that has opened up to us has simultaneously induced us to neglect the 'life-size' realm. What future can we envision for the critical task of Umwelt mapping? After a general introduction to this topic matter I will introduce an original, tentatively all-inclusive model of various *levels of biosemiosis*. According to this model there are six levels of biosemiosis, falling under three broader categories.

CATEGORIES	PRIMARY REALM	PRIMARY FIELD OF SEMIOTICS OF NATURE
SUB-PERCEPTUAL SEMIOSIS	Somatic	
= MICROSCOPIC SEMIOSIS		Biosemiotics
Intra-cellular semiosis		
Inter-cellular semiosis		
PERCEPTUAL SEMIOSIS	Social	Zoosemiotics
= ORGANISMIC SEMIOSIS		
Intra-organismic semiosis		
Inter-organismic semiosis*		
Extra-organismic semiosis		
SUPER-PERCEPTUAL SEMIOSIS	Ecological	Ecosemiotics
= MACROSCOPIC SEMIOSIS		
Super-organismic semiosis*		

** social proper, in the sense of involving several individuals*

The tripartite model is relevant for simple and complex life forms alike (though in the case of very simple – non-social – creatures it collapses into a two-category model). As it demonstrates, perception is at the core of biosemiosis, even though not all biosemiosis is perceptual, and even though perception constitutes but one level (or layer) of biosemiosis. The standing of perception is intimately tied to the standing of the individual. With such an overall model of biosemiosis, the individual organism (and its lifeworld) is methodologically placed at the center of biological research.

On the Information Transfer in Immune Cell Signaling

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In the field of cellular signal transduction, metaphorical words such as signal, message, transduction, communication and information are used almost on a daily basis probably without examining what they really mean, despite the fact that the process of information transfer, for example, is a key to the understanding of the function and the fate of a cell. The study of information was invigorated when Claude Shannon proposed probabilistic, non-semantic information in his information theory in 1948. The concept of information transfer was first introduced in molecular biology by Francis Crick in 1958. Because of this historical background, discussion on information in biology has been heavily focused on the genetic system and on the information transfer from DNA to RNA to protein. Consequently, philosophical studies have been limited as to the nature of information transmitted from the cell surface receptor to the nucleus. Given this context, we try to address the information transfer in the immune system by focusing on signaling processes from antigen receptors on lymphocytes to their effector functions. The function of B and T cells is primarily to detect foreign substances by the antigen receptors and destroy them if harmful to the organism. In this sense, information seems to be transferred to predetermined effectors to fulfill a 'purpose' of a signal. As we closely examine what happens at each step of signal transduction, particularly during the early phase, it becomes clear that the conformation and the function of a signaling molecule are modified by the biochemical process called tyrosine phosphorylation and that the modification in turn induces another change in the subsequent target molecule. Thus, information may be defined as something that is transferred by a sequence of changes in the "meaning", so to speak, of a molecule that induces subsequent "semantic" changes in another molecule, and so forth. How to incorporate biosemiotic perspectives in this analysis remains to be seen.

Notes