

Søren Brier

Copenhagen Business School, department of Management, Politics and Philosophy, sbr.lpf@cbs.dk

The Paradigm of Peircean Biosemiotics

Abstract

The failure of modern science to create a common scientific framework for nature and consciousness makes it necessary to look for broader foundations in a new philosophy. Although controversial for modern science, the Peircean semiotic, evolutionary, pragmatic and triadic philosophy has been the only modern conceptual framework that can support that transdisciplinary change in our view of knowing that bridges the two cultures and transgresses Cartesian dualism. It therefore seems ideal to build on it for modern biosemiotics and can, in combination with Luhmann's theory of communication, encompass modern information theory, complexity science and thermodynamics. It allows focus on the connection between the concept of codes and signs in living systems, and makes it possible to re-conceptualize both internal and external processes of the human body, mind and communication in models that fit into one framework.

Keywords: autopoiesis, biosemiotics, Cybersemiotics, Peirce, Sebeok, Hoffmeyer, Kull, Emmeche, Brier, zoösemiotics, phytosemiotics, endosemiotics, ethology, Copenhagen School of Biosemiotics

Introduction

Semiotics (from the Greek word for sign) is a transdisciplinary study and doctrine of signs in general including signification, perception, communication, codes, media, language and the sign systems used parallel with language. Another way to define it is as the science of signs and their life in society.

Code is broadly defined as: everything of a more systematic/orderly nature that the source and the receiver need to know *a priori* about the relation between the signs in a message both in analogue and digital form, and the area of reality they refer to in order to interpret it. Codes are not universal in the way we expect natural laws to be, but are related to meaningful relations between two different areas of reality in specific contexts and related to specific interests. Thus DNA is

only a code for amino acid sequences in proteins inside a living cell in an environment of RNA, Ribosomes and a numerous specific enzymes, and promoting factors just like language codes only work in specific cultural contexts.

Although one can trace the origins of semiotics to the classical Greek period, and follow important developments in the Middle Ages, modern semiotics developed in the 19th century with Charles S. Peirce (1839-1914) and semiology with Ferdinand de Saussure (1857-1913), working independently of each other. But both see sign study as a more comprehensive and general framework than linguistics. Semiotics, including the semiology of Saussure is the study of all sign systems, including non-verbal, paralinguistic and machine codes. It studies how something comes to stand for something else for somebody in certain situations in a certain way:

1. As the word 'blue' stands for a certain range of color, but also has come to stand for an emotional state.
2. As the flag is a sign for the nation (a symbol).
3. As a shaken fist can be a sign of anger.
4. As the red spots on the skin can be a sign for small pox.
5. As the wagging of the dog's tail can be a sign of friendliness for both dogs and humans.
6. As pheromones can be a sign of heat to the other sex of the species.
7. As the hormone oxytocine from the pituitary can be a sign to the cells in the lactating glands of the breast to release the milk (into the baby's mouth).

Two basic semiotic paradigms

Thus semiotics has two major paradigms:

1. A mostly French structuralist one, usually called *semiology*, originating in the Swiss Ferdinand de Saussure's posthumous published *Course in General Linguistics* (trans., 1972 org. 1916). In his linguistics Saussure redefines and describes the linguistic "sign" in functionalist terms as the union of a concept (the *signified*) and a sound image (*signifier*). The linguistic sign is more a

process than a thing. It is a mental relationship between a sound pattern (signal/signifier) and a concept (*signified/signification*). The signifier is the sound pattern. The image of the object in the mind is called the signified. He writes that a "linguistic sign is not a link between a thing and a name, but between a concept and a sound pattern. The sound pattern is not actually a sound; for a sound is something physical. A sound pattern is the hearer's psychological impression of a sound." (Saussure 1972, p. 66). Thus Saussure refers to the "psychological impression of a sound" as the "signal/signifier" and to the "concept" as the "signification/signified" (Harris/Baskin translations), and it is the link between them that comprises the sign. It is a relation from one abstract entity to another, and the relation between these cognitive structures constitutes the sign. The relation to objects in the world is not made very clear, as the language is first of all seen as a system in itself as there are no universal fixed ideas, no universal conceptual objects, since these change from one language to another. Therefore the signified is arbitrary too.

Their coupling is functional as neither the signified nor the signifier is the "cause" of the other. Their relation is arbitrary and determined by cultural convention. There is no natural or logical relation between a particular sound image and a concept. The sign is a compound of a word that signifies, and the idea in the mind which is the signified. Saussure held that words and other language elements (*signifiers*) bore no sensual or formal connection with the things indicated (*signified*) and indicated only by means of the structural role of the word within the whole language.

Thus the basic element of language is defined relationally and the reason we can recognize different occurrences of a word is its place as an element in the system of the "structural whole," of language, which he calls 'Langue'. Any individual unit or speech act dependent on that system (signs such as words or concepts) he calls 'Parole'. Langue can only arise in social relations. It takes a community to set up the relations between any particular sound image and any particular concepts (Parole). The individual cannot make this, as there can be

no private languages, but has to make a kind of contract with Parole in order to express him/herself to others.

There are two places where a mental process is taking place: when speaking between the "mind" and the mouth, and when listening between the ears and the "mind". It seems that both processes are a pairing between a sound and a concept. Semiology rests on the assumption that both the processes are governed by the same set of principles based on Saussure's notion of the "linguistic sign". It is interesting that Saussure wanted to examine systematically the problem of chance as the inevitable foundation of everything, focusing on the material facts and interdependence of chance and meaning, not losing himself in a search for hidden meanings and avoiding all the problems arising from consciousness (see Saussure 1997). He sees thought as a shapeless mass, which is only ordered by language.

Saussure's aim with his semiology was to go beyond linguistic science and to study the life of signs within society. His work emphasises cultural codes and structures, plus literary artifacts constituted by those structures or articulated by them. It is mainly used in linguistic, cultural studies and analysis. It was developed by Louis Hjelmslev (1899-1965) who created glossematics, Roman Jakobson (1896-1982) with his semiotic linguistics, Algirdas J. Griemas' structural Semantics, Roland Barthes (1915-1980) and his text semiotics demonstrated in his *Mythologies* (how clothes, advertisements, sports, and many other objects and forms of behavior are systems of signs which can be analyzed and interpreted in order to understand their social implications). Umberto Eco has developed a general semiotics that blends aspects of Saussurean semiology with Peircean semiotics. The application of Saussure's terminology in biology is mostly influenced by the work of M. Florkin (1974), but also by Roman Jakobson (1971).

Semiologists would usually not accept examples 3-6 above as genuine signs, because they are not self-consciously intentional human acts. It is worth noting those semiologists are not phenomenological in their approach. They are

(social) structuralists and view language as the most basic social system. They consider semiology to be the study of the systems of rules and conventions, which enable social and cultural phenomena viewed as signs. In literary theory, semiotics is the analysis of text in terms of its use of language as dependent on and influenced by literary conventions and modes of discourse.

Often you see the terms "semiotics" and "semiology" used interchangeably. But here we have distinguished between the two paradigms. Originally the followers of Peirce wanted to use his term 'semeiotic', but like semiology it has not had "staying power". We thus put semiotics to be the super term for them both. Starting in the 1990s, the key biosemioticians have used the approach of the semiotics of C. S. Peirce as the philosophical basis to their development of biosemiotics (Hoffmeyer and Emmeche 1991; Hoffmeyer 1996, 2005).

But it is worth noting that, for instance Markos (2002), uses Gadamer's hermeneutics, Witzany (1993) uses Habermas' pragmatics of language as a philosophical foundation, and Barbieri (2001/ 2003) characterizes his own work as biosemantics, but has recently put it under the heading of biosemiotics, developing then a theory that features a concept of biological meaning that is neither Saussurian, nor Peircean, as we shall return to below.

The problem I see in making a biosemiotic paradigm founded on views like this is that one would need to argue for nature or at least living systems to have a basic linguistic dynamics. But I think, this waters down the concept of language to an unacceptable degree. Further, since the concepts of semiology and semiotics have already been invented by virtue of the necessity of having more general frameworks than linguistics to deal with signification and communication systems that cannot live up to the more advanced definitions of being a language as such, I see no reason to make an already difficult task any more difficult. Many semioticians from the humanities and social sciences still find that biosemiotics waters down the concept of semiosis.

Another view would be that the linguistic or hermeneutic view is just a useful metaphor and we are not to take claims of truth as seriously as in classical science, logical positivism and analytical philosophy. We only look for coherence in meanings, not for any foundational statements about truth conditions. We live in a time when researchers in major parts of social science and the humanities might say that the right understanding of scientific knowledge (broadly speaking) is no longer something like "justified true belief" as Plato stated it, but instead "the construction of power relations." Principles of skepticism and the rejection of the possibility of knowledge seems to have become a truism to many people both inside philosophy and outside, that truth claims in science are social constructions with their own conventions and arbitrariness. Thus a metaphorical model is OK if it is "useful". But this would mean that the quest for commonly true knowledge as an over all construction of common knowledge models turns into a quest for constructing models and theories to be used to express one's political/ religious/ economic/race/class/gender consciousness and interest. All that is left is different forms and combinations of power and meaning games in a post-modern age.

I think this is a dangerous path to tread for a democratic society based on power division and functionally differentiated systems as it is, and science being a very important one of them side by side with law, money, power, religion and art. Further I believe that there are good reasons for it not being true. Kuhn, Feyerabend, Popper, Lakatos, Peirce, and many of the post-modern and STS (science technology studies) thinkers were right and wrong at the same time. They all described dubious aspects of what scientists did, but each ignored other aspects. Yes, science can too easily be led by background assumptions that are not objective. Yes, there is no 'one thing' that is the scientific method, and science is a much messier and stranger affair than many scientists want to admit, leaving too much room for mis-steps. But science is still a discipline worth pursuing, although there is no one method that can encapsulate it and despite the fact that it does demand some kind of critical realism and pragmatism to believe that. If one thinks, like many radical and social

constructivists, that the world is a continuum only carved up by words and/or social practices then one is not able to uphold any kind of theory of truth and representation. Though the world is very much process-like, one has to grant it structures to have any kind of cognitive theory. The founder of second order cybernetics, Heinz von Foerster, recognized this (see Brier 1996b) and created a good compromise with his theory of Eigenvalues in a self-organizing evolving nature. He writes:

Eigenvalues have been found ontologically to be discrete, stable, separable and composable, while ontogenetically to arise as equilibria that determine themselves through circular processes. Ontologically, Eigenvalues and objects, and likewise, ontogenetically, stable behavior and the manifestation of a subject's "grasp" of an object cannot be distinguished. (Von Foerster 2003, p. 266)

This self-organizing behavior is seen both in natural processes in chemical and ecological evolution as well as in the gestalt characteristics of cognition as such. Von Foerster saw that the ecological niche and the organism's cognition of its surrounding – what I call its 'signification sphere' – is an interdependent co-evolution. The stabilization of the processes here between the constraints produced by whatever stable process forms self-organization in evolution allows and the possible eigen-values that can be established by a cognitive system's motivated interpretations is what makes signs possible. He writes:

There is an additional point I want to make, an important point. Out of an infinite continuum of possibilities, recursive operations carve out a precise set of discrete solutions. Eigen-behavior generates discrete, identifiable entities. Producing discreteness out of infinite variety has incredibly important consequences. It permits us to begin naming things. Language is the possibility of carving out of an infinite number of possible experiences those experiences which allow stable interactions of your-self with yourself. (von Foerster in Segal 2001, p. 127-128)

This is a good foundation for an understanding of Peircean semiotics and it also helps us to look at science through a crossword metaphor instead of seeing a linear development or a total fragmentation (Haack 1998). Some questions (entries) may partially help with other questions (intersecting entries). Sometimes one answer turns out to be false (a wrongly filled in entry) and misleads scientists on others (as the wrong entry provides a wrong 'clue' to the other). Scientists must then backtrack to figure out how much of the 'puzzle' has been filled in correctly and how much can be left as is. The important thing is that science is not a linear pattern per se, but consists of many different and not always connected entries that assist with and are assisted or destroyed by intersecting entries. We can therefore say that the scientific process is, when used properly, as objective a method as one can get, but it is not in anyway a straightforward simple process. Nevertheless, science has achieved overwhelming success in discovering true things rather than simply inventing or constructing them.

In opposition to postmodernism and coherentism is a view one could call 'foundationalism'. It is the view that a system of meaning and interpretation cannot be solipsistically self-contained but must at some point have a cognitively significant form of contact with external - at least partly -independent reality. One cannot suspend judgment on whether there is *a priori* knowledge or not, since nothing less than a metaphysical theory of (also *a priori*) knowledge can provide an explanation of how empirical objects are *cognitively* available for our inspection in experience - how it is possible that we can reflect on our sense experiences. But it is, on the other hand, also important to realize that the relationship between subject and object is *not* a causal relationship in the physical sense. The actual objects of empirical knowledge, the phenomenal objects, must to a certain degree themselves be contents of consciousness, and therefore available for inspection in a non-causal relationship between subject and object, which is the way it is viewed in semiotics. As such, this philosophy is consistent with Peirce's semiotic philosophy. Foundationalism

thus draws its strength from insights about truth and the significance of *knowledge*, as opposed to opinion or fiction theories only based on coherentism which cannot distinguish these things and therefore have given up any concept of truth, as in much phenomenology, hermeneutics, discourse analysis and structuralist semiology, which only focus on the unpacking of history and presuppositions of the semantic terms. The philosophical analysis of the concept of truth is a very deep and complicated thing that has to include an evolutionary pragmatism as Peirce saw it; but that does not make us or him leave Aristotle's view that truth is to say of what *is* that it is and of what *is not* that it is not.

I will therefore here argue for the Peircean approach in its late pragmaticistic version, where he turns his critique on superficial pragmatism (see for instance Haack 1998). This pragmatic philosophy still meets the standards of a philosophical view in not giving up at least a version of the correspondence theory of truth deeply intertwined with Peirce's semiotics. To this I will add what I consider necessary and useful elements from the autopoiesis theory in the form Luhmann has used in his system theoretical communication-based sociology, in order better to be able to understand the differences and relations between the biological, the psychological, and the social communicative systems in humans and their societies.

2. So, the second main paradigm in semiotics is the triadic, American, pragmaticistic, transdisciplinary, evolutionary doctrine originating in the work of Peirce. As Peirce's semiotics is the only sign study that deals systematically with non-intentional signs of the body and of nature at large, accepting examples 3-6 above as genuine semiosis, it has become the main source for semiotic contemplations of the similarities and differences of signs of inorganic nature, signs of living systems, including diagnostics of medicine, as well as signs of machines (especially computer semiotics, see the groundbreaking book of Bøgh Andersen 1990).

To develop his fundamental theory of semiosis Peirce designed a philosophical alternative to both the dualism of rationalism and the materialistic monism of most empirical science. He combined realism and idealism into an objective idealism¹, then combined this with synechism, the view that the basic “stuff” of reality is continuous, manifesting as both mind and matter, an evolutionary ontology (process view) and a pragmatic epistemology.

His world view can therefore be summed up as one of evolutionary objective idealistic social pragmatic realism. Reality is what affects our world of bio-social signification. Things cannot therefore be more real than signs, because signs can also be objects. The same applies to laws. If something is so persistent that we refer to it as an object/thing, then there must be stable habits (“laws”) connected to it, as well as qualities that make it possible for us to understand it.

Peirce's consideration of the relationship between the human and nature presupposes that the analogies between human thought and the “thought”-habits of nature are valid. These analogies are based upon the commonalities of the (semiotic) forces that make things happen.

Peirce's semiotics embeds logic within it. But Peirce's interest in science and epistemology led him in directions different from those taken by Frege. All symbols have an indexical component, and signs such as sentences have to be analyzed as multifunctional semiotic expressions. Thus he does not create the split between logic and indexicality that plagues the langue-parole dichotomy troubling Saussure. Predicates describe qualities or states of affairs, while indices point to objects, external reality, or aspects of their context of use.

¹ Objective idealism is the view that existence consists, fundamentally, of a vast mental “absolute.” It is a metaphysics that postulates that there is in an important sense only one perceiver and that this perceiver is one with that, which is perceived, at least in the beginning, before it split up in an absolute or transcendental aspect and a relative aspect in time and space. In some philosophies these are then absolutely separated. In Peirce’s theory they are connected through his principle of synechism, which then connects the immanent and the transcendent of the One, the sacred, the divine or whatever names one calls it.

The value of an icon consists in its exhibiting the features of a state of things regarded as if it were purely imaginary. The value of an index is that it assures us of positive fact. The value of a symbol is that it serves to make thought and conduct rational and enables us to predict the future. ... the most perfect of signs are those in which the iconic, indicative, and symbolic characters are blended as equally as possible. (CP of CS Peirce, §4.448)

Peircean biosemiotics is based on Peirce's theory of mind as a basic part of reality, (in Firstness) existing in the material aspect of reality, (in Secondness) as the "inner aspect of matter" (hylozoism) manifesting itself as awareness and experience in animals, and finally as consciousness in humans. Combining this with a general systems theory of emergence, self-organization and closure/autopoiesis, it forms an explicit theory of how the inner world of an organism is constituted and, therefore, how first-person views are possible and just as real as matter. Through this foundation for semiosis, a theory of meaning and interpretation including mind -- at least as immanent in nature -- is possible; and cybernetic views of information as well as autopoietic views on 'linguaging' can be combined with pragmatic theories of language in the biosemiotic perspective. Propositions are viewed meta-indexically in that they represent the predicates of the objects pointed out by indices, in contrast to Saussure's much more logomorphic and logocentric semiology. The barrier between the empirical content – here in form of the indexicality - and logical form, which is also problematic in classical and analytical philosophy of logic, does not exist for Peirce, as the indexical aspect is built into all referring terms, and classical logic is a part of semiotics. Thus this makes hypotheses about them empirical testable².

² Peirce invented the term 'abduction' as a description of how we first come to our ideas, concepts, and hypotheses about the world, and this is essentially the semiotic process where we connect representamens with objects through creating our interpretants. From this we deduct consequences of our abduction, and then test them

Peircean (bio)-semiotics is distinct from other semiotic paradigms in that it not only deals with intentional signs of communication, but also encompasses non-intentional signs such as symptoms of the body and patterns of inanimate nature. Peircean semiotics breaks with the traditional dualistic epistemological problem of first-order science by framing its basic concept of cognition, *signification*, within a triadic semiotic philosophy. The triadic semiotics is integrated into a theory of continuity between mind and matter (*Synechism*) where the three basic categories (*Firstness, Secondness and Thirdness*) are not only inside the perceiver's mind, but also in the nature perceived. This is connected to the second important ontological belief in Peirce's philosophy, namely *Tychism*, which sees chance and chaos as basic characteristics of Firstness. This is combined with an evolutionary theory of mind (*Agapism*), where mind has a tendency to form habits in nature.

Chaos and chance is seen as a First, which is not to be explained further (for instance, by regularities). It is the basis of habit forming and evolution. The chaos of Firstness is not seen as the lack of law, as it is in mechanicism and rationalism, but as something full of potential qualities to be manifested individually in Secondness, and as general habits and knowledge in dynamic objects and semiosis in Thirdness (Peirce 1992). This is an alternative to viewing knowledge either as justified true belief or causally produced or as in contemporary approaches to language that derive from Turing machine analogies or computer models.

empirical and evaluate them inductively. Through his understanding of the interacting roles of abduction, induction, and deduction in a social process of scientific inquiry a semiotic and logical process becomes a public, self-correcting process. Reality is that which the community of inquirers would ultimately agree upon as true, not arbitrarily socially constructivistically, but because we have a deep connection to reality through the categories and evolution. Saussure's theory of language relies implicitly much more on a rationalist theory of meaning and consciousness, since its notion of sign is based on the idea that signs represent ideas which precede any actual utterances, and are consequently considered to be much more timeless and context-free than in Peirce's pragmatism.

Peircean semiotics differs from those approaches, which start with logical form and then ask how it gets instantiated by language or mental processes. Instead, his semiotic pragmatistic philosophy links these processes to his epistemology of abduction and reasoning to the best explanatory hypothesis. This sees the development of knowledge as a dynamic relation between belief, doubt, desire, and inquiry, and the self-correcting nature of semiosis. Beliefs are certain behavioral dispositions that manifest themselves in a given context based on certain desires. They may be changed through processes of inference, which change our representations of the world. Truth and reality, thus, to a certain extent, depend on the social construction of inquiry. But, on the other hand in his triadic evolutionary view, semiosis can be viewed as self-correcting in its reproduction of Thirdness. This is the deep evolutionary foundation of Peirce's pragmatism that fits so well with biological evolutionary and ecological thinking, but provides an alternative to "selfish genes" and other reductionistic genetic approaches, and hopefully can help us to connect genes and biological functionality in a more fruitful way.

The semiotic threshold in biosemiotics

Ever since Umberto Eco (1976) formulated the problem of the "semiotic threshold," semiotics -- especially Peircean semiotics -- has developed further into the realm of biology. As a result of the innovative work of Thomas Sebeok, Peirce's semiotics is now interpreted as covering all living signifying systems in biosemiotics. The efforts of Thomas Sebeok (1920- 2001) (see for instance Sebeok 1976, 1986, 1989; and Petrilli and Ponzio 2001 for a short history) have led to the development of a biosemiotics encompassing all living systems, including plants and micro-organisms, as sign users. I have listed Sebeok's major works in animal communication and biosemiotics in the reference list.

Sebeok's name is associated most of all with the term zoösemiotics, the study of animal sign use. It was coined in 1963, and it deals with species-specific communication systems, and their signifying behavior. Zoösemiotics is concerned more with a synchronic perspective than an ethologic one, which focuses primarily on the diachronic dimension. The transmission of information

among animals was, for instance, the subject of the book *Animal Communication* (1968), which Sebeok edited. His research succeeded in broadening the definition of semiotics beyond human language and culture to encompassing human non-verbal communication as well as communication between, and sign processes within, all living organisms. Later, Sebeok decided that zoösemiotics rests on a more comprehensive science of *biosemiotics*. This global conception of semiotics – namely biosemiotics - equates life with sign interpretation or mediation. He was most proud of having inspired a group of theoretical biologists and semioticians to pursue this field of investigation.

Although biosemiotics was already prefigured in Jakob von Uexküll's *Umweltlehre*, Sebeok fruitfully combined the influences of von Uexküll and Charles S. Peirce, and merged them into an original whole, in an evolutionary perspective, arriving at the thesis that symbiosis and semiosis are one and the same. Biosemiotics finds its place as a master-science, which in the animal cognition and communication area encompass the parallel disciplines of ethology and developmental psychology.

As Uexküll was one of Konrad Lorenz' most important teachers, the ethology he and Tinbergen developed fitted nicely as a part of biosemiotics. In von Uexküll's writings one finds the roots of important concepts such as sign stimuli, innate release mechanisms, and motivation, later utilized in Lorenz' ethological research program. As previously discussed in Brier (2001a), von Uexküll's "tone" becomes Lorenz' "motivation," the "sign stimuli" in ethology becomes the "subjectively defined object," and the "IRM" becomes the "functional relation between receptors and effectors." But it is clear that von Uexküll's bio-cybernetic concepts differ from the partially mechanistic framework found in the theoretical foundation of Lorenz and Tinbergen's articles from around 1950. About "tone", von Uexküll writes the following:

The *Umwelt* only acquires its admirable surety for animals if we include the functional tones in our contemplation of it. We may say that the number of objects that an animal can distinguish in its own world equals the number

of functions it can carry out. If, along with few functions, it possesses few functional images, its world, too, will consist of few objects. As a result its world is indeed poorer, but all the more secure. (von Uexküll 1957, p. 49)

Von Uexküll's "tone" concept is the root of Lorenz' specific motivation – but it seems more closely related to Gibson's affordances, although it is unclear whether Gibson ever read von Uexküll. nevertheless it is important to underline that Jakob von Uexküll's framework is behavioral and functionalistic like the cybernetics his functional cycle with its feedback system was inspired by. He is in no way to be considered a bio-phenomenologist.

Jakob von Uexküll's type of theory is very much like Maturana and Varela's (1980) autopoiesis and Bateson's cybernetic ecological mind theory (Bateson 1972). There is no theory of first person experience, or the origin of qualia, feeling and willing. He always, like the cyberneticians, underlines the functional aspect. Bateson's 'pattern that connects' is "The Lonely Skeleton of Truth", as he calls it in a poem in *Angels Fear*. His 'mind' is a cybernetic feedback and homeostatic cybernetic goal oriented system like a thermostat acting on 'differences'. Thus it is my view that Peirce's semiotic philosophy delivers the missing element to both von Uexküll's philosophy of science and Lorenzian ethology, providing a post-mechanistic explanation (Brier 2008).

The empiricist and natural science readings Sebeok offers for communication were new to the semiotic field. References to animal models are made throughout his work in the context of ethology. The approaches of ethology and sociobiology have been controversial and, in their applicability to human culture and society, accused of reductionism. Sebeok shows that some of this controversy may find itself played out in the new transdisciplinary framework of biosemiotics. In 1992 he and his wife Jean Umiker-Sebeok published *The Semiotic Web 1991* as a volume titled *Biosemiotics*. This volume was predicated on a book they edited in 1980, *Speaking of Apes*, which presented a detailed critical evaluation of current investigations of the ability of apes to learn

language. Sebeok showed in a profound critique of the way the experiments were constructed that it is very doubtful that apes have such capabilities. This work and its profound consequences are summed up and developed further in the collection, *Life Signs (2000)*. Thus biosemiotics does not entail that there are no significant differences between man and apes.

Sebeok argued that the biosphere and the semiosphere are linked in a closed cybernetic loop, where meaning itself powers creation in self-excited circuits. This is a thinking that clearly encompasses the similar ideas as are considered in second-order cybernetics (von Foerster), autopoiesis theory of Maturana and Varela (1980), Niklas Luhmann (1995) and enaction theory of Varela, Thompson. and Rosch (1992)

Sebeok founded biosemiotics through a Peircean reinterpretation of Jakob von Uexküll's *Umweltslehre*. In the last 20 years of his life he worked in collaboration with, among others, the Copenhagen and Tartu Schools of Biosemiotics³. Thus this semiotic doctrine accepts also non-consciously-intentional signs in humans (example no. 3) and between animals (nos. 5 and 6) as well as between animals and humans (no. 4), non-intentional signs (no. 4), and signs between organs and cells in the body (no. 7) called *endosemiotics*, (Uexküll et. al. 1993) for instance a special area of *immunosemiotics* dealing with the immunological code, immunological memory and recognition (Sebeok 1997a, 2001c). The way that we now know that the nervous system, the hormone system and the immunological system's communicative codes work on each other is considered to be the basis of *the biological self*: an endosemiotic self-organized cybernetic system with homeostasis. Maybe it was better named *the biosemiotic self*?

But biosemiotics does not only deal with animals in *zoösemiotics*, it also deals with signs in plants: *phytosemiotics* (Krampen 1981), as well as with bacterial communication. According to one standard scheme for the broad classification

³ Jesper Hoffmeyer, Claus Emmeche, Frederik Stjernfelt and Søren Brier in Copenhagen and Kalevi Kull at the Jakob von Uexküll centre in Tartu. and at Tartu university.

of organisms, five super kingdoms are now distinguished: protists; bacteria; plants; animals; and fungi, thus the major classification categories in biosemiotics are according to Deely (1990): *bacteriosemiotics*, *protistosemiotics*, *phytosemiotics*, *mycosemiotics*, and *zoösemiotics*.

Within zoösemiotics the Peircean antroposemiotics encompasses the traditional semiotics of language and culture mostly inspired by Saussure. There has, at the Gatherings in Biosemiotics conferences, been some discussion of antroposemiotics and with it the semiotics of language should be seen as a special part of biosemiotics - as I endorse - or should be considered to be an area outside biosemiotics. Thus biosemiotics could be seen as a new foundation for biology, or as a supplement to the mechanistic and informational ones. Asking Hoffmeyer if this was the right interpretation of his view - as expressed in Hoffmeyer (2007) - he corrected my text to the following:

According to Hoffmeyer antroposemiotics deals with levels of semiotic freedom far beyond anything known in the pre-human world, and for that reason antroposemiotics requires research strategies that are radically different from those of biosemiotics proper. Antroposemiotics, however, cannot escape the fact that human semiotic interactions are evolutionarily rooted in much simpler biosemiotic interaction patterns, and this fact must be reflected in the foundational understanding of antroposemiotic research, whatever kind it is.

Thus Hoffmeyer sees unity on the ontological level including the consequences of an evolutionary view, as Peirce does, but qualitative differences on the epistemological level because the semiotic freedom changes radically when we move into the level of symbol use in language where the directionality is now controlled by grammar as Per Durst-Andersen points out in his paper in this journal.

Agreeing with Hoffmeyer on these points I still think that there are also important epistemological continuities between the zoösemiotic and the antroposemiotics levels in the form of the understanding of knowledge coming from Peirce's philosophy of the three categories, his theory of abduction and its connection to deduction and induction.

There has been a well-known debate about the concepts of primary and secondary modelling systems (see, e.g., Sebeok and Danesi 2000) in linguistics, which have now been changed by biosemiotics. Originally language was seen as the primary modeling system, whereas culture comprised the secondary one. But through biosemiotics Sebeok has argued that there exists a nonverbal zoösemiotic system as the foundation of human language, which has to be called the primary one, thus language becomes the secondary, and culture the tertiary (e.g., Sebeok 1994). The ethology developed by Lorenz (1970-71) and Tinbergen (1973) from the 1920's on (inspired by Jakob von Uexküll) has for a long time pointed out that some animal species react to certain aspects of nature or other animals as signs to be interpreted in fixed action patterns, and that animals communicate with these in a ritualized form giving some of them a symbolic character. In addition to directly biosemiotic problems, Sebeok also touches, in some of his writings, on the area of representations of (and approaches to) nature in cultures nowadays known as *ecosemiotics* (Nöth 1998). This should be taken as different from biosemiotics, because it does not deal with biological problems and belongs rather to the domain of the semiotics of culture.

Modern Peircean biosemiotics is very different from the symbolic semiotics of human language that cyberneticians distanced themselves from many years ago. The theories of Heinz von Foerster and Humberto Maturana & Francisco Varela have had significant influence on the development of the Copenhagen school of biosemiotics. This school focuses mainly on a new interpretation of biology and life as having an important communicative aspect to their organization. They look at the basically biological aspect of biosemiotics

especially as endosemiotics, and its significance for understanding ecological and hereditary relations in a non-reductionistic evolutionary view; it opposes views like Richard Dawkins' theory of selfish genes.

The concept of 'code' and 'coding' in biosemiotics

Biosemiotics is the study of signs and signification of cognition and communication – also in the form of language - in all living systems. This can further be specified as the theory of living systems seen as sign systems as well as the study of biological codes. Biosemiotics attempts to integrate the findings of biology and semiotics to form a new view of life and meaning as immanent features of the natural world and transcends on the one hand the purely chemical description of life in molecular biology and on the other hand the traditional idea that semiotics is only the study of sign use in the language and culture of human beings. Biosemiotics presently considers the simplest system that possesses real semiotic competence to be the living cell. It is based on a view of the internal as well as external processes between, for instance, protein molecules, especially as enzymes, transmitters and hormones - and the functions of the various forms of RNA and DNA and their interaction with proteins

This goes for single cell organisms such as bacteria or algae as well as a member of a tissue or an organ in a multi-cellular organism, be it a tissue like muscle fibers, an organ like the liver or a system like the nervous system. One can view tissues as distinct bio-communicative systems created through the embryological process. In the tradition of Peirce, who founded semiotics as a logical and scientific study of dynamic sign action in human and non-human nature, biosemiotics attempts to use semiotic concepts to answer questions about the biological and evolutionary emergence of meaning, intentionality, and a psychical world, based on his three categories. The organism is only partially coupled to its environment, and hence is in an ongoing interpretation of it while at the same time being constrained in partly unexpected ways.

Hoffmeyer (1996 and 2007) therefore talks about *the semiotic niche* as that part of the semiosphere which the genomic lineage has learned to master in order to control survival and proliferation of organisms. The behavior of organisms represents neither internal “organization” nor external “information” but interpretations of one through the other in the phenotype as well as the genotype. This cybernetic circularity - or developmental spiraling - over time of signification is what Hoffmeyer and Emmeche call *code-duality*. One could say that it is a sort hermeneutic circle or spiral on an evolutionary time scale.

Peircean biosemiotics builds on Peirce’s unique triadic concept of semiosis, where the ‘interpretant’ is the sign concept in the organism that makes it see/recognize something as an object. The Interpretant is the individual’s interpretation of what the outer sign vehicle “stands for” in a motivated context by relating to a code that is connected to that specific functionality.

The role of living systems in establishing true semiosis is unclear in Peirce’s theory, as are the special biological qualities that allow this to happen. Peirce did, however, recognize that chance-spontaneity in nerve cells is “the outward aspect of that which within itself is feeling” (Peirce, CP: 265; Santaella Braga 1999). But a deeper understanding of the concept of coding in a semiotic context might help us in the right direction.

The concept of ‘code’ in Peircean biosemiotics

The term *quasi-semiotic objects and processes* (Nöth 2002) recognizes that systems in nature and culture work with differences, often in the form of coding from outside, instead of through either physical causality or meaningful semiosis. Systems of Secondness have established an information level above the energetic and causal level of nature. This area, delimited from a semiotic point of view, is part of what classical first-order cybernetics considers their subject area: goal-oriented machines and pattern-forming, self-organized processes in nature, based on information. The terms “informational,” “coding,”

and “signal” are used mainly in cybernetic contexts for these systems. But where one can define ‘information’ and ‘signal’ in a meaning free paradigm, I do not find this compatible with the concept of ‘code’.

A code is a set of process rules or habits (for instance how the ribosome works) which connect elements in one area (for instance genes) with another area (for instance a sequence of amino acids in proteins) in a specific meaning context (here the procreation, function, and survival of the cell). Language, of course, depends on social and cultural codes. What are biological codes, then? Marcello Barbieri (2001) has pointed to the importance of codes in living systems such as the genetic code, signal codes for hormones, and between nerve cells and nerve cells and muscles, codes for recognition of foreign substances and life form in the immune system etc.

Barbieri uses the standard definition of *codes as rules of correspondence between two independent worlds*, as for instance the Morse code standing for letters in the alphabet, money standing for purchasing value, the song of a bird for its willingness to defend its territory etc. Thus a code gives meaning to differences, relations or information in one area relating them to the other in certain contexts. Thus pauses in telegraphing using Morse code relate to the qualitative difference between the letters in the alphabet. To most biosemioticians it is crucial that the *correspondence in codes is not a universal natural law, but is local and conceptualized or rather motivated from a living signifying system*. Thus machines do not make codes themselves. A sequence of differences such as the base pairs in DNA can be information for coding, but is not a code in itself. From Peircean biosemiotics one argue that codes are part of triadic sign processes where an interpretant makes the motivated connection between objects and signs (representamens). The functioning of living systems is based on self-constructed codes. The ribosomal system for building proteins uses the base sequence as information for the DNA to determine the amino acid sequence in the proteins through the use of messenger RNA and of transport RNAs. Barbieri (2001) thus points out that living systems are built of

artificially produced code-based molecules from the cells' molecular assembler machine. The cells are therefore not only autopoietic – as pointed out by Maturana and Varela - as they produce their own elements and internal organization, but also artificial as some of its most vital molecules do not appear in the natural world outside living systems.

The Ribosomes are systems that are capable of assembling molecules by binding their subunits together in the order provided by a template. Cell proteins have the sequences of their amino acids determined by the internal code system in the cell between the gene and the ribosome systems. The self-organized codes of life differentiate living systems from physical, chemical and technological systems. Computers do not make their own codes as they function causally according to the codes we have made and installed. The structure of living systems, their organization and processes are determined by internal codes, and they are therefore in a certain way artificial as they are organized by something – local and contextual - in addition to natural laws. The proteins in the living cell are different from proteins created through external spontaneous chemical processes. Living systems are not natural in the same way as physical and chemical systems, because the protein molecules from which they are self-constructed are manufactured by molecular machines (the Ribosomes and connected processes), as Barbieri points out.

But in his work Barbieri⁴ claims a third model of semiosis was suggested already in the 1980s. It proceeds from biological theory that the cell is a triad of genotype, phenotype and ribotype, where the ribotype is the ribonucleoprotein system of the cell and represents its “codemaker”, i.e. the seat of the genetic code (Barbieri, 1981, 1985, 2003). Thus the cell contains a “codemaker” but not an “interpreter”. Barbieri holds that the rules of the genetic code do not depend on interpretation from any kind of mind. For Barbieri it is always an act of coding that is the origin to semiosis. The first semiotic system in the history of life was

⁴ The following description of Barbieri's theory is taken from a long email discussion with him attempting to get a deep understanding of this theory and its disciplinary matrix. I try to follow his formulations as close as possible. This part of the article is controlled by Barbieri.

the apparatus of protein synthesis (the ribotype) and that apparatus does not need interpretation because the rules of the genetic code are the same in all living systems, he claims. But he also says that we cannot have a sign without a meaning, because a sign must signify something, and further we cannot have a meaning without a sign because a meaning must be the meaning of something. But the meaning is to be sought in the world of objects and their relations in his view.

Thus, according to Barbieri's theory, we have a world of objects that we call *signs* and a world of objects that represent their *meanings*. Codes are the arbitrary (not necessarily physical) connections between them. A *semiotic system is a system made of two independent worlds that are connected by the conventional rules of a code*. A semiotic system is constructed by the triad *signs, meaning, and code*.

This is a contrasting view to Peirce's semiotics, according to which it is made of signs (representamens), objects, and interpretants, and these concepts are understood as belonging to Firstness, Secondness, and Thirdness in that order. Barbieri works from some kind of biological material worldview, where meaning appears in living systems out of a meaningless physical and chemical world through coding and then semiosis. It is the rules of a code that create a correspondence between signs and meanings. Thus, it is a codemaker who is "the agent" that produces the signs, meanings, and conventions. He calls his theory "the codemaking model of semiosis".

In this theory semiosis appeared at the origin of life, and therefore meaning is first, and then mind and interpretation came much later, developed on the basis of semiotic processes. Thus we can have meaning without interpretation. This theory is only based on the mechanisms of evolution consisting of natural selection and natural conventions. Moreover, the view that the deep structure of the cell is a trinity of genotype, phenotype and ribotype, which is the seat of the "makers" (copymakers and codemakers); and the artifact-makers necessarily

come before the artifacts, which are the genes and proteins. The theory is then based on a possible co-evolution of the genes, the proteins and the ribosomes, as is also suggested in Eigen's hypercycles theories; but in Barbieri's theory the resulting interaction is seen as semiotics producing new 'designed' molecules, representing a new level of biological meaning.

I agree here from a Peircean point of view, that a sign is an object that is a part of some self-reproducing system. A sign is always useful for the system, and its value can be determined by its contribution to the reproductive value, survival, and/or life joy of the entire system. Semiosis is a crucial part of those processes that make systems living entities, and lift them out of the physical world's efficient causality through the informational realm of the formal causality of chemistry into the final causation in semiotic processes. The problem is to do with the question of what kind of philosophical framework is necessary to formulate such a theory in a consistent way. My view is that Barbieri's theory is not sufficient to explain what he wants to explain, but he wants to retain it to avoid the - from the received view of science – controversial world view of Peirce semiotic philosophy, which he – probably with the majority of scientists - considers 'unscientific'.

According to the way Peirce defines these three types of causality, revising Aristotle's concepts:

1. *Efficient causality* works through the transfer of energy, and is quantitatively measurable.
2. *Formal causality* works through pattern fitting bits and with signals as information in a dualistic proto-semiotic matter.
3. *Final causation* is semiotic signification and interpretation. Codes in living systems are correspondences based on final causation, which cannot be inferred directly from natural laws as they are viewed in non-semiotic world

views such as the mechanical and the complexity and system sciences informational views⁵.

They are based on the formal causation of differences and pattern fitting information mostly on the chemical level of interaction. The physical interactions are based on laws and efficient causation of energy transfer. But they do not have a concept of final causation, though they struggle to define concepts of agency and mind emerging in nature through Neo-Darwinian evolution.

Thus from a Peircean biosemiotic view molecules are composed of sequences of atoms and make three-dimensional shapes. They interact informational through formal causality. Cells then interpret the molecules as coded signs and interact with them through final causation in semiosis. Organisms are governed by final causality in the sense of their tendency to make habits, and to generate future interpretants of the present sign actions. Therefore biosemiotics sees the evolution of life and the evolution of semiotic systems as two aspects of the same process. But for Barbieri this is done “scientifically”, namely without any reference to an inner world of experiences in living systems, but with the idea that such a theory can be developed on the basis of this semiotic theory (explaining mind and consciousness scientifically). I do not here see any significant difference from the information processing paradigm of the cognitive sciences, which also hopes to make a theory of mind and consciousness without any phenomenological component. I have criticized this paradigm – in spite of its being the most accepted view of science – because I think it neglects one of our main problems of ever obtaining a coherent theory of consciousness and meaning. (Brier 1992, 1993, 1995, 1997, 1998, 2001a and c, 2003 a and b, 2005).

The standard scientific approach to, or the received view of, the origin and evolution of life has, from a Peircean view, overlooked the inner qualitative aspects of sign action, leading to a reduced picture of causality. The evolution

⁵ One would do well in remembering that Peirces concepts are somewhat different from Aristotle’s as they function in his semiotic evolutionary and pragmatic philosophy.

of life is not only based on physical, chemical and even informational processes, but on the development of semiotic possibilities, or *semiotic freedom* as Jesper Hoffmeyer (1996) calls it. It is the evolution of semiotic freedom that creates the zoösemiotic system or '*sign games*' (Brier 1995) that is the primary system behind the foundation of human language games and the tertiary system of culture as Thomas Sebeok and Marcel Danesi (2000) have pointed out in their Modeling Systems Theory.

Subjectivity and meaning are always produced from embodied beings with some kind of individuality that orders perception of objects, events and possibilities into its own functionality and survival. *Sebeok points out that the semiosphere, the totality of interconnected signs, is identical with the biosphere or - one might add - is a broader and more profound understanding of it. Biological systems are then understood as being held together by "communicative causality"⁶, and are therefore not natural kinds in a physical-chemical sense. They are communicative structures.*

Re-interpreting von Uexküll on this basis creates a biosemiotics more suited to encompassing the phenomenological aspects of life and cognition with a realistic view of nature. Because in Peircean semiotic philosophy, these levels can be bound together by Synechism, Tychism, and Agapism, combined with an evolutionary view of the interactions between Firstness, Secondness, and Thirdness. The view of Firstness as a blend of qualities of mind and matter containing qualia and living feeling and a tendency to form habits, is crucial for understanding the self-organizing capabilities of nature and how what seems to be "dead" matter can, through evolutionary self-organization, become autopoietic and alive with cognitive/semiotic and feeling abilities. The embodied mind is the overlap between zoösemiotics and anthroposemiotics, and one can hope that the conceptualization of the embodied internal intercellular

⁶ I am aware that this expression has a certain paradigmatic flavor about it, as for many scientist causality is only something that can come about through material interactions. This is not so in Peirce's semiotic philosophy, which operates with sufficient, formal and final causation and a theory of semiotic interactions in his synechistic ontology.

communication dynamics as endosemiotics could bring body and mind to the same level.

Still, aspects of the development of embodiment and meaning that von Uexküll did not consider are partially missing. Concepts of the closure, self-organization, and differentiation of biological, psychological, and social systems developed in a second-order cybernetics and autopoiesis theory need to be integrated into theories of embodiment, before biosemiotics can also be defined as a study of non-conscious semiosis in humans and animals. Niklas Luhmann has used Maturana and Varela's autopoiesis theory to create a framework of triple autopoiesis, which points to some of the basic problems here, and in my opinion also to the solution, if it is integrated into a framework of Peircean biosemiotics. I call it Cybersemiotics (Brier 2008).

Luhmann's Triadic Autopoietic Systems

Luhmann has generalized the autopoietic concept of Maturana and Varela (1980) in order to also comprise psychological thinking systems and socio-communicative systems. Luhmann (1990) thus operates with three types of autopoietic systems: 1. The biological, 2. the psychological and 3. the socio-communicative. See figure 1 for an illustration. Of those, only the psychic and the communication system operates on meaning. But he views the psyche as a silent closed system of perception, emotions, thinking and volitions. Thus minds or psychic systems do not communicate; only communication communicates. A special socio-linguistic system has to be created for communication to happen. Communication is again an organizationally closed system. Communication systems create their own elements, connect them with each other and with action, and develop them further in an evolutionary process. Social systems are viewed as communicative systems with human bodies and minds as mere surroundings.

To Luhmann (1995) communication is a sequence of selections of differences, namely of 1) information, 2) utterance and 3) interpretation or understanding. The two first have to be made by what we traditionally call “the sender”, the last one by the receiver. Information is constituted by choices related to subject matter, utterance is choices pertaining to the way to say something, and understanding amounts to the choices of interpretation of the listener depending on his evaluation of the human context. S/he chooses an understanding of the signs produced, and then one could say that a message is only produced when the receiver says something, which the sender chooses to understand as a confirmation of some kind of understanding of his first message. Finally, in a fourth selection, the message is connected to present practice and accepted as worth paying attention to, and initiates communication, stepping into the system. The listener can choose not to listen or not to perceive the sounds made as communication.

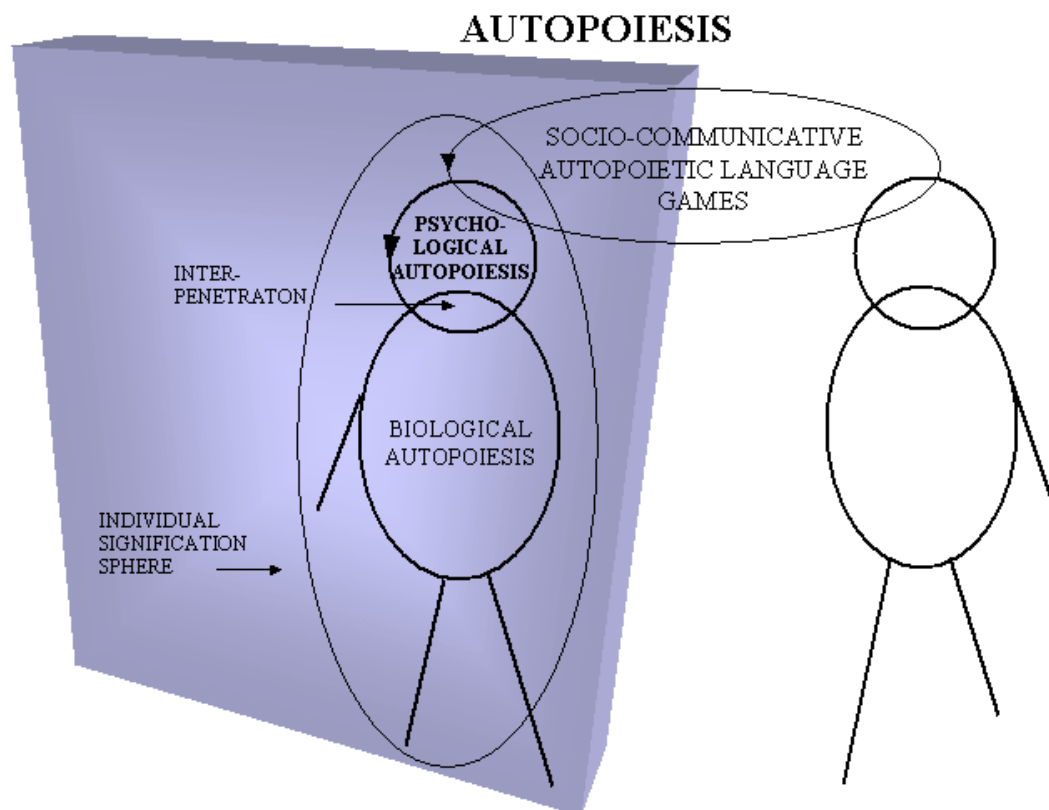


Figure1 : Luhmann's three autopoietic systems working separately to make communication possible, but also using each other as resources by interpenetration. "Signification sphere" is the biosemiotic term for von Uexküll's *Umwelt* and Maturana's *Cognitive domain*", reinterpreted here within a Peircean biosemiotics. Quoted from Brier 2008.

Although Luhmann's view of information is loosely based on Bateson's concept of information as 'a difference that makes a difference', Luhmann (1990 and 1995) does not believe in its use outside of human social communication. Thus, he does not want to generalize it outside the analysis of human messages. Also, Luhmann does not seem to believe that information exists in nature independently of human perception. The information concept functions as a quantitative aspect within a meaningful human context in a specific utterance only. This is how he combines information with aspects of utterance and meaning. Luhmann stresses that both the sender and the receiver have to make their choices – or sections, as he calls it - to produce a meaningful

message. From a Peircean biosemiotic point of view I think that instinctive reactions would also count as such a choice, but on a non-conscious level. In humans we can decide on the conscious level, whether we want to follow the call of our instincts. Further, Luhmann's theory has problems producing a concept of meaning that relates deeply to the flesh, blood, and life (conditions) of biological systems, and the existential conditions of human consciousness. Here embodied cognitive language philosophy, like Lakoff and Johnson's embodied cognitive semantics combined with ethology, all seen within a Peircean biosemiotic framework (Brier 2000a), tell us that signs as concepts and classifications arise in our embodied biological and social "life forms". From our inner world we express our bodily experiences in social relations. It is especially regarding the social communicative construction of meaning that Luhmann's theory connects so well with semiotics. But Luhmann himself did not connect to semiotics in any systematic way. Instead, he attempts to integrate Husserl's phenomenology into his autopoietic system thinking. But I have shown elsewhere that in doing so he destroys the very foundation made phenomenology work (Brier 2007) and thereby question his system theory of meaning from an ontological point of view..

The Cybersemiotic View of Cognition and Communication

One way to understand our inner mental world is to see it as a way of representing our bodily interactions with the environment through the constructions of a felt signification sphere. In this way an individual "point of view" as a center of cognition, interest, and interpretation is created. What Spinoza calls conatus, self-value and self-interest in preserving the individual's and species' self-organizing structure is basic to living systems' ability to signify. But this individual signification sphere is again perturbed by the species' specific social interactions starting with mating, rearing of the young, competing for hunting territory, and falling in line in the hierarchy of the group, co-operating in food gathering and hunting. These social interactive activities first generate sign games, and later in evolution, the human language games.

The construction or development of meaningful and informative messages has as a prerequisite autopoiesis, signification and conatus/motivation/intentionality. It is only within this triad that the selections of information, utterance, and meaning are possible.

Viewed in this way, Luhmann's three autopoietic systems (see Luhmann 1990) are all needed to create the meaning of a message, and one needs the sign concept to understand their interaction. One way of getting out of the impasse of Luhmann's functionalism, where the role of body and mind in the production and meaning of social communication has not been adequately grasped by theory, is to view the interpenetration between the three organizationally closed systems semiotically. Signs acquire meaning where the systems interpenetrate. Interpenetration is Luhmann's term for the interaction between biological autopoiesis, psychic closure and the socio-communicative system with its own closure at the social level, when they use each other as a resource.

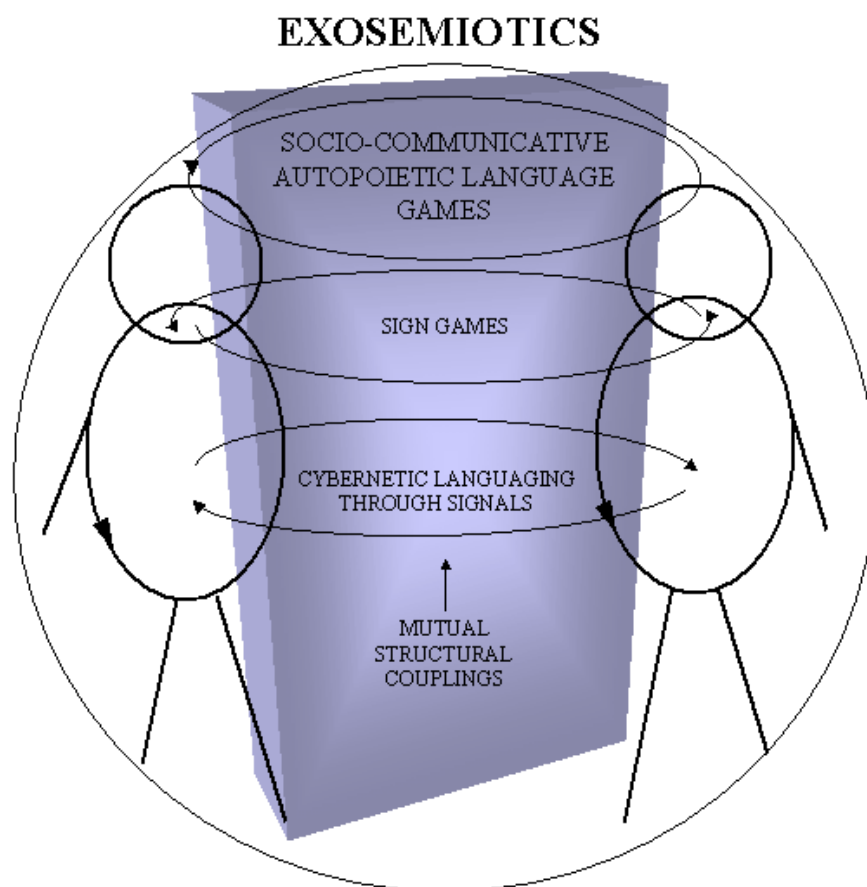


Figure 2 : The three levels of communication systems, where the semiotic ones are created where the biological and the psychic autopoietic systems interpenetrate and where the psychic and the socio-communicative systems interpenetrate. Quoted from Brier 2008.

My theory (Brier 2008a) is thus *sign and language games arise on the basis of the interpenetration of the three different autopoietic systems*. Meaning is seen as being generated by the interpenetration of the systems. For example, language is a part of the socio-communicative system, but it does not really acquire meaning until it interpenetrates with the psychical system, and then indicates differences of emotions, volitions, and perceptions; “putting words” to our silent inner being. But our cognitive, emotional, and volitional qualities would

only have a weak connection to reality if they were not connected to the survival of the living systems' organization as a body through its interaction with the environment's differences and their development of a signification sphere in the course of evolution of the species. See figure 2 for an illustration. Still, you can, of course, like Luhmann, just study the socio-communicative systems' autopoietic eigen-behavior. But as a transdisciplinary framework for communication, cognition and signification it is not satisfying standing alone.

In Brier (2000a), I have shown that ethology and embodied metaphor theory have both discovered that the conception of a sign as standing for something to somebody in a particular way, is controlled by some releasing mechanisms that connect motivation, perception, and behavior/action into one systemic process, as Jacob von Uexküll had already described in his "Funktionskreis" and, which Heinz von Foerster refers to as perceptual "Eigenvalues". Instinctually, the actual IRM (Innate Release Mechanism) is chosen through the urge coming from a specific motivation. This is again based on biological expectancies and vital needs, like the need for food and mating. I argue that the linguistic motivation, which Lakoff and Johnson claim controls the ICM (Idealized Conceptual Models), is connected to the biological motivations in many instances. This is obvious in the much-used example where a woman classifies a man as a bachelor, and therefore as a potential mating partner. It is our bio-psychological embodiment that ties these relations together in a cultural and linguistic context.

Furthermore, I showed that a phenomenological-emotional concept was necessary to understand the production of meaning. I want to point out here that this is consistent with Peirce's defining feeling as an attribute of Firstness. In his evolutionary theory, feeling becomes an immanent inner reality, also in matter, which manifests more and more as the living systems self-organize with the nervous systems that allow an inner (virtual?) mental world to appear.

Peirce's view that we cannot with any good reasons split the concepts of mind and matter, as a starting point, is a very sound and a profound foundation for a transdisciplinary metaphysical framework. I do not see any good reason why the inner world of cognition, emotions and volition should not be accepted as just as real as the physical world as well as our cultural world of signs and meaning. With Peirce one may say that there will always be some kind of psyche in any kind of biological autopoietic and code dual system. Still, a partly autonomous inner world of emotions, perceptions and volitions, only seems to arise in multi-cellular chordates with a central nervous system. Lorenz (1973) argues that such a system with emotions and experiences of pleasure is necessary for animals to have appetitive behavior, searching for the objects or situations that can elicit their instinctual behavior, and release the motivational urge built up behind it. This is qualitatively different from how reflexes function on a signal, which is a proto-semiotic informational level. The instinctual sign function operates on a genuine semiotic level.

Luhmann's theory of the socio-communicative being consisting of three levels of autopoiesis can be used in Cybersemiotics to distinguish between 1) the languaging (Maturana) of the biological systems, which is the coordination of coordination of behaviors between individuals of a species on the reflexive signal level through mutual structural couplings, 2) the motivation-driven sign games of the bio-psychological systems and, finally, 3) the language game level of the self-conscious linguistic human through generalized media in the socio-communicative systems using symbols and grammar. A semiotic understanding has thus been added to Luhmann's conception, and his theory has been placed in Peircean triadic metaphysics. In the following section, I will explain and develop this further.

Intra-, pheno- and thought semiotics

In inner world of animals there are emotional and instinctual *bio-psychological sign games* (Brier 1995), which in the human animal function as unconscious

paralinguistic signs, such as facial mimics, hand movement gestures, and body positions with origins in the evolution of species-specific signification processes in living systems. This is where Lorenz' concept of instinctual drive meets with Freud's Id. But there are also endosemiotic parallels to these exosemiotic processes:

The terms endosemiosis and exosemiosis were probably both coined by Sebeok (1976, p3), *endosemiosis* denoting the semiosis that takes place inside the organisms, and *exosemiosis being the sign process that occurs between organisms*. Endosemiosis was developed to a common term in semiotic discourse by Uexküll et. al. (1993), meaning a semiotic interaction at a purely biological level between cells, tissues and organs. Nöth (2001) introduced the term *ecosemiotics*, specifically for the signification process of non-intentional signs from the environment or other living beings, which take on a meaning to another organism, for instance, to a hunting animal, the scent of prey. Thus the sign signifying an organism as a suitable prey is not intentionally emitted by the organism preyed on, and is therefore rather ecosemiotic than exosemiotic. What can we then call the internal semiotic interaction between the biological and the psychological systems?

But when you combine this biosemiotics foundation with Luhmann's three types of autopoiesis new levels of semiosis appear to which it is necessary to coin new technical terms:

1. The interactions between the psyche and the body are – in my view - internal, but not purely biological as in endosemiotics. I call the semiotic aspect of this interpenetration between the biological and the psychological autopoiesis *intrasemiotics* (Brier 2000b). Today we know that there are semiotic interactions between the hormone systems, the transmitters in the brain and the immune system, and that their interactions are very important for the establishment of the autopoietic system of the second order, which a multicellular organism constructs as a kind of biological self. Its parts are cells that are themselves

autopoietic systems and these are again on a new level organized in an autopoietic system. The nervous system, the hormonal system, and the immune system seem to be incorporated into one big self-organized sign web.

But we do not have good causal models of the relations between our lived inner world of feeling, volitions and intentions, and the biological system. It seems that certain kinds of attention on bodily functions, such as imaging, can create physiological effects in this combined system. As mentioned above, this is partly carried out by different substances that have a sign effect on organs and specific cell types in the body (endosemiotics). We also know that our hormonal level influences our sexual and maternal responses. Fear turns on a series of chemicals that change the state and reaction time of several body functions, and so on. This is a very significant part of the embodiment of our mind. Intrasemiotics seem to function as meta-patterns of endosemiotic processes. For example, our state of mind determines our body posture through the tightness of our muscles. There is a subtle interplay between our perceptions, thoughts and feelings, and our bodily state, working among other things through the reticular activation system. There is still a lot we do not know about the interaction between these systems.

2. I then suggest calling the silent inner cognitive, experiential, emotional and will-oriented mental processes in their semiotic, but yet non-conceptual or pre-linguistic states, as they are not yet recognized by conceptual consciousness, *phenosemiotic processes*. For short I just call them *phenosemiosis*.

3. The interaction between the psyche as phenosemiotics and the linguistic system I call *thought semiotics*. This is where our culture, through concepts and the grammatical structure of language, offers us possible classifications, orientations and structuralizations of our inner state of feelings, perceptions, and volitions. We, for instance, know that the color naming and classification systems are often different from culture to culture.

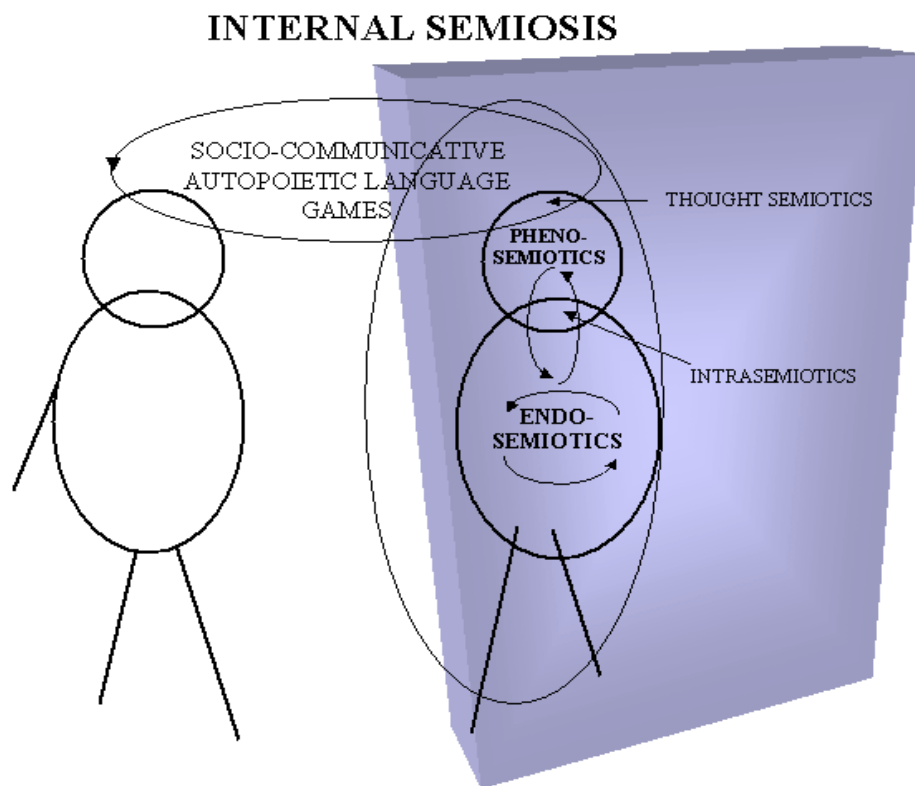


Figure 3 shows in a symbolic way the relationship between endosemiotics and the new areas of phenosemiotics, thought semiotics, and intrasemiotics. Quoted from Brier 2008.

Now, the autopoietic description of living cybernetic systems with closure does not really open for sign production between them in *exosemiotics* per se, at least in Maturana's conception. Luhmann establishes a theory of communication as a closed system of differences of information and meaning, but does not produce a theory of signs as such. On the other hand semiotics in itself does not reflect very much on the role of embodiment in creating signification. Thus, the cybersemiotic suggestion to solve this problem is that signs are produced when the systems interpenetrate in different ways. The three closed systems produce different kinds of semiosis and signification through different types of interpenetration, plus a level of structural couplings

and cybernetic “linguaging”, as Maturana and Varela (1980) call it. Autopoiesis theory underlines that two interpenetrating systems are primarily closed black boxes to each other. But interpenetration between them develops a coordination of behavior which Maturana calls linguaging. These systems are primarily inherited and based on reflexes, and are foundational for communication to develop as it is the underlying cognitive coupling that is the coordination necessary for communication to develop as a signification system with its own organizational closure.

I would, therefore, suggest that we distinguish between linguaging and *sign games* at the level between reflexes and instinctual movements (Brier 2000b) as already mentioned. Thus, the schooling behavior of fish is reflexive informational linguaging, but courtship communication is instinctual sign games. The perception eliciting reflexes is independent of motivation, whereas the perception of sign stimuli is motivation-dependent, which leads into the instinctual sign games. Ethologists would here point to how certain instinctual movements become ritualized and get a release value for instinctive behavior as “sign-stimuli”. Lorenz (1973), in his last period of the theoretical development of ethology, realized that emotions had to be connected to the performances of instinctual movements to create the motivational urge of appetitive behavior. We here see how the connection between signs and internal or phenomenological understanding is constructed (Brier 2000b). Lakoff (1987), and Lakoff and Johnson (1998) have shown us how this basic mechanism of bodily meaning can be explained, by metaphorical processes, in order to encompass socially and culturally produced signs.

Sign games are developed into *language games* through evolution and in the life of the infant human. As we are born and grow into human social communication the psyche is perfused with signs. Our mind is infected with language and we become semiotic cyborgs or what we call humans. *We are in this view born as animals with a capacity to construct this interpenetration between the psychical and socio-communicative systems, creating internal*

interpretants that are meaningful to us because of the mutual structural couplings of languaging established in evolution.

Finally, we will look at the organism's perceptual connections to the environment, creating its signification sphere. With Nöth and Kull (2001) we call this signification aspect eco-semiotics. Realizing that a signification sphere not only pertains to the environment, but also to the perception of other members of the species in cultural and proto-cultural behavior, as well as to perceptions of own "mind-and-body-hood", I use a little "eco" as a prefix to the signification sphere, when it is the aspect of it pertaining especially to non-intentional nature and culture outside the species in question. In both inanimate nature, as well as in other species and in cultural processes, we can observe differences that signify meaning to us, although never intended by the object.

This is also true for the human species, indicating that our language has a deep inner connection to the ecology of our culture. Any existing culture is collective ways of making a social system survive ecologically. As such, the Cybersemiotic theory of mind, perception, and cognition is a realistic one, but not a materialistic or mechanistic one. It builds on an inner semiotic connection between living beings, nature, culture and consciousness carried by the three Peircean categories in a synechistic and tychistic ontology in an agapistic theory of evolution, delivering a philosophy going beyond the dualistic oppositions between idealism (or spiritualism) and materialism (or mechanism).

Based on the concept relations described, we can go back and now see that the linguistic motivation, mentioned earlier, must be placed in the area of thought-semiotics where our internal non-linguistic phenosemiotic processes of mind meet with the concepts of language and imbue them with inner meaning, whereas the animal motivation stems from the intrasemiotic area where the endosemiotic processes of the body cells meet with the phenosemiotic processes of mind and awareness. Thus body, mind and language have been encompassed by a shared framework able to conceptualize their interactions on

the same process level, but now integrating concepts of meaning and qualia. This gives us hope that the Cybersemiotic development of biosemiotics can contribute to a new inter- and transdisciplinary semiotic theory of mind, cognition, communication and consciousness (Brier 2008a).

As Barbieri senses, then, Peirce's semiotic, evolutionary and synechistic theory changes our view of nature and reality and therefore of science and knowledge processes (knowing) as such in a way that also leads into reconsidering the relation between science and religion and therefore between the concepts of nature and the sacred. It will take too much space to develop these points here, but I have described and compared the reformulation attempts from the two big interdisciplinarians: Gregory Bateson and C.S. Peirce in Brier (2008b). It must here be enough to say that both Peircean biosemiotics and cybersemiotics develops a transdisciplinary philosophical foundation for biology and the sciences of non-living nature that unite them with the humanities and social sciences - not on the basis of a physicalistic or even informational reductionism, but on the basis of the flow and development of self-organizing semiosis.

Conclusion

1. Signs are the basic units for the study of life.
2. Peircean semiotics is most useful as the foundation of developing biosemiotics because it has a theory of signification of non-intentional signs, and a realistic, pragmatic, and evolutionary philosophical framework.
3. On the level of animal cognition and communication, biosemiotics is already prefigured in Jakob von Uexküll's Umweltlehre and Lorenz and Tinbergen's ethology, which Thomas Sebeok used to found zoösemiotics. But biosemiotics goes further.

4. Biosemiotics encompasses all living systems from bacteria, fungi, plants and animals to humans as sign producers and interpreters.
5. Biosemiotics further encompasses endosemiotics between the cells of multicellular organisms.
6. Though the living systems are a part of both the physical and the chemical world and have to work within the frames of their laws, life is primary functioning within the realms of codes.
7. Codes are mappings between different areas of reality within a specific context and a specific purpose. They are an important part of making sign relations in living systems.
8. Living systems are – amongst other things - defined by the so called code-duality, which is a looped interaction between a digital code in the genotype and an analogue one in the phenotype. The gene is a code for memory and self-representation, and the individual living body is a code for action and interaction with the real world and its ecology.
9. Thus life appears to be a communicative interplay of different types of self- and other- descriptions carried by molecules in the single cell organism and endosemiotically, and by sound, smell, tactility and vision in multicellular organisms with nervous systems.
10. The essential question for the current debate about the possibility of a transdisciplinary information/signification science is whether Peircean biosemiotics can comprise un-interpreted “natural objects,” dissipative structures, and other spontaneous generations of order and patterns in nature as signs. These objects were previously described in physico-chemical terms. Now some adherents of the pan-informational paradigm, such as Stonier (1997), want to explain them in purely informational terms. From a Peircean view, these phenomena are protosemiotic, or quasi-semiotic, when compared to the semiosis of living systems, because they are only displays of Secondness (Nöth 2002). This is not the discussion of whether *any natural thing can become a sign* when placed in a meaningful context by a living system, but whether the objects and their processes are signs *per se*.

11. There is a lot of work to do for serious philosophy, considering how many central philosophical topics of mind, language, epistemology, and metaphysics are affected by the biosemiotic and cybersemiotic development. We have dealt with some of them in arguing for the pragmatic triadic semiotics of Peirce over all other approaches based on linguistics, semiology, structuralism, semantics and communicational ethics.
12. Biosemiotics is one of the most promising reconceptualizations of the truth-seeking enterprise of science and its relation to the concepts of function, purpose and meaning coming from the humanities and social sciences.
13. According to Kuhn's paradigm theory, the development of specific methods is an important part of the disciplinary matrix. Biosemiotics has progressed into developing new definitions of concepts, new values of biological research and a new worldview and epistemology. But the empirical and methodological aspects need to be developed, and practical and testable results gained from the work in order to get this new transdisciplinary paradigm to be taken seriously also within the sciences. It is well established in semiotics, bio-philosophy and information philosophy and in some linguistic, cultural and social studies. The final test is whether it can offer something the sciences actually want enough to leave their present frozen position to enter into the new reformulation of the relation between the humanities, natural and social sciences. What kinds of methods can the biosemiotic perspective add to traditional biology? Can biosemiotics make new empirical discoveries, or is it just a reconceptualization of the already known? These are crucial questions to answer.
14. Biosemiotics is further developed in Cyber(bio)semiotics to include computers, information theory and science, as well as cybernetics and embodied sign- and language games in culture. Concepts of the closure, self-organization, and differentiation of biological, psychological, and social systems developed in a second-order cybernetics and autopoiesis

theory are further integrated into with biosemiotics into what Brier (2001, 2003, 2008a) calls Cybersemiotics.

References

- Barbieri , M.(2001): *The Organic Codes: The Birth of Semantic Biology*, PeQuod. Republished in 2003 as *The Organic Codes. An Introduction to Semantic Biology*, Cambridge: Cambridge University Press.
- Brier, S. (1992): "Information and Consciousness: A Critique of the Mechanistic Foundation of the Concept of Information" in *Cybernetics & Human Knowing*, Denmark, Vol.1, no. 2/3, pp 71- 94.
- Brier, S. (1993): "A Cybernetic and Semiotic view on a Galilean Theory of Psychology" in *Cybernetics & Human Knowing*, Vol. 2, no. 2, pp. 31-45.
- Brier, S. (1995): "Cyber-Semiotics: On Autopoiesis, Code-Duality and Sign Games in Bio-Semiotics," *Cybernetics & Human Knowing*, Vol. 3, no. 1, pp. 3-14.
- Brier, S. (1996a): "Cybersemiotics: A New Interdisciplinary Development Applied to the Problems of Knowledge Organisation and Document Retrieval in Information Science," *Journal of Documentation*, 52(3), September 1996, pp. 296-344.
- Brier, S. (1996b): "From Second Order Cybernetics to Cybersemiotics: A Semiotic Reentry into the Second Order Cybernetics of Heinz von Foerster," *Systems Research*, Vol. 13, no. 3, pp. 229-244 (A Festschrift to Heinz von Foerster).
- Brier, S. (1996c): "The Usefulness of Cybersemiotics in Dealing with Problems of Knowledge Organization and Document-Mediating Systems," *Cybernetica: Quarterly Review of the International Association for Cybernetics*, Vol. XXXIX, no. 4, pp. 273-299.
- Brier, S. (1997): "What is a Possible Ontological and Epistemological Framework for a True Universal Information Science: The Suggestion of Cybersemiotics." *World Futures*, 1997, Vol. 49, pp. 287-308.

Brier, S. (1998a): "Cybersemiotics: A Transdisciplinary Framework for Information Studies," *BioSystems*, 46 (1998) 185-191.

Brier, S. (1998b): "The Cybersemiotic Explanation of the Emergence of Cognition: The Explanation of Cognition, Signification and Communication in a non-Cartesian Cognitive Biology," *Evolution, and Cognition*, Vol. 4, no.1, pp. 90-102.

Brier, S. (1999): "Biosemiotics and the Foundation of Cybersemiotics. Reconceptualizing the Insights of Ethology, Second Order Cybernetics and Peirce's Semiotics in Biosemiotics to Create a non-Cartesian Information Science," *Semiotica*, 127-1/4, 1999, 169-198. Special issue on Biosemiotics.

Brier, S. (2000): "Konstruktion und Information. Ein semiotisches re-entry in Heinz von Foersters metaphysische Konstruktion der Kybernetik zweiter Ordnung" in *Beobachtungen des Unbeobachtbaren*, Jahraus, Oliver, Nina Ort und Benjamin Marius Schmidt. Velbrück Wissenschaft, Weilerswist 2000, pp. 254-295.

Brier, S. (2000): "Trans-Scientific Frameworks of Knowing: Complementarity Views of the Different Types of Human Knowledge", *Yearbook Edition of Systems Research and Behavioral Science*, V.17, No. 5, pp. 433-458.

Brier, S. (2001a): "Cybersemiotics and Umweltslehre," *Semiotica*, 134-1/4 (2001), 779-814, *Systems Research and Behavioral Science*, 18, 421-427.

Brier, S. (2001b): "Ecosemiotics and Cybersemiotics", *Sign System Studies* 29.1, 107-120.

Brier, S. (2001c): "Cybersemiotics: A Reconceptualization of the Foundation for Information Science." *Systems Research and Behavioral Science, Yearbook. Systems Research* 18, 421-427.

Brier, S. (2001d): "The Three Medias Spheres and the Position of the Sciences in the Knowledge Society", Evans, R.H., Andersen, A.M. og Sørensen, H. (ed.) the 5Th *European Science Education Summerschool: Bridging Research Methodology and Research Aims*, Danish University of Education, pp.350-367.

Brier, S. (2002a): "Intrasemiotics and Cybersemiotics", *Sign System Studies* 30.1:113-127.

Brier, S. (2002b): "Varela's Contribution to the Creation of Cybersemiotics: The Calculus of Self-reference", ASC-column, *Cybernetics & Human Knowing*, 9, 2:77-82.

Brier, S. (2002c): "The Five-Leveled Cybersemiotic Model of FIS" (Best paper award in its session), Trappl, R. (ed.): "*Cybernetics and Systems vol. 1, 2002*", Austrian Society for Cybernetic Studies. 1:197-202.

Brier, S. (2002/2003): "Luhmann Semiotized", *Journal of Sociocybernetics*, Vol. 3, No. 2, 2002/2003, pp. 13-22.
<http://www.unizar.es/sociocybernetics/Journal/dentro.html>

Brier, S. (2003a): "Information Seen as Part of the Development of Living Intelligence: "The Five Leveled Cybersemiotic Framework for FIS." *Entropy*. 2003, 5, 88-99. <http://www.mdpi.org/entropy/list03.htm>

Brier, S. (2003b): "The Cybersemiotic Model of Communication: An evolutionary View on the Threshold between Semiosis and Informational Exchange." *TripleC* 1(1): 71-94. [http://triplec.uti.at/articles/tripleC1\(1\)_Brier.pdf](http://triplec.uti.at/articles/tripleC1(1)_Brier.pdf) .

Brier, S. (2003c): "Cybersemiotics and the Question of Semiotic and Informational Thresholds", *World Futures*, 59: 361-380.

Brier, S. (2005a): "The Construction of Information and Communication: A Cybersemiotic Re-entry into Heinz von Foerster's Metaphysical Construction of Second Order Cybernetics" in *Semiotica* 154-1/4 (2005), 355-399.

Brier, S (2005b) "Third Culture: Cybersemiotic's inclusion of a Biosemiotic Theory of Mind", *Axiomathes*, 15:211-228.

Brier, S. (2007): "Applying Luhmann's system theory as part of a transdisciplinary frame for communication science", *Cybernetics & Human Knowing*, Vol. 14, no. 2-3. Pp. 29-65.

Brier, S. (2008a): *Cybersemiotics: Why Information Is Not Enough*. Toronto Studies in Semiotics and Communication, University of Toronto Press.

Brier, S. (2008c): "Bateson and Peirce on the pattern that connects and the sacred", Hoffmeyer, J. (ed.)(2008): *Gregory Bateson as a precursor for biosemiotic thinking*, Springer Book Series on Biosemiotics, London: Springer Verlag.

CP of Peirce see Peirce, C.S. (1931-58):

Deely, J. (1990): *Basics of Semiotics*, Bloomington, Indiana University Press.

Deely, J. (1998): Physiosemiosis and Semiotics. In (eds. Spinks, C. W and Deely J) *Semiotics*, Peter Lang, New York.

Deely, J. (2001a): Physiosemiosis in the Semiotic Spiral: A play of Musement. Colloquium" *Sign System Studies* 29.1, pp.27-48.

Deely, J. (2001b): *Four ages of understanding: The first postmodern survey of philosophy from ancient times to the turn of the twenty-first century*, The University of Toronto Press.

Eco, U. (1979): *A Theory of Semiotics*. Bloomington: Indiana University Press.

Emmeche, C. (1998) "Defining Life as a Semiotic Phenomenon." In *Cybernetics & Human Knowing*, Vol. 5, No. 1, pp. 33-42.

Fodor, J. (2001): *The mind does not work that way: The scope and limits of computational psychology*, The MIT Press, Cambridge Massachusetts.

von Foerster in L.Segal (2001): *The Dream of Reality. Heintz von Foerster's Constructivism*, NY: Springer.

von Foerster, H. 2003: "Objects: Tokens for Eigen-Behaviors",pp. 261-271 in *Understanding Understanding: Essays on Cybernetics and Cognition* , NY: Springer Verlag.

Gardner, H. (1985): *The Mind's New Science: A History of the Cognitive Revolution*. New York: Basic Books, Inc., Publishers.

Haack, S. (1998): *Manifesto of a Passionate Moderate: Unfashionable Essays* (Chicago, 1998),

Heidegger, M. (1962, org. 1949): *Being and Time (Sein und Zeit)*. Harper & Row.

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

Hoffmeyer, Jesper 2005. *Biosemiotik: en afhandling om livets tegn og tegnenes liv*. Charlottenlund: Ries Forlag.

Hoffmeyer, Jesper (2007): *Biosemiotics: An Examination into the Signs of Life and the Life of Signs*. Distributed for the University of Scranton Press.

Hoffmeyer, Jesper; Emmeche, Claus (1991). Code-Duality and the Semiotics of Nature. In: Anderson, Myrdene; Merrell, Floyd (eds.). *On Semiotic Modeling*. Berlin: Mouton de Gruyter, 117–166.

Kaufman, S. (1995): *At Home in the Universe*, Oxford University Press.

Jakobson, Roman (1971): *Selected Writings: II Word and Language*. The Hague: Mouton.

Krampen, Martin (1981): Phytosemiotics. *Semiotica* 36(3/4): 187–209.

Kull, Kalevi (1999a): Biosemiotics in the Twentieth Century: A View from Biology. *Semiotica* 127(1/4): 385–414.

Kull K. (1999b): On the History of Joining Bio with Semio: F.S.Rothschild and the Biosemiotic Rules. *Sign Systems Studies* 27, 128–138.

Lindsay, P. & Norman, D. A. (1977): *Human Information Processing: An Introduction to Psychology* (2nd ed.). New York: Academic Press.

Lorenz, K. (1970-71): *Studies in Animal and Human Behaviour I and II*, Cambridge: MA: Harvard University Press.

Luhmann, N. (1990). *Essays on Self-Reference*, New York: Columbia University Press.

Luhmann, N. (1995): *Social Systems*, Stanford, Stanford University Press.

Maturana, H & Varela, F. (1980): *Autopoiesis and Cognition: The Realization of the Living*, Reidel, London.

Markos, Anton 2002: *Readers of the Book of Life: Conceptualizing Developmental Evolutionary Biology*. Oxford: Oxford University Press.

Nöth, Winfried (1998): [Ecosemiotics](#). *Sign Systems Studies* 26: 332-343.

Nöth, W. (2001): "Protosemiotics and Physicosemiosis", *Sign System Studies*, 29.1, pp. 13-26.

Nöth, W. (2002): "Semiotic Machines". *Cybernetics and Human Knowing*, Vol.9, No.1, pp 3-22.

Peirce, C.S. (1931-58): *Collected Papers vol. I-VIII*. (eds.) Hartshorne and Weiss. Cambridge MA: Harvard University Press. CD-ROM version from Past Masters.

Posner, R., Robering, K., Sebeok, T.A. (eds)(1997-2003): *Semiotik : ein Handbuch zu den zeichentheoretischen Grundlagen von Natur und Kultur. 1,2 and 3. Teilband / Semiotics. A handbook on the sign-theoretic foundations of nature and culture. Vol. 1,2 and 3*. (Handbücher zur Sprach- und Kommunikationswissenschaft; 13.2) Berlin [u.a.] : de Gruyter 1998 - XVI,1200 - 2339 p.

Prigogine, I. and Stengers, I. (1984): *Order Out of Chaos: Man's New Dialogue with Nature*
New York: Bantam Books.

Rothschild, Friedrich Salomon (1962): Laws of Symbolic Mediation in the Dynamics of Self and Personality. *Annals of New York Academy of Sciences* 96: 774–784.

Santaella Braga, L (1999): "Peirce and Biology." *Semiotica*, Vol. 127, 1/4, Special Issue: Biosemiotica, pp. 5-21.

Saussure, de F. (1972): *Course in General Linguistics: Ferdinand de Saussure*, Open Court Publishing Company. LaSalle, Illinois. (Translated by: Roy Harris).

Saussure, F. de (1997): *The John Hopkins Guide to Literary Theory and Criticism, Saussure, de Ferdinand*, by Ronald Schleifer.
http://www.press.jhu.edu/books/hopkins_guide_to_literary_theory/ferdinand_de_saussure.html

Sebeok, Thomas A. (1962): Coding in the Evolution of Signalling Behavior. *Behavioral Science* 7: 430–442.

Sebeok, Thomas A. (1963): Communication among Social Bees; Porpoises and Sonar; Man and Dolphin. *Language* 39: 448–466.

Sebeok, Thomas A. (1965a): Animal Communication. *Science* 147: 1006–1014.

Sebeok, Thomas A. (1965b): Zoösemiotics: A New Key to Linguistics. *The Review* 7: 27–33.

Sebeok, Thomas A. (1965c): Coding in Animals and Man. *ETC* 22: 330–249.

Sebeok, Thomas A. (1968) *Animal Communication: Techniques of Study and Results of Research*. Bloomington: Indiana University Press.

Sebeok, Thomas A. (1969): Semiotics and Ethology. In: Sebeok, Thomas A.; Ramsay, Alexandra (eds.), *Approaches to Animal Communication*. The Hague: Mouton, 200–231.

Sebeok, Thomas A. (1972): *Perspectives in Zoösemiotics*. The Hague: Mouton.

Sebeok, Thomas A. (1976): *Contributions to the Doctrine of Signs*. Bloomington: Indiana University Press.

Sebeok, Thomas A. (ed.) (1986): *Encyclopedic Dictionary of Semiotics*. Vol. 1–3. Berlin: Mouton de Gruyter.

Sebeok, T. (1989). *The Sign & Its Masters*. Sources in Semiotics VIII. New York: University Press of America.

Sebeok, Thomas A. 1990. *Essays in Zoösemiotics*. Toronto: Toronto Semiotic Circle.

Sebeok, Thomas A. 1991. *A Sign is Just a Sign*. Bloomington: Indiana University Press.

Sebeok, Thomas A. 1992. 'Tell me, Where is Fancy Bred?': The Biosemiotic Self. In: Sebeok, Umiker-Sebeok (eds.) 1992: 333–343.

Sebeok, Thomas A. 1994. *Signs: An Introduction to Semiotics*. Toronto: University of Toronto Press.

Sebeok, Thomas A. (2001). *Global Semiotics*. Bloomington: Indiana University Press.

Sebeok, Thomas A.; Danesi, M. (2000). *The Forms of Meaning: Modeling Systems Theory and Semiotic Analysis*. Berlin: Mouton de Gruyter.

Sebeok, Thomas A.; Ramsay, Alexandra (eds.) 1969. *Approaches to Animal Communication*. The Hague: Mouton.

Sebeok, Thomas A.; Umiker-Sebeok, Jean (eds.) 1980. *Speaking of Apes: A Critical Anthology of Two-Way Communication with Man*. New York: Plenum Press.

Sebeok, Thomas A.; Umiker-Sebeok, Jean (eds.) 1992. *Biosemiotics: The Semiotic Web 1991*. Berlin: Mouton de Gruyter.

Stonier, T. (1997): *Information and Meaning: An Evolutionary Perspective*, Berlin: Springer Verlag.

Thellefsen, T.L., Brier, S. and Thellefsen, M.L. (2003): "Problems Concerning the Process of Subject Analysis and the Practice of Indexing: A Peircian Semiotic and Semantic Approach Toward User Oriented Needs in Document Searching," *Semiotica*, 144-1/4 (2003), 177-218.

Tinbergen, N. (1973): "Ethology" in Tinbergen, N.: *The Animal in Its World*. London: Allan & Unwin. pp. 136-196.

Uexküll, J. von (1934). "A Stroll through the Worlds of Animals and Men. A Picture Book of Invisible Worlds" in Schiller, Claire H. (ed.) (1957): *Instinctive Behavior. The Development of a Modern Concept*, New York, International Universities Press, Inc., 1957, pp. 5-80.

Uexküll, Thure von, Geigges, Werner, Herrmann Jörg M. (1993): "Endosemiosis," *Semiotica* 96(1/2), 5-51.

Varela, F.J. Thompson, E. and Rosch, E. (1992): *The Embodied Mind*, MIT Press, Cambridge.

Vehkavaara, Tommi 2002. Why and How to Naturalize Semiotic Concepts for Biosemiotics. *Sign Systems Studies* 30(1): 293–313

Vickery, A. & Vickery, B.(1988): *Information Science - Theory and Practice*, London: Bowker-Saur, London.

Winograd, T. and Flores, F. (1987): *Understanding Computers and Cognition: A new Foundation for Design*, Addison-Wesley Company Inc., Reading, Massachusetts.

Witzany, Günther (1993). *Natur der Sprache - Sprache der Natur: Sprachpragmatische Philosophie der Biologie*. Würzburg: Königshausen & Neumann.

I am going to compare critical this paradigm against a Peircean biosemiotics because it has so many interesting things to say and wants to stay clear of Peircean foundations to stay "scientific". But what does mean? Kalevi Kull asks: What kind of Wissenschaft is biosemiotics? It deals with problems that I started to research on in 1978 in studying the cognitive models behind ethology (Lorenz, Maturana, Sebeok): The role of experience and feeling and their connection with meaning. 2 ? I see the remaining problem in the paradigm to be to offer us a deeper theoretical explanation, not an addition to the received views description of evolution, because that has so far not produced a theory of experiential life and mind that can explain how signification arise in certain systems in our universe. Biosemiotics acknowledge that semiosis is an essential part of all living systems and that semiotics should have the sign games of all living systems as its subject area. Again the problem of total explanation arises: can we go on from here to a pan-semiotic view without wanting to explain too much? It is my view that the advantages of using the semiotic concepts are lost if we make everything semiotic, because then nothing is not semiotic. By Søren Brier. The paradigm of Peircean biosemiotics. By Søren Brier. Language as an Ecological Force. Biosemiotics is a growing field that investigates semiotic processes in the living realm in an attempt to combine the findings of the biological sciences and semiotics. Semiotic processes are more or less what biologists have typically referred to as "signals," "codes," and "information processing" in biosystems, but these processes are here understood under the more general notion of semiosis, that is, the production, action, and interpretation of signs. Thus, biosemiotics can be seen as biology interpreted as a study of living sign systems"which also means that semiosis or sign process can... New York: Crown Publishers. The Paradigm of Peircean Biosemiotics. Søren Brier. http://sugartexts.dk/Brier_2008_peircean_biosemiotics.pdf.