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Biosemiotics:
To Know, What Life Knows

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The field of semiotics is described as a general study of knowing. Knowing in a broad sense as a process that assumes (and includes) at least memory (together with heredity), anticipation, communication, meaningful information, and needs, is a distinctive feature of living systems. Sciences are distinguished accordingly into phi-sciences (that use physicalist methodology) and sigma-sciences (that use semiotic methodology). Jesper Hoffmeyer's book Biosemiotics is viewed as an inquiry into the sigma-scientific approach to living systems.
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Whether biology has studied what organisms know?

Lamarck, after his countrymen, was probably one after whom biology took its shape as a study of adaptations—both the processes of adaptation and the organic forms as adaptations. Once the correspondences of organisms to the world are not eternal but a result of (ontogenetic or phylogenetic) experience, the adaptations turn out to be a kind of knowledge, a model that is acquired or worked out via certain mechanisms (either developmental or evolutionary). Possessing an adaptation or habit would mean that one has some experience through which the adaptation has formed.

Thus via a study of organic functions that characterize adaptations, biology has described the information the organisms have, including the memory and the purpose. Adaptations which are always relations, bonds of life, qualitative phenomena, can be seen as iconic relations (or in more complex situations also as indexical or symbolic relations), that is, sign relations. Since the sign relations are modelling relations, so are adaptations certain kind of models.[2] Their description and explanation has turned the attention of biology towards the concepts of history and meaning. And this has always made biology the "humanities" of the natural sciences.

Stating this, one should notice that much of the work in biology has digressed from this path. Once the adaptation is defined quantitatively via fitness—via the number of copies one makes—its fundamental feature of qualitative *fit* is lost from the description. In other words, the meaning was lost. This were like description of sign without paying attention to its reference.

Back on the track with a semiotic approach, it simply means that we are going to take the biological study of qualitative relations seriously. In this, Jakob von Uexküll's approach has been most steadfast. However, at least as a tacit intention, biology has

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2. Although, there have not been many writings in which a morphological adaptation has been directly identified as a *model* produced by the organism (e.g., Frost, 1987).

obviously always attempted to describe the billion-year experience that living systems hide in themselves.

1. Semiotics and life's knowing

What makes the living and the non-living very different from each other is their different relation to what is not, to what is absent. That which is alive has expectancies. Once dead, one does not expect.

Expectancy, or anticipation, means that something is not only itself but also stands for something else – for that which is expected. This is exactly the general feature of the sign, according to Peirce's widely repeated definition.

The sign vehicle, or representamen (or sign, *sensu stricto*), stands for an object. This is the relation that is created by semiosis. The object, thus, has an interesting duality—it is both there and is not there—because it is both connected and anticipated.[3] The relation of *standing for* is possible owing to the absence of what is referred to (the object) and, concurrently, there cannot be semiosis without the existence of a reference (an object).

Analogously *not being something* may characterize also the sign vehicle, and interpretant—this is the very feature of being a sign. Semiosis is what makes anything plural.[4] Semiosis creates objects, and makes each object plural. Each is sign, which means each is simultaneously something else, each is many. To mean is to be plural.

The simultaneous *what-is* and *what-is-not* is related to another fundamental feature of the sign—simultaneous arbitrariness and non-arbitrariness. In its *standing for*, the sign's relation to object is always arbitrary (because one has not determined the other). As a relation to the object in the triadic relation, the object exists in an entirely non-arbitrary way.

How such a duality (or more exactly, plurality) occurs, can be described by the models of semiosis, of which the Peircean triadic model and the Uexküllean functional cycle model are currently the two most valuable.[5] Both descriptions include the epistemological aspect of the interpretation process and thus disclose the ontological plurality of meaning.

Semiosic systems are simultaneously modelling systems, as was emphasized already in the 1960s by the Tartu-Moscow school (Lotman, 1967; Levchenko & Salupere, 1999). Anderson and Merrell (1991, p. 4) admit that "signs ... are themselves models, and semiosis constitutes modeling, par excellence." The modelling systems include both the organismic and cultural systems. Thus, semiotics can be "modeling of modeling" (Anderson & Merrell, p. 4).

This essential epistemological aspect of semiosis—that semiosis is a modelling process—has been emphasized not only by Tartu school. Sebeok's (2001, p. 156) view strongly resonates: "*semiosis* [is the] capacity of a species to produce and comprehend

3. On the concept of anticipation, see also Kull (1998).
4. See also Kauffman (2005), Kull (2007b), Merrell (2007).
5. See also Krampen (1997).

the specific types of models it requires for processing and codifying perceptual input in its own way." Via Sebeok's thesis, which identifies life process as semiosis, also life process turns out to be modelling.

Robert Rosen, concluding his major work, *Life Itself*, writes in the final paragraph of the book: "We began this discussion with the question, 'What is life?' We ended with the answer: Life is the manifestation of a certain kind of (relational) model. A particular material system is *living* if it realizes this model" (Rosen, 1991, p. 254). If we use the word *model* in the broadest sense, then we could also say: Life is the process of modelling *sensu lato*, the living system is itself a model.

This aspect of life can be specially focused, which means that organisms can be studied from the point of view of a theory of knowing—that is, of semiotics, including biosemiotics. This is because semiosis—that is life process—does not only transfer messages, it also produces messages, that is, a knowledge.[6]

The methodology of empirical biosemiotic work, however, is not that of the physical sciences, nor of the humanities or the social sciences in which one can carry out interviews.[7] The main question of biosemiotic methodology is: *how to know what organisms know.* Similarly, Robert Rosen has stated that "what is important in biology is not how we see the systems which are interacting, but how they see each other" (Rosen, Pattee, & Sormorjai, 1979, p. 87). Empirical studies in biosemiotics should be studies of knowing what is available to other species, and how they obtain it, and how they use it.

In this way, using a very general notion of knowing (the one that precisely covers the sphere of signs, or meaningful information),[8] it would be easier to see the methodological particulars.[9] Keeping in mind that if what we are studying are not molecules, but the *knowing* that living systems possess, it is obvious that, for instance, statistical methods and measurements can only be very much secondary tools in this research. On the other hand, field experiments would be an important tool in order to study what organisms can distinguish; still, though, the principle of *ceteris paribus* is generally inapplicable, because knowledge is relational in principle. This is entirely scientific, despite the fact that it appears to be opposed to the methodological standards of the physical sciences. The way to acquire truth in semiotics is rather the way we utilise dialogue, or implement the process of translation.

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6. The concept of knowledge has been treated in a similar way by Canguilhem (2008).
7. Cf. Manning (1987).
8. Similarly, Tommi Vehkavaara (1998) has written about the extended concept of knowledge that would characterize living beings.
9. It is relevant to add here that, according to Short (2007, p. 289), "Peirce's early semeiotic was a *theory of mind*: it identified thoughts as signs interpreting signs. The mature semeiotic *retains that identification* but embeds it in a wider context" (my emphasis). "The mature semeiotic entails a naturalistic theory of mind" (Short, p. 289) in two respects — as a natural history of semiosis (including animal behavior), and as attributing an intentionality to all forms of it (e.g., as also Deely, 2007 argues for). Short (p. 289) adds: "The attribution of purpose, although it grounds valuation, is an empirical hypothesis, testable against observation. And the explanation of purposeful behavior, although not mechanistic, is naturalistic."

2. *Σ*-sciences

Semiosic practice—the behavior of organisms, including the everyday behavior of humans—is an acquisition and application of knowledge. In humans, due to the usage of propositional and narrative sign systems, semiosic practice turns (develops) into knowing of knowing, or semiotics *sensu lato* (in the sense of the human as semiotic animal). A methodical acquisition and organization of knowledge leads to science.

Sciences have been developed into diverse kinds. For instance, Peirce makes a distinction between idioscopic (primarily physical) and cenoscopic (primarily semiotic) sciences.[10] Following Locke, sciences can be divided into three: physics, ethics, and semiotics.

> "Science may be divided into three sorts. ... First, The knowledge of things, as they are in their own proper beings, their constitutions, properties, and operations ... This in a little more enlarged sense of the word, I call *Phusike* ... Secondly, *Praktike*, The skill of right applying our own powers and actions, for the attainment of things good and useful. The most considerable under this head, is ethicks ... The third branch may be called *Semeiotike*, or the doctrine of signs"; "the ways and means whereby the knowledge of both the one and the other of these, are attained and communicated." (Locke, 2008, pp. 462–463 [Ch. 21])

The first deals with knowledge as knowledge about things, the second as knowledge about purpose, and the third as knowledge about knowledge. Complementarity between these sciences is obvious; however, the principles of building the theory and the methods of practice (e.g., descriptive, prescriptive, interactive, and appraising) evince vast differences. Without focusing on ethics as science here, in order to place biosemiotics into a relation with physicalist biology, we still need to distinguish between physical theory and semiotic theory as two basic complementary ways of doing science. Accordingly, the models built in science are of two quite different kinds: physical, and semiotic (*sensu stricto*).

More precisely, in philosophy of science, Rein Vihalemm (2007) has pointed to a different role that the historical explanation has in the major types of sciences, and on this bases he has made a distinction between *Φ*-sciences and non-*Φ*-sciences, the latter called also *Σ*-sciences. *Φ*-sciences do not require historical explanation, they model the world using universal laws and depend on quantitative methods; *Σ*-sciences, instead, are dependent on historical explanations, they model the world on qualitative basis and use primarily qualitative methods.

The two are based on (and interrelated via) the semiosic practice, which includes everyday communication and practical processes of classification and measurement (Table 1).[11] As mentioned by Peirce, "measurement ... is a business fundamentally of

10. Due to the wording given by Peirce, it is easy to misidentify his distinction. Following Jeremy Bentham, Peirce defines idioscopy as the science "which discovers new phenomena", and cenoscopy as the "science that is founded upon the common experience of all men" (CP 8.199). A bit misleading may be his formulation about cenoscopy as "studies which do not depend upon new special observations" (CP 8.342), which he still directly identifies as science of ***semeiotic,*** or the cenoscopic science of signs" (CP 8.343). However, I think that the correspondence between Locke's and Peirce's distinctions can be interpreted as correct.

the same nature as classification" (CP 1.275). At the stage of modelling and theory, however, the approaches diverge, *Φ*-science as a modelling based on quantitative convertibility, and *Σ*-science as a modelling based on qualitative diversity. An important point here is that this is not the well-known separation between the humanities and the sciences; this is, instead, science as it necessarily includes the complementary approaches. In principle, *Φ*-sciences can cover the whole world via physical descriptions, and *Σ*-sciences can cover the whole world as the sum of knowledge. However, it would be weird for *Φ*-sciences to describe the meaningfulness, whereas *Σ*-sciences may include at least the science of all forms of life as much as it studies organisms' knowledge and sign processes.

Table 1: The Distinction Between Σ-sciences and Φ-sciences, or Physical and Semiotic Approaches.

SOCIAL (everyday) domain	Semiosic Practice (*inter alia* includes measurement and classification as human activities)	
SCIENTIFIC subdomains	*Φ*-sciences Physical approach Study of things	*Σ*-sciences Semiotic approach Study of knowing
General assumptions for MODELS	Universal laws of nature Faultless world Monist ontology	Local codes Erroneous world Pluralist ontology

3. Why Biosemiotics: Jesper Hoffmeyer's Book

Why is it that biology cannot do without a semiotic approach, and why is it that semiotics cannot do without biosemiotics? Jesper Hoffmeyer's (2008)[12] book provides further answers to these questions. The route to the understanding of life itself has been, via many models, meandering and blundering. Hoffmeyer lists reductionism and vitalism, Cartesian dualism and anthropomorphism, etc., and carefully compares the biosemiotic approach with many others on the basis of the analysis of particular biological examples. It does this in a much more detailed fashion than in his earlier *Signs of Meaning in the Universe* (Hoffmeyer, 1996).[13] In a way, Hoffmeyer is like a therapist of biology (likewise, a role of semiotics, in part, can be seen as being a therapist of culture).

A few more words may illustrate the point here. Hoffmeyer (2008, p. 24) writes: "Biosemiotics considers human mental processes not as unique phenomena in the

11. Regarding this distinction, see also Kull (2007a).
12. This book was first published in Danish (Hoffmeyer, 2005). The English version is not just a translation, but a translation by the author together with biosemiotician Donald Favareau, with some new details added.
13. For analysis of his earlier statements, together with a full bibliography of Hoffmeyer to that date, see Emmeche, Kull, & Stjernfelt (2002).

ontological sense, but rather as extremely interesting extensions of a much more general mode of biological organization and interaction that human beings share with all other living creatures." He adds: "So it is namely a question of information, which in one or another sense has a meaning, or is meaningful ... which again assumes a valuable or preferred direction and it is just the kind of information that we associate with *signs* and *sign processes* or *semiosis*" (Hoffmeyer, 2008, p. 12). Thus, life (of organisms) and human mental life belong ontologically together. That is why semiotics cannot be whole without biosemiotics.

Hoffmeyer has repeatedly drawn the attention of biosemioticians to a somewhat paradoxical situation in which the physical approach in biology uses semiotically flavoured terms:

> with such fundamental concepts as *genetic code*, *messenger RNA*, *transcription* and *translation* it is obvious that the revolution of molecular biology, right from its beginnings, implied a powerful semiotic input to biology. ... Molecular biology, the field in which I myself was trained, soon gave rise to a deep understanding of cellular communication processes that indirectly came to pave the way for the formulation of the modern project of *biosemiotics*. (Hoffmeyer, 2008, p. 360, italics in original)

This usage of *semi-semiotic terminology* in molecular biology, which has been called *information talk* (El-Hani, Queiroz, & Emmeche, 2009), has filled the biological textbooks within the last half of century. This has certainly influenced semiotics, via Roman Jakobson's writings *inter alia*. Information talk has induced biologists to think about the problem of roots of information processes, but the theoretical basis for its solution came from elsewhere – from semiotics proper, together with an impact from certain parts of theoretical (epigenetic) biology.

The identification of biosemiotics as a Σ-science can be illustrated by a couple of central emphases made by Hoffmeyer. One of these is the concept of semiotic freedom – the possibility of living creatures to make choices, or, in a better formulation, "the depth of meaning an individual or species is capable of communicating" (Hoffmeyer 2005, p. 434). Another is the importance of including the first-person perspective:

> biology is in principle prevented from including "I" phenomena into its theory structure ... Biology exclusively deals with phenomena that may be described in the language of third-person phenomena, and thus ... excludes this science from arriving at a theoretical understanding of the human biosystem as a first-person being. (Hoffmeyer, 2008, p. 333–334)

He adds, "Biosemiotics must take cognizance of the fact that dynamic systems theory does not exhibit any apparent curiosity about the evolutionary problem of deriving first-person experiential worlds from an ancestry that exhibit nothing but third-person phenomena" (Hoffmeyer, 2008, p. 338).

Biosemiotics as a study of the living world, while taking into account that which is essential for life is that life is the process of knowing, puts quite strong demands on any biosemiotic work. Thus, a rigorous study in biosemiotics should be

simultaneously rigorous in terms of semiotics, of theoretical biology, and in terms of empirical biology. Hoffmeyer's work clearly meets these standards.

Empirical biosemiotics is particularly tricky because there is no well-framed and established tradition for doing it.[14] Biosemiotic research has to be based on qualitative methods, but until now the clear understanding of differences between the quantitative and qualitative research methods in biology has not been common. Meaning is not a molecule, but a relation. Accordingly, empirical biosemiotics is a study of relations, functions, distinctions that organisms make, communication, plurality of meaning, and so forth. This is a demonstration of how the sign processes build up the entire diversity of life, how the development of organic forms and their functional organization is related to the grammar of codes and plurality of meanings, what is the role of ontological ambiguity in the formation of organic wholes and ecological balance, how the development and evolution of living systems can be fundamentally understood in terms of transformation between the types of semiosis, how the modelling of living systems has to reflect the modelling processes of life itself, and so forth.

Brief conclusion.

Together with the origin of life and the origin of semiosis, sign relations as the relations of knowing have been produced. Semiotics as the science of knowing, i.e. knowing of knowing, cannot be a whole without biosemiotics, which studies the knowing as it occurs in all forms of life. These formulations depend on our assumption which states that it is founded to generalize the concept of knowing as being applicable for all sign processes.

Biosemiotics studies what life knows. While paradoxically, "it is not knowing, but the love of learning, that characterizes the scientific man" (CP 1.44).

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C.P. See: Peirce, C. S. (1931–1935, & 1958).

14. See Kull, Emmeche, & Favareau, 2008.

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