THE SHAPE OF BIOLOGY TO COME? THE ACCOUNT OF FORM AND FORM OF ACCOUNT IN HOFFMEYER'S BIOSEMIOTICS

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Keywords: biosemiotics, Jesper Hoffmeyer, Michael Polanyi, multi-layered ontology, emergence, anti-reductionism, the Modern Synthesis, punctuated equilibrium

ABSTRACT

The essay discusses congruency issues in the biosemiotic approach of the Danish biochemist, Jesper Hoffmeyer. The authors understand Hoffmeyer's anti-reductionistic approach to be similar to Michael Polanyi's multi-layered ontology, but suggest that the Polanyian approach has fewer handicaps as a model-building enterprise. We offer a historical review of Hoffmeyer's polarized narrative of 20th century biology and investigate his central thesis that life and semiosis are coextensive. We argue that Hoffmeyer conflates temporal and spatial features of semiotic systems, his account of emergentism is unclear and the relationship between semiotic evolution and punctuated equilibrium is vague, possibly entailing incongruent metaphysical views.

Introduction: Two Biosemiotics Approaches

In this essay, we point to some congruency issues in the biosemiotic approach to life, as is exemplified in the work of the Danish biochemist, Jesper Hoffmeyer. Our starting point is his evaluation of the understanding of life and meaning inspired by the biologist Jakob von Uexküll plus the semiotic approaches of Charles S. Peirce and Thomas Sebeok (Gulick 2012, 23). We understand Hoffmeyer's approach to be similar to Michael Polanyi's, as recently discussed in Gulick (2012). Both are anti-reductionist

enterprises (Goldstein 2012, Hoffmeyer 2008), but our comparison suggests that the Polanyian approach has fewer handicaps as a model-building enterprise conducive to supporting research programs. As Gulick notes:

> a Polanyian biosemiotics avoids the tendency found in many epistemological schemes to atomize moments of knowing. The tendency toward epistemological atomism is exhibited to some degree in Whitehead's great stress on a concrescing occasion or in Peirce's emphasis on signs rather than bodies, communities, etc. If one overstresses the subsidiary-focal, tacit-explicit or from-to relations in Polanyi's epistemology, one can be guilty of this sort of atomism… The "from" dimension can be analyzed in terms of many levels. The biologist can unpack the physiological functions and anatomical structures that make cognition possible; the psychologist can speak of the roles of memory, desire, fear, and such factors in behavior; and the sociologist can root the "from" at a transpersonal level in social mores, status-seeking, ideological beliefs, and the like to make generalizations about group behavior (Gulick 2012, 29).

It is important to note that the approaches of Polanyi and Hoffmeyer diverge on how they address the domain of the living, "the vastly extended scale of increasing complexity and enhanced ability to respond to their niches from single-celled bacteria to the mammals" (Gulick 2012, 22).

Polanyi builds his multi-layered account from form, structure, and boundary conditions (Polanyi 1968; see also Margitay 2010 and 2012). For Polanyi, active centers play a key role in the identification of entities and levels of description, where it makes sense to talk about "originality as a performance, the procedure of which we cannot specify" (*PK,* 336). Polanyi builds on practices of inquiry, where individuality is a "personal fact, and to that extent unspecifiable" (*PK,* 343). For Polanyi, the dynamo-physical world is the substrate of second order emergence, which produces self-centered functioning (Gulick 2012, 21) of life and living systems, and eventually, a third order of emergence which accounts for humans evolving from signal awareness to symbol-produced conception (for both Polanyi and Gulick).[1] Studying a living thing, we learn about the second emergent level, and to study how a living thing studies a living thing clearly belongs to the third, reflexive level.

Hoffmeyer's biosemiotics focuses on meaning and semiosis and has to negotiate between a constrained thermodynamic system-framing organic evolution and a "spectrum of signs," or messages, where "a principal and distinctive characteristic of semiotic biology lies in the understanding that in living, entities do not interact like mechanical bodies, but rather as messages, the pieces of text" (Kull 1999, 385). By relying on

some of the old obstacles of a text-based (Saussurian) representative culture in a semi-Peircean packaging, the following question seems natural: can the primarily exegetical approach of Hoffmeyer provide a unifying account of life in its myriad shapes and forms and meanings? Does it provide an answer to the Big Question of life's nature?

The Hoffmeyerian strand of biosemiotics appears to claim the prize, but before we discuss some of the basic tenets offered by this "new synthesis," we first investigate the question from a historiographical perspective, as Hoffmeyer often portrays his enterprise as radically different from so-called traditional ("reductionistic") biology. Hoffmeyer's offer to replace the "old synthesis" comes with historical partisanship, and the often monumentally present precursors, commonly depicted in a markedly "whig" historical narrative suggests that the focus is more on attacking some metaphysical views, than offering a theoretically meaningful alternative synthetic theory.

In the first part of this article, we give a historical review of Hoffmeyer's narrative of the New Synthesis (Sections 2-4), then we will discuss some examples of entangled ontological commitments as we investigate the coextension of life and semiosis (Section 5), the gradation of the Great Semiotic Chain (Section 6), and the analogy drawn between biosemiotics and the "punctuated equilibrium" model by Gould and Eldredge (Section 7).

Precursors to Biosemiotics: Notes on Hoffmeyer's Approach to the Past

Hoffmeyer claims that twentieth century biological sciences were dominated by two major trends. A negative trend is the "molecular and genetic" reductionism that tries to offer a quantitative analysis of various phenomena, whereas a less noticed but in his view positive trend is the "semiotization of nature." The former is stigmatized as being dogmatic, because "semiotic creativity of biological systems at all levels of complexity is systematically excluded from the explanatory universe of the synthesis" (Hoffmeyer 1997a). The need to polarize the discussion and divide groups is a sign of dichotomization, where important aspects of contemporary debates can easily be lost. Otto Neurath, the Vienna Circle positivist, noted that "dichotomies…are not only crude intellectually, but also mostly the product of scientific pugnacity" (Neurath 1983, 15), and the militant debate-seeking rhetoric might even be detrimental to knowledge-production and can hardly be considered as beneficial epistemically. This reductionist or "extrapolationist" interpretation is quite common amongst the opponents of the Neo-Darwinian program (e.g., Gould & Lewontin 1979; Noble 2011 and 2015), but this popular depiction of the synthetic theory is strongly oversimplified (Somocovitis 1996 and Lennox 2008).[2]

For Hoffmeyer, the modern Neo-Darwinian theory of evolution was never a "real synthesis" (Hoffmeyer 1997a), because it was "lacking in the way that significantly

reflects remnants of ontological ideas that by and large are characteristic of twentieth-century natural science" (Hoffmeyer 2008, 7). This reconstruction of the developments of twentieth century biology is characterized by the retrospective heraldization and deification of certain figures. With "whiggish" overtones, it offers a polemical attack on some straw-man "ultradarwinism" (Grene 1997). It is noteworthy how the supposedly cornered opponent is demonized in an elliptical and distorted narrative.

In this historical sketch, the other modern trend is "less noticed but in the long run is just as important" (Hoffmeyer 1997a), namely, the semiotization of nature. Emmeche uses the term "spontaneous semiotics" (Emmeche 1999, 274) to describe these varied practices within modern biology. According to Hoffmeyer's historical analysis, "the earliest manifestation of this trend [i.e., a proto-biosemiotic approach] is probably in the work of the German biologist Jakob von Uexküll, who in the first part of this century developed his Umweltsforschung" (Hoffmeyer 1997a), a "line of thought which is, at heart, semiotic, or biosemiotic, though he himself never used these terms" (Hoffmeyer 1997b, 56). Framing von Uexküll's approach as proto-biosemiotic downplays the relevance of intellectual lineage connecting Johannes Müller's specific sensory energies and the intense development in the physiology of perception. Von Uexküll's work is generally connected to later developments in the narratives, like the phenomenological tradition (Harney 2015), and not to the rich soil of early twentieth century scientific model-building conventions studying life and the living, which, among other achievements, gave birth to the New Synthesis. The historical lacunae (e.g., forgetting that one of the fathers of Neo-Darwinism, Sewall Wright, subscribed to some form of panpsychic organicism) helps Hoffmeyer to portray the biosemiotic enterprise as an underdog with integrative potential, as semioticizing approaches are "already tacitly permitted in the disciplines," but "it simply remains to become developed as a new integrated paradigm" (Hoffmeyer 2008, 15).

In Sebeok's thesis, semiosis is what distinguishes all that is animate from what is life-less; it is "at the heart of life" (Sebeok 1991a, 85), is "the criterial attribute of life" (Sebeok 1991b, 124), and it presupposed life (Sebeok 2001 as cited in Hoffmeyer 1997a). According to Hoffmeyer's co-extension thesis, semiosis has been essential to life from the very beginning (Hoffmeyer & Stjernfelt, forthcoming, 3). It is an emergent property, "appearing with the first life forms nearly 4 billion years ago," leading to a modern unification of biology, based on the fundamentally semiotic nature of life (Hoffmeyer 1997a). This emergent process started with the very first life forms, reaching its provisional peak in the rich creativity of human thought and language (Hoffmeyer & Stjernfelt forthcoming, 21): "Cultural sign processes must be regarded as special instances of a more general and extensive biosemiosis" (Hoffmeyer 2008, 4) that is co-extensive with life itself (Kull et al. 2009, 168).[3]

The Telic Aspect of Living

Although biosemiotics portrays itself as a biological enterprise, it is not the self-autonomous, metabolizing life form, but the sign-process that is individuated, and this increases indeterminacy of description. Hoffmeyerian biosemiotics in principle assumes the usual, one-level structure of explanation. We think that it is here that Polanyi's inquiry-based multi-layered account fares better than an approach utilizing a universal semiotic formula (agnostic with respect to the ontology of "habits"). Polanyi transposes a conceptual framework fit to study artistic creativity to animal and life-form creativity (*PK,* 336), and builds his multi-layered ontological order from form, structure, and boundary conditions.

It is instructive to investigate the different utilization of one of the common denominators in Polanyi's and Hoffmeyer's account, that of the neo-vitalist von Driesch. Polanyi was taking up a teleological point of view of life which he had first encountered in his studies of the vitalist von Driesch, who is also one of the favourite "early pioneers" of biosemiotics. One of the most disconcerting hiatuses in Hoffmeyer's approach is the limited acknowledgement of the traditions leading up to von Driesch (Lenoir 1982). While Polanyi utilizes the neo-vitalist author together with Roux and Spemann (*PK* 355-357) to develop requirements for the telic interpretation of behavior and his concept of equipotential systems, Hoffmeyer laments that "It was perhaps unfortunate that thermodynamics in Driesch's time was not yet ready to function as the foundation for such a nonvitalistic solution," and that the theory "became for many biologists the quintessential example of how badly it can go when philosophical considerations are given credence in connection with internal controversies in the biological disciplines" (Hoffmeyer 2008, 11). Nevertheless, his approach "in a radical sense transcends" some "molecular genetics," more broadly some "hardcore reductionism. . .all the way back to Descartes's time" (ibid.).

Even Descartes clearly saw that a machine model cannot be the model of life, only a possible hypothesis concerning the functioning of a living being. Life, this hard-to-eradicate fire in living things, is more mysterious. As he wrote in a letter to Regius,

> A simple alteration is a process which does not change the form of a subject, such as the heating of wood; whereas generation is a process which changes the form, such as setting fire to the wood. Although both kinds of processes come about in the same way, there is a great difference in the way of conceiving them and also in reality. For forms, at least the more perfect ones, are collections of a number of qualities with a power of mutual preservation. In wood there is only moderate heat, to which it returns of its own accord after being heated; but in fire there is strong heat, which it always preserves as

long as it is fire (see Adam and Tanner 1996, 461; Cottingham, et al 1991, 200-201; and Kékedi 2015, 145).

Biosemiotics claims that life is a "causally efficacious matrix of biological interaction, the utterly natural product of organisms' interaction" (Hoffmeyer 2008, 8). But this either boils down to reductionism, as in physical causation, or to incongruity, as in semiotic causation, some aspects of which will be discussed below. It anyway fails to give a "meaningful" boundary to the living form and the entity-level description. As opposed to materialistic accounts, it is information-driven and is located in a universe of theoretical kinds, downplaying the relevance of forms of life.

Dreisch's *entelechy* has a longer and more exciting history than Hoffmeyer's simple polarization of opinions that non-experts in the history of biology might accept. The philosophical roots from Leibniz to Kant are just as relevant to this story as the historical empirical and experimental programs that relied upon the perceived inadequacies of mechanistic and reductive explanations. By the early 20th century, cytology in general has left behind the simplifying mechanistic cell concept (Hoppe 1997, 38). Driesch was connected to a major nineteenth century trend in conceiving of the biological, most clearly articulated in Kant, Blumenbach, and Goethe.[4] But this teleomechanical strand also influenced Owen, Darwin, and evolutionary theory, just as it did anti-Darwinists, such as D'Arcy W. Thompson in his "On Growth and Form," leading up to Polanyi and beyond, even Gould in some of his many brilliant moods. The teleomechanical tradition connected the study of form, function, *telos*, and the modelling practices with explanatory frameworks that had proved to be useful for the study of the non-living. It attempted to *integrate* the telic aspects of life with the mechanistic accounts of living functional forms. Although strongest in Germany, British natural history was also clearly informed about the stakes.

Classification and Adaptation

Darwin, for example, was not trying to propose a theory which explained fully the nature of life (i.e., answer the Big Question), but was merely trying to find an entry point addressing, to a small extent, change in life forms. In support of the remark that he did not destroy teleology, but rather put it on a scientific footing, note what Darwin wrote to Asa Gray in 1874: "What you say about Teleology pleases me especially and I do not think anyone else has ever noted that" (quoted in Gotthelf 1999, 23). Natural selection since then became accepted to be a part of the Big Answer, but Darwinism never tried to extend it to look like the Big Answer. Neither did von Uexküll or von Driesch. That is, adaptive explanations are teleological, but teleological explanations are not only adaptive. Polanyi's inquiry-approach in principle allows for many answers to gradually and partially map domains of creativity, including Life. Polanyi is a thinker

like others who distinguishes between a) the realm of physics and chemistry, b) the emergent realm of living things, and c) the emergence of humanity. "While the first rise of living individuals overcame the meaninglessness of the universe by establishing in it centres of subjective interests, the rise of human thought in its turn overcame these subjective interests by its universal intent" (*PK,* 389).

Biosemiotics, in contrast, seems to opt for some vaguely explicated co-extensivity-thesis, and every theoretician who carved out more carefully the territory of the *explanandum* becomes a proto-theoretician, a precursor. Militant Darwinists, in the last epoch most notoriously Dawkins, sometimes are guilty of asserting some form of the co-extensivity-thesis by trying to eliminate teleology, and Hoffmeyerian biosemiotics in its focus on signs comes dangerously close to doing this as well, supposing that life can be a *product* of interactions and sign processes.

At stake is our insight into the Big Question: how can a framework grasp Life? With Linnaeus, hierarchical sets entered the Garden of Eden, and a grip was found on ever-changing Life. As the saying went: "*Deus creavit, Linnaeus disposuit*." God created, the "Second Adam," Linnaeus, organized (Lindroth 1994, 22). This attempt at classification was nothing new to the biological tradition that has for millenia been struggling with ever-changing Life. Hierarchical classification does not have much in common with Life, and putting items in boxes or tying them to things can only partially constrain the Living. Darwin focused on one of the most established and seemingly stable aspects of the living, the categorizability of the morphing/morphed forms into genera and species. His theory targeted the "existence of stable, autonomous, and self-reproducing entities" (Keller 2009, 8). The target idea of stable species was duly destroyed, as from the strict ranked hierarchy of family, order, class—in other terms, classification—evolved the age of redefinable "clades," the groups of organisms classified together on the basis of evolution from a common ancestor.

In a footnote added to "An Historical Sketch," appended to later editions of *The Origin of Species*, Darwin acknowledged his debt to Goethe, who was named a worthy forerunner, an "extreme partisan" with his morphology, an approach to studying living forms and their formation. Goethe was eager to follow up on the Big Question, and he started a dialogue with the mystery that stands in the way of systematization: "Natural system—a contradiction in terms. Nature has no system; she has, she is life and its progress from an unknown centre toward an unknowable goal. Scientific research is therefore endless" (quoted in Müller 1989, 116). Goethe cautioned the practitioner in his article, "Problem":

> The concept of metamorphosis is a highly estimable gift from above, but at the same time a highly dangerous one…It leads to formlessness, destroys knowledge, disintegrates it. It is like centrifugal force and would lose itself in the infinite if a counterweight were not provided.

> I am referring to the specification force [*Spezifikationstrieb*], that tenacious capacity for persistence inherent in whatever has attained existence, a centripetal force (Müller 1989, 116).

Darwinian evolution grew on the rich soil of this morphological tradition, where plasticity always had to be allowed for to account for evolvability. The journal *Nature* started its first issue (4 November 1869) with Goethe's orphic aphorisms on nature, the influence of which Thomas Henry Huxley took care to admit. In this tradition, failures and irregularities with respect to our norms and standards, informative "exemplars" were considered epistemically valuable, in fact superior to the examples of the regular, the schematic, the propositional textbook-knowledge that helps one to interactional, but not contributory expertise.

One of the strange exemplars of Goethe's morphology is the perfoliate rose, a deviant form, which nevertheless testifies to some lawfulness, and helps a "higher order" understanding of organization. The entelechy can only be pursued and not grasped, and the search for the lawful has to be alert to the seemingly unlawful, but in Hoffmeyer's biosemiotics there is little space carved out for "error-handling," ways of making use of going amiss. Let us not forget that Polanyi is extensively using this technique of so many progressive research programs (including Darwin's), utilizing deviations and teratology in his account, from Lashley's mutilated rats to the crippled Renoir to establish the domains of emergence (*PK,* 337).

Since Polanyi's time, modelling relations and explanatory structures have received much attention, and the issue of emergence has become a hot topic in the contemporary philosophy of mind and philosophy of science (e.g. Butterfield 2011, Crane 2001, Cunningham 2001, Harré 2006, Kistler 2006). There are several different concepts of emergence (for possible taxonomies see Bedau 1997 and 2010, along with Chalmers 2008), but Hoffmeyer's notions of emergence and emergent properties are very unsubstantiated and vague. His unusual and little-developed emergentism suggests that living systems should be studied as semiotic systems on their own right (Hoffmeyer 2010, 189). The vague ontology includes only a thermodynamic constraint, ignoring the venerable tradition that, to account for life, one needs to account for the organism's self-drive to live, not just the chemistry of the inner machinery, population genetics, evolutionary history, and semiotic relationships.

It is claimed that semiosis is an emergent property in our universe appearing with the first life forms nearly 4 billion years ago (Hoffmeyer 1997), but we take this more as an underspecified claim of co-extension than a bold and original assumption. To locate the spatial coordinates of the first semiotic system, we run into difficulties, as semiosis transcends the boundaries of the living form to include aspects of the environment, and temporal delineation has congruency-problems.

Life, Semiosis, Coextension

For Hoffmeyer, the terms semiotic freedom, semiosphere, and semiotic niche represent real features of the world. Semiotic evolution through the history of life enhances *semiotic freedom*, the increasing complexity and sophistication of types of semiotic causality and influence within individuals and between species. The growth of semiotic freedom has a far-reaching historical dimension:

> The historical nature of the world has profound consequences for the study of life, because it confronts us with the problem of organization in a new way. If the complex forms of organization exhibited by living systems—from the cell to the ecosystem—are not the inescapable result of predictable lawfulness, they must instead have emerged through processes that are still in need of discovery (Hoffmeyer 2010, 191-192).

The degree of semiotic complexity increases from the first steps of molecular recognition to the highest-level forms of semiosis. This affects "the depth of meaning that an individual or species is capable of communicating" (Hoffmeyer 2008, 186). However, the growth of semiotic freedom brings increasing indeterminacy in Hoffmeyer's biosemiotic account—or rather his account of accounts, a theory-driven aggregate of explanations, with little consideration for individual, deviant forms. For example, the perfoliate rose (Image 1), an example of irregular metamorphosis once seen by Goethe, must have had a semiotic niche in the semiosphere, its organism-centered Umwelt. It must also have become part of our semiotic niche, thanks to our increased intellectual semiotic freedom and the notion of co-extensivity. This long gone organism was once part of the semiosphere, and, although no longer living, retains a ghost-like existence in the semiosphere. Is the semiosphere therefore an abstract collection of past and present forms and perhaps future possibilities?

Image 1: The perfoliate Rose (Hans Wahl, Anton Kippenberg: Goethe und seine Welt, Insel-Verlag, Leipzig 1932 S.143)

The semiosphere emerged when meaning or significance in the realm of matter and energy was born in itself and by itself. The semiosphere, created by biosemiosis, is likened to some *natural* phenomena; it is "a sphere just like the atmosphere, the hydrosphere, and the biosphere." It confronts life in a continuously unfolding present, as it "penetrates to every corner of these other spheres, incorporating all forms of communication: sounds, smells, movements, colors, shapes, electrical fields, thermal

radiation, waves of all kinds, chemical signals, touching, and so on. In short, signs of life" (Hoffmeyer 1997b, vii).

And, to make a radical enough alternative to reductionism, biosemiotics also incorporates elements from the future. "Peirce was of the opinion that it is untenable doctrine to say that the future does not influence the present" (Deely 2015, 355). With the increase of semiotic freedom in the semiosphere, anticipatory functions model the possible future of the organism in acts of semiosis, thus freedom incorporates more and more of the temporal dimension into the organism.[5] But couldn't future development be non-semiotically produced or controlled by past habits? The present moment of the biosphere is just as it is, while the present moment of co-occurring biosemiotic spheres is entangled with the future, and, as it is also an evolutionary theory, it encompasses the past. Control develops as anticipation improves, thus with growth of freedom in the semiosphere, in contrast to deterministic constraint, comes increasing indeterminacy and entanglement of matter with time, as it will have more and more closed loops of entailment (models of anticipatory systems, Rosen 1999, 95). Much of modern theorizing in biology is strongly connected with rejecting the co-extensivity assumption.

The self-sustaining living thing is a non-transparently functioning but teleological system, historically shaped by elements of its surroundings, a compound corporeal system. Its development is somehow closely connected to coming to grips with its preformed and evolved mereology. This thing that is alive is also informed by countless earlier living forms constituting its ancestry, and, higher up the biosemiotic ladder of freedom, it anticipates more and more of the future, and starts to transform it, as it is in constant fusion with its environment. Such a multi-faceted account of the organismic cannot be limited to just the biosemiotic facet of the teleologically informed aspects of the mystery.

The Great Chain of Semiosis

In a forthcoming article, Hoffmeyer and Stjernfelt claim there is a progressive trend in the history of life, the Great Chain of Biosemiosis, where the progression in semiotic freedom gives rise to discrete steps or levels, into a "scaling [which] immediately catches the eye" (1). Let us see how they understand the biosemiotic framework to separate these discrete steps (indicated by capital letters).

A rather primitive form of semiosis is the Division of Labor in Multicellular Organism (Endosemiosis), a crucial evolutionary step from uni- to multicellular organism involving "the differentiation between different, collaborating cell types and hence the semiotic coordination of different behaviors of those cells" (8). Occupying a slightly higher position at the semiotic scale is From Irritability to Phenotypic Plasticity in Plants, a system's physiological response to a stimulus. "'Irritability' is semiotically more developed than 'molecular recognition' since it occurs at the level of the organ

or whole organism and typically implies the simultaneous activation of several parallel and/or consecutive recognition processes" (8).

Description of the lower level utilizes a behavioristic account, while a "slightly" more advanced level already talks of recognition, and even proto-cognitive capacities with respect to the phenotypic plasticity of plants.

> Here, a primitive division of labor anticipates the distinction between germ cells and soma cells, as the lower cells in the stalk so to speak sacrifice themselves for the survival of the group. Such large-scale coordination between cells presupposes the recognition of conspecifics and a sophisticated chemical-espatial communication between them (8).

Discrete levels of biosemiosis seem questionable as is the assumed discreteness of the entity that we characterize in an act of biosemiosis. First, consider the redwood forest, Sequoia sempervirens, where each tree responds physiologically via sophisticated machinery, adapting to the ever-changing environment. Now, consider the same forest as a clonal entity, as some are, where the forest is a single organism (gamet) and "response" includes the demise of some gamets, along with the generation of some new shoots. At least some research suggests that the extent of clones and their spatial structure may have important evolutionary implications (Douhovnikoff & Dodd 2004). As most plants with plasma-bridges connecting their intercellular matrices cannot really be called bounded on the cellular level, the forest has, at the same time, the semiotic capabilities of only a unicellular organism, and at least the proto-cognitive capability of a plant. And isn't then the redwood tree in a similar state of self-organizing chaos as social insects, exhibiting a form of swarm intelligence (Hoffmeyer 1997b, 113)? As a myriad of ants build an ant-hill, a divided cell builds a myriad of trees, the clonal redwood-forest. Can different types of semiosis operate simultaneously on one level, and the same type on different ones (cell, tree, forest)?

Thanks to the epigenetic wisdom of plants, seeds of the same species grown on different soils produce seeds that *reflect* the challenges posed by the particularities of the environment. Higher up on the Great Biosemiotic Chain, just as the peak of Sentience is reached, the Learning and Social Intelligence attributable to fish would also seemingly be characteristic of self-fertilizing plants. "If learning is something like *a capacity for modifying one's responsive predispositions and [aligning] them to the challenges posed by the particularities of one's environment*, . . .then advanced learning skills have been a part of life on Earth for more than 400 million years" (15).

When we look at the amorphously bounded and permeable steps that stand for the structure of the theoretical Great Chain of Semiosis, we see how difficulties are encountered once organizational constraints get fused with the "sphere of sign processes and

elements of meaning that constitute a frame of understanding within which biology must work" (Hoffmeyer 2008, 5).

Punctuated Semiotic Evolution

The vague positioning of the enterprise with respect to delineability and discreteness of individuals and types also affects the "structure-thesis" of biosemiotics, a recurring portrayal in terms of current evolutionary theory that is connected to Stephen Jay Gould and Niles Eldredge, and their famous punctuated equilibrium model. Gould and Eldredge introduced their model as a consequence of apparent bursts of speciation after mass extinctions, i.e., the emergence of new species challenging the traditional thinking about the tempo and mode of evolutionary change (Eldredge & Gould 1972, Gould & Eldredge 1977). While speciation and the process of evolution according to Darwin involves slow, gradualistic change, Gould and Eldredge state that most evolutionary changes happen—geologically speaking—very quickly during speciation events. How does biosemiotics relate to the issue of rapid versus gradual evolutionary change? Biosemiotic thought appears to be modeled on punctuated equilibrium as understood by Gould and Eldridge: "If we accept punctuated equilibrium as a basic structure in biological evolution, we should expect the semiotic evolution to follow the same structure, hence displaying a ladder of increasingly complex sign types" (Stjernfelt 2002, 338).

Biological evolution and semiotic evolution, as co-extensive, conditionally instantiate isomorphic structures.[6] Hoffmeyer holds that semiotic evolution can in principle provide an explanation of sympatric species generation (that is, separate species developing from a common ancestor in the same geographical area).

> Recognition not only of mates, but also of a multitude of other cues in the environment, might influence the reproductive pattern in such a way as to create isolation. Thus sympatric speciation—which for many reasons seems to be the more attractive model, if only one could find a plausible mechanism—might be obtained by a number of purely semiotic barriers. So semiotics might even hold the clue to this most central of Darwinian events: the origin of new species (Hoffmeyer 1997b).

While speciation and the process of evolution, according to Darwin, happens gradually within the species' geographical range, Gould and Eldredge claim that much of the phenotypic change is quick during allopatric (geographically separate) speciation events. The theorists of punctuated equilibrium see allopatric speciation as the dominant form of speciation, while sympatric speciation is mostly viewed as irrelevant to our understanding of large-scale evolutionary patterns. However, it seems odd that in

the case of the Hoffmeyerian version of biosemiotics, which on the basis of co-extension should parallel punctuated equilibrium theory, it is sympatric speciation that is stressed, as it can warrant semiotic freedom.

Biosemiotics reaches for a non-gradualist narrative of organic evolution without clearly explicating the structure or the landscape of the "Great Chain;" they merely point to the Semiosphere:

> In this sphere the dynamics of history (evolution) changed and began to become individualised, so that each little section of history became unique and henceforward no big formulas could be erected covering the whole process…if quantification is wanted, it should be searched not at the level of genetics, but at the level of the constrained thermodynamic system framing organic evolution (Hoffmeyer, 1997a).

This in our view comes close to forgetting the actual developing shape of a particular living being when trying to account for biological processes. Hoffmeyer holds that "the most pronounced feature of organic evolution was…not the creation of a multiplicity of amazing morphological structures, but the general expansion of "semiotic freedom'" (Hoffmeyer 2008, 188).[7]

Hoffmeyer is more of a selectionist than Gould and Eldredge, whose theory assumes that something other is more formative in speciation than semiosis, "sign action, i.e., a process whereby a sign induces a receptive system to make an interpretation" (Hoffmeyer & Stjernfelt, forthcoming, 2). When we look for the implied structure of the approach of biosemiotics, just as in the steps in evolution, we see that only a loose mapping is offered, as the recent programmatic article talks of chains, scales, and a "provisional peak in the rich combination possibilities of human thought and language" (Hoffmeyer & Stjernfelt forthcoming, 22). The result is a framework where seemingly increasing levels of complexity are ascribed stages in the growth of biosemiotic freedom, yet the levels get entangled and cannot be clearly distinguished.

Biosemiotics can only partially illuminate life, as functional sign-relations cannot constitute entities, nor can they delineate meaningful levels of organismic complexity. As the sign processes are quantitized, the implications of this co-extensivity thesis assuming the same spatial or temporal scope of biosemiosis and life appears odd as no semiotic map of any phenomenal domain is coextensive with its territory, having the same spatial or temporal scope with what it is the mapping of.[8]

Some popular accounts of current biosemiotics focus so much on meaning and semiosis that non-functional signs of life become "dead weight," best discarded, left behind. In an illuminating example, Hoffmeyer states that a "moth's sonic universe… can pick up only one particular note…emitted…by a bat. This note enables the moth to determine how far off its enemy may be and in what direction" (Hoffmeyer 1997b,

53). The moth's sonic universe has functional, semiotic meaning. The functional vibrations from the bat enter the moth's semiotic universe, the noise that humans hear as the moth flies by does not. It has been discovered that some moths rub their genitals to jam bat echolocation and startle or deceive bats (Barber & Kawahara 2013), but only once the discovery is made, does the moth's own sound enter the semiotic universe. Non-functional forms and signs of life are mostly up for grabs in the semiotic tradition, where meanings are first and foremost ascribed to readable or decodable signs, but not to the puzzling and mysterious forms, shapes, and morphings of Life.

Concluding Remarks

We started out with a comparison between Polanyi's multi-layered ontology and Hoffmeyer's biosemiotic enterprise. We highlighted some of the benefits of the former while pointing to deficits of Hoffmeyer's overtly polarized, whiggish narrative, according to which, there are "two major trends in twentieth century biology." One is the molecular and genetic reductionism (basically interpreted as the modern Neo-Darwinian synthesis) and other is the so-called semiotization of nature. Polemic narrative-constructions re-appearing in various loci of this strand of the biosemiotic corpus were suggested to obscure the systematic theory-construction required for a comprehensive, synthetic theory. The lacunae mask the continuity of the inventive struggle to incorporate the teleology of living things in our understanding of nature from Aristotle to Schrödinger, and stand in the way of integrating the modern biosemiotic tradition (providing many key insights) within the broader history of biological theorizing.

We investigated some elements of this innovative approach to trace how forms of life are handled by Hoffmeyerian biosemiotics. Hoffmeyer offers some basic notions to analyze this question: semiotic freedom, semiotic niche, semiosphere and the co-extensivity thesis. Semiosis is called an emergent trait, co-extensive with life, thus appearing with the first life forms. This co-extension gave rise to the semiosphere, incorporating every sign of life and aspects of the past, the present, and the future. According to Hoffmeyer, the degree of semiotic complexity in the semiosphere increases from the very beginning of life on Earth. But the conflation of temporal and spatial features of semiotic systems is problematic and possibly implies incongruent metaphysical views.

Hoffmeyer's emergentism is another source of entangled ontological commitments. The progressive trend in evolution constitutes the Great Chain of Semiosis, but the approach maneuvers between meaningfully discrete layers or levels, on the one hand, and a loose gradualist mapping conforming to some unspecified topography of the domain, on the other hand. We argued that it is not clear what the relationship is between this pattern of increasing semiotic freedom in the course of life and the model

of punctuated equilibrium. What is the exact structure of this non-gradualist narrative? Does it really have one?

Endnotes

[1]"There are then two principles at work in animals: namely, (1) the use of machine-like contrivances and (2) the inventive powers of animal life" (*PK,* 337).

[2]Hoffmeyer's concept of reduction and reductionism is not informed by recent debates surrounding the philosophy of biology (Rosenberg 2006, Brigandt & Love 2015). In the citation above from Hoffmeyer 1997a, he uses "molecular" and "genetic." If "genetic" is understood as molecular, it is superfluous, and if "genertic" is understood as evolutionary, the statement is false. For a more informed historical overview, see Müller-Wille and Rheinberger (2009) for the philosophical stakes, Kitcher (1984) Morrison (2000).

[3]Making no clear distinctions between the "phases" of the semiosphere allows the enterprise to remain mostly non-reflexive, thus questionably able to account for metacognition and "second-order-survival" (Oeser 1997, 87).

[4]This connection is acknowledged in some historical accounts, see Fernandez (forthcoming).

[5]For these reasons of dubious temporality, we do not clearly understand how the semiotic niche concept is analogous to the ecological one. In order to occupy a semiotic niche, an organism or species "has to master a set of signs of a visual, acoustic, olfactory, tactile, and chemical nature, by means of which it can control its survival in the semiosphere" (Hoffmeyer 2008, 185). Expansion of semiotic freedom involves the union of all semiotic niches, each definable in an n-dimensional hypervolume.

[6]See the difference between similarity and isomorphy in Suarez (2010)

[7]"The semiotic ordering (through spans of evolutionary history) of chemistry holds the key to the function of this chemistry. In this sense, and only in this sense, is life an irreducible phenomenon" (Hoffmeyer, 1997a). A living organism is both a unity in multiplicity, and a multiplicity in unity, posing a mereological problem that cannot be solved via thermodynamics only (Bortoft 1996, 343).

[8]Causal complexity generally requires reconstitution of phenomena (Kronfeldner 2015), but biosemiotics tends to present the partial structure as the whole picture.

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