# *God and the World of Signs: Semiotics and the Emergence of Life*

*with Andrew Robinson and Christopher Southgate, "Introduction: Toward a Metaphysic of Meaning"; Christopher Southgate and Andrew Robinson, "Interpretation and the Origin of Life"; Bruce H. Weber, "Selection, Interpretation, and the Emergence of Living Systems"; Jesper Hoffmeyer, "A Biosemiotic Approach to the Question of Meaning"; Robert E. Ulanowicz, "Process Ecology: Stepping Stones to Biosemiosis"; Andrew Robinson and Christopher Southgate with Terrence Deacon, "Discussion of the Conceptual Basis of Biosemiotics"*

## DISCUSSION OF THE CONCEPTUAL BASIS OF BIOSEMIOTICS

*by Andrew Robinson and Christopher Southgate*
*in conversation with Terrence Deacon*

*Abstract*. Kalevi Kull and colleagues recently proposed eight theses as a conceptual basis for the field of biosemiotics. We use these theses as a framework for discussing important current areas of debate in biosemiotics with particular reference to the articles collected in this issue of *Zygon*.

*Keywords:* biosemiotics; emergence; function; life; origin of life; Saka theses; semiotics; teleology

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### THE SAKA THESES

In August 2008 a group of Peircean biosemioticians met at Saka on the Baltic coast of Estonia to formulate a conceptual basis for biosemiotics (Kull et al. 2009), resulting in the following eight theses:

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I. “The semiotic–nonsemiotic distinction is coextensive with the life/nonlife distinction.”

II. “Biology is incomplete as a science without a semiotic grounding.”

III. “The predictive power of biology is embedded in the functional aspect and cannot be based on chemistry alone.”

IV. “Differences in methodology distinguish a semiotic biology from a nonsemiotic one.”

V. “Function is intrinsically related to organization, signification, and the concept of an autonomous agent or self.”

VI. “The grounding of general semiotics has to use biosemiotic tools.”

VII. “Semiosis is a central concept for biology that requires a more exact definition.”

VIII. “Organisms create their own *Umwelten*.”

Under thesis VII the Saka group suggest seven properties that might constitute the necessary and sufficient conditions of semiosis. These include:

- agency
- normativity (the possibility of misrepresentation)
- teleofunctionality (embeddedness in a process that is end-directed)
- form generation
- differentiation of the sign-vehicle from the form-generating process
- the possibility of categorizing (i.e., generalizing) signs.
- acknowledgment of the plurality of semiotic and developmental processes.

It is instructive to consider how the Saka theses compare with the approaches to biosemiotics represented in the articles in this issue of *Zygon*. In the section that follows we explore the similarities and differences between the Saka theses and the Southgate-Robinson definition of interpretation (Robinson and Southgate 2010; Southgate and Robinson 2010). This discussion focuses on Saka theses I and VII and takes the form of a conversation between the three authors of the present article, one of whom (Terrence Deacon) participated in the Saka meeting. We then make some broader observations about how the approaches taken in the articles collected here may cohere with the other main theses.

## CONVERSATION ON SAKA THESES I AND VII

We begin with Thesis VII: “Semiosis is a central concept for biology, however it requires a more exact definition.” The Saka group did not set out to offer a precise definition of interpretation but instead suggested seven properties or conditions that must be met (bulleted below). We consider these in turn.

- *Agency: a unit system with a capacity to generate end-directed behaviors.*

*Robinson and Southgate (AR/CS):* We agree that an interpretative system must have a capacity to behave in an end-directed manner. According to our definition, in this context *behavior* may mean, minimally, a change of state of the system from, say, S1 to S2. In our minimal molecular semiotic entity this change of state is a change of conformation of the molecule. We believe it is helpful to reserve the term *agency* for systems that store energy for the purpose of making this response; on our account agency is a property of systems that are able to make interpretative responses and perform work-cycles in order to do so (Robinson and Southgate 2010).

- *Teleo-functionality: Semiosis is always embedded in a process that is end-directed. . . . This is what determines the normative properties of a sign-interpreting process.* (For the purpose of this discussion we have reversed the order of the Saka group's properties 2 and 3.)

*AR/CS:* We agree with this statement on teleo-functionality. In our general definition a purpose (general possible type of outcome) is integral to any event of interpretation. It is the end-directedness of interpretation that makes it irreducible to mechanistic causes. Hence the importance of also providing a naturalistic and irreducible account of purpose, as our definition, elaborating the work of T. L. Short, does (see Short 2007).

- *Normativity. . . . This includes the possibility that the representation is in error or that its consequence . . . can be either compatible with or incompatible with preserving the integrity of the living system in which it occurs.*

*AR/CS:* We agree that a general definition of interpretation must give an account of the fallibility of interpretations, as our definition does. The purpose of an interpretation *may* be to preserve the integrity of the organism, though higher animals (humans particularly) are able to choose their own purposes. Interestingly, our "interpretative autocell" interprets the environment not in order to preserve its individual integrity (which is in fact lost as a consequence of the interpretation) but to increase the production of new autocells.

*TD:* You make an assumption, which the group tried to avoid, though with some failure because it is so ubiquitous. Your assumption is that the interpreting individual (meant as individuated interpretive system) is a particular collection of molecules, whereas the Saka group would see the lineage as an extended individual linked by an unbroken dynamical topology as well as some necessary material overlap. Thus reproduction becomes part of the interpretive process. This is critical in order to understand the evolutionary process as semiotic, not merely a collection of semiotic fragments.

*AR/CS:* This emphasis on dynamics is very helpful. An evolutionary perspective is implicit in our insistence, in our definition, that the interpretative response must have been selected for. We think it could be very fruitful to attempt to combine our approach to the definition of interpretation with the Saka group's emphasis on the importance of the dynamic origins of semiosis (see Deacon 2006a).

- *Form generation. The systemic organization that is responsible for interpreting the semiotic function of a sign-vehicle must include a form-generating process that in either a direct or indirect way contributes to the persistence (re-presentation) of that function.*

*AR/CS:* Here we identify a difference of emphasis between our approach, which focuses on an account of what it is for an organism to interpret something, *X*, as a sign of something else, *O*, and that of the Saka group, which builds on Deacon's innovative account of emergent "teleo-dynamics" (Deacon 2003; 2006a). We do not see interpretation as necessarily form-generating in itself, though we recognize the importance of giving an account of the relation of interpretative processes to Deacon's teleodynamics (hence our interest in giving an account of an "interpretative" version of Deacon's autocell). An illustration of the difference in emphasis is that we regard our hypothetical minimal molecular semiotic entity (the two-state ribozyme) as capable of interpretation but not (in the interpretative response) form-generation. On the other hand, we regard Deacon's autocell as capable of form generation but not of semiosis—until it acquires the interpretative property that we have modeled.

*TD:* This is a clear point of distinction between your position and that of the Saka contributors. It is interesting that again this difference may be related to the question of whether the genesis of semiosis is located in organism responses or in the evolutionary lineage of such responses. This is almost certainly related to the difference between Short's and my respective reinterpretations of Peirce, and the importance that I place on emergence as a critical aspect of semiosis, in contrast to what I would argue is Short's "flat" metaphysical analysis.

*AR/CS:* We look forward to further conversations with you as to why Short's metaphysics is to be regarded as "flat," and as to your own metaphysical stance.

- *Differentiation of the sign-vehicle from the dynamics of the reciprocal form-generating process.*

*AR/CS:* The Saka group have in mind here, we believe, the necessity of internal sign-vehicles such as a DNA nucleotide sequence and its interpretative machinery being insulated from the evolution of the forms to whose generation they contribute. We tend to regard the “trick” of storing “information” relevant to form generation as a special case, and probably not the earliest form, of semiosis. In the context of that special case the Saka group’s point may well be interesting and important.

*TD:* Considering that in the Saka account autocells without template molecules or coding are considered to be useful models of the earliest semiotic-like processes, we would agree with you that DNA-type information is an evolutionarily derived trick and not necessarily the essence of biosemiosis. The Saka group, however, felt willing to remain somewhat agnostic in drawing a sharp boundary, and described the autocell-like (morphota) era of protolife as a gray area (“threshold zone”) where it may be difficult to differentiate semiosis from functionality—that is, where there may be a more holistic fusion of these aspects of teleodynamics. The distinction between what Peirce would call representamena (sign-vehicles) and the interpretive process of generating them can probably be traced to Howard Pattee’s argument that semiosis is first clearly distinguishable from the dynamics in which it is embedded when there is a codependency between a rate-dependent and rate-independent aspect of the system (Pattee 1995). The rate-independent feature is what allows accumulation and memory and hence Re-presentation. Evolution ultimately requires this sort of cumulative potential, and so again we encounter the locus question between organism and lineage.

- *Categorization. . . . Functionally similar instances of signs (tokens) are subsumed under a general type. At the same time what signs refer to is also categorized.*

*AR/CS:* We agree with this. The point is more explicit in Short’s definition of interpretation than in our modification of his formula: We fully concur with Short that *R* must be “based on a relation . . . of *X* to *O or of things of* X*’s type to things of* O*’s type*” (Short 2007, 158; emphasis added). The range of things, $X_1$, $X_2$, . . . , to which a response *R* may be made, and of things, $O_1$, $O_2$, . . . , to which *X* has a relation, determines the sensitivity and selectivity of the response.

- *Various developmental processes . . . create novel fitted correspondence relationships, and are presumed to be the principal means by which semiotic relationships are generated.*

*AR/CS:* This final point (point 7 of Thesis VII) concerns the plurality of biological processes—genetic, developmental, communicational, memory, and consciousness—to which semiosis is central. Our general definition of interpretation is entirely consistent with such a view.

*TD:* I think that point 7 is actually a point of agreement, though it may be obscured by the Saka consortium's willingness to recognize a gray area in the transition to protolife forms.

*AR/CS:* So far we have discussed the seven points that the Saka group's Thesis VII proposed as properties or conditions for the emergence of semiosis. We now turn to the first of the Saka theses:

*Thesis I: The semiotic/nonsemiotic distinction is coextensive with the life/nonlife distinction.*

*AR/CS:* Here there is an interesting difference between our position and that of the Saka group. We agree that it is helpful to think in terms of the sequential emergence, rather than simultaneous origin, of the various properties normally regarded as essential to life. We suggest that it may be valuable to consider the range of properties that are proposed as crucial attributes of protobiotic entities, such as localization, autocatalysis, and ability to complete a thermodynamic work-cycle, as well as semiotic interpretation, and to ask: What would be the probable next evolutionary step by which different possible protobionts would draw closer to the range of properties associated with life itself? (Southgate and Robinson 2010) The Saka group appear to assume that authentic semiosis must have been a late-emerging feature and that it is only reliably attributed to entities with a complexity approaching that of known living organisms. We suggest that this may unnecessarily restrict empirical investigation of the role of semiosis in the emergence of life. Our proposal for a minimal molecular semiotic entity suggests that semiosis might have played a role at a counterintuitively early phase in the "threshold zone" between nonlife and life.

*TD:* I think that your comments about Saka Thesis I are a mischaracterization, as noted above, in that the gray area we struggled to leave ambiguous on this point represents not so much a postponement of the initiation of semiosis in its most general sense but rather the full differentiation of semiosis out of an initial holistic identification of function and semiosis where the two aspects cannot be distinguished from each other. To be more explicit, the Saka perspective simply recognizes phases in this differentiation process but does *not* assume that semiosis appears only late in the process, for example with the emergence of DNA-like template functions. So, one might describe the transition to teleodynamics, as in a simple (not responsive to any specific environmental substrate) autocell, as the origins of UR-semiosis. This would actually make the Saka interpretation of the origins of semiosis *earlier* and *simpler* than in your proposal (Robinson and Southgate 2010; Southgate and Robinson 2010).

*AR/CS:* We see why you feel we misrepresented the Saka group when we said that their position implied that authentic semiosis must be a late-emerging phenomenon, reliably recognizable only in relatively complex organisms. We note in particular your attribution of UR-semiosis to the (in our terms) noninterpreting autocell. We would like to understand this attribution better as it seems a key area of differing emphasis.

We understand that the Saka group envisage the emergence of grades of semiotic processes within the threshold zone from the ambiguous (such as teleodynamics of the autocell) to the unambiguous (similar to that which occurs in familiar kinds of organism). It would have been better if we had simply said that the Saka group do not expect semiosis to be *unambiguously* present until the higher end of the transition zone. We would then still wish to press our original point—that our definition of interpretation opens up the possibility of semiosis having played an *unambiguous* role at an earlier stage than seems to be envisaged in Saka thesis I.

*TD:* The question of the "threshold zone" is a wonderful place to focus this debate because it requires a very fine-grained discussion of the defining properties of function, information, semiosis, normativity, and so forth. The Saka group left this as a "zone" because we recognized that a more precise analysis would eventually be required and that the tools for this were not yet sufficiently developed. We felt that recognizing a transition from holistic semio-functional organization to differentiated semiosis-driven function both was consistent with an evolutionary emergence paradigm (in which a process of progressive differentiation from holistic to differentiated is ubiquitous) and also left a context for future more subtle distinctions to be drawn that could open the door to both theoretical improvements and empirical testing.

*AR/CS:* We agree that a key concept to be explored further is that of the threshold zone. But is this zone best thought about as (a) the threshold zone before the evolution of full Semeota, (b) the threshold zone in which entities possess some but not all of the attributes of living organisms, or (c) the threshold zone in which semiosis has evolved but is not accompanied in a full sense by "agency" or yet "choice"? (See the section "Is our minimal molecular semiotic entity too minimal?" in Robinson and Southgate 2010.)

## Concluding Remarks on Biosemiotics

The discussion above focused on some detailed questions concerning the cardinal features of semiosis (Thesis VII) and the relation between semiosis and the emergence of life (Thesis I). We conclude with some further observations about the conceptual basis of biosemiotics based on the other main theses formulated by the Saka group with particular reference to the articles in this issue of *Zygon*.

A core hypothesis in the biosemiotic research program is the idea that biology is incomplete as a science without reference to the fundamental importance of semiosis to living systems (Thesis II). This idea is explored and richly illustrated in Jesper Hoffmeyer's contribution to this collection of articles (Hoffmeyer 2010). (Hoffmeyer was himself a member of the Saka group.) A further major area of interest in biosemiotics is the nature of purpose and the place of teleological forms of explanation. The concept of function is central to biology (Thesis III), and the concepts of function, organization, signification, and selfhood are closely linked (Thesis V). The Saka group identify the precise relation between function and semiosis as an important question for investigation. In our contribution (Southgate and Robinson 2010) we suggest, following Short, that interpretation is a particular kind of change of state occurring for a purpose. More generally, it seems that biosemiotics promises to facilitate a rehabilitation of the concept of purpose in biology by providing a stimulus for the exploration (or rediscovery) of a naturalized teleology.

One of the tasks that distinguishes semiotic from nonsemiotic approaches to biology (Thesis IV) is that biosemiotics must seek to ground the widespread use of apparently semiotic terminology in biology (such as *information*, *code*, *signal*, and so forth) in fundamental physical and chemical processes. If this cannot be done the suspicion will remain that such terminology is ultimately a dispensable, anthropocentric, metaphorical transfer. Robert Ulanowicz's "bottom-up" approach to biosemiotics via the concept of process ecology is one attempt to provide such a grounding (Ulanowicz 2010). Deacon's work on the emergence of semiosis from morphodynamics and teleodynamics is another important contribution to this field and underpins his autocell proposal (Deacon 2006a, b; see also Weber 2010).

The project of seeking to ground biosemiotics by means of a new understanding of the dynamics of fundamental physical processes raised the possibility that general semiotic theories might ultimately be derived from biosemiotic investigations, rather than biosemiotic concepts being drawn from general semiotics (Thesis VI). Here is an interesting tension, to which Ulanowicz draws attention in his article, between top-down and bottom-up biosemiotic theories. Deacon (2006a, b) and Ulanowicz each develop bottom-up approaches based on highly original reconceptions of the fundamental dynamics of natural processes. Hoffmeyer's approach is more top-down, offering a synthesizing overview of the role of semiotic processes across the spectrum of levels of semiotic freedom. In our essay we arguably combine top-down and bottom-up features. The top-down characteristics of our account derive from Short's concern to give a naturalized account of human intentionality (Short 2007). The bottom-up aspects follow from a commitment to exclude all "homunculi" from the definition of interpretation. (A homunculus is Deacon's term for the hidden assumptions of purposiveness that bedevil many accounts of the emergence of intentionality; see Deacon in press.)

The final Saka thesis (VIII) draws attention to the nature of the relation between the interpretative organism and its semiotic environment, reflected in the concepts of *Umwelt* and semiotic niche (see the section "Biosemiotics" in Hoffmeyer 2010). Ulanowicz's emphasis on the importance of self-reference and the history of the interaction of a system with its environment in the emergence of simple autocatalytic processes is perhaps a reflection of similar principles at prebiotic levels of organization.

In conclusion, we believe that the articles collected in this issue of *Zygon* reflect the possibility that biosemiotics is ready to move from being a plausible general philosophy of nature to offering new, empirically testable hypotheses about fundamental aspects of biological organization and evolution. We (CS and AR) began by setting out our own proposal for a general definition of interpretation and its application to origin-of-life research. Bruce Weber responded by setting this proposal with the wider context of the current state of origin of life research. Hoffmeyer broadened the perspective further with an overview of his vision of the field of biosemiotics. Ulanowicz proposed a complementary bottom-up approach to biosemiotics via process thinking and the concept of process ecology. Finally, the authors of the present article explored some important areas of current debate about the conceptual basis for biosemiotics.

Having thus introduced and, we hope, contributed constructively to the field of biosemiotics, the scene is set for an exploration in the next issue of *Zygon* (September 2010) of the theological ramifications of a semiotic philosophy of nature.

## REFERENCES

Deacon, Terrence W. 2003. "The Hierarchic Logic of Emergence: Untangling the Interdependence of Evolution and Self-Organization." In *Evolution and Learning: The Baldwin Effect Reconsidered*, ed. B. H. Weber and D. J. Depew, 273–308. Cambridge: MIT Press.

———. 2006a. "Emergence: The Hole at the Wheel's Hub." In *The Re-Emergence of Emergence: The Emergentist Hypothesis from Science to Religion*, ed. P. Clayton and P. Davies, 111–50. Oxford: Oxford University Press.

———. 2006b. "Reciprocal Linkage between Self-organizing Processes Is Sufficient for Self-reproduction and Evolvability." *Biological Theory* 1 (2): 1–14.

———. In press. *Mind from Matter: The Emergent Dynamics of Life.* New York: W. W. Norton.

Hoffmeyer, Jesper. 2010. "A Biosemiotic Approach to the Question of Meaning." *Zygon: Journal of Religion and Science* 45:367–90.

Kull, Kalevi, Terrence Deacon, Claus Emmeche, Jesper Hoffmeyer, and Frederik Stjernfeldt. 2009. "Theses on Biosemiotics: The Saka Convention." *Biological Theory* 4 (2): 1–7.

Pattee, Howard H. 1995. "Evolving self-reference: Matter, symbols, and semantic closure." *Communication and Cognition—Artificial Intelligence* 12:9-27.

Robinson, Andrew, and Christopher Southgate. 2010. "A General Definition of Interpretation and Its Application to Origin of Life Research." *Biology and Philosophy* 25:163–82.

Short, T. L. 2007. *Peirce's Theory of Signs*. Cambridge: Cambridge Univ. Press.

Southgate, Christopher, and Andrew Robinson. 2010. "Interpretation and the Origin of Life." *Zygon: Journal of Religion and Science* 45:345–60.
Ulanowicz, Robert E. 2010. "Process Ecology: Stepping Stones to Biosemiosis." *Zygon: Journal of Religion and Science* 45:391–408.
Weber, Bruce H. 2010. "Selection, Interpretation, and the Emergence of Living Systems." *Zygon: Journal of Religion and Science* 45:361–66.