Review article

Life's journey through the semiosphere*

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As its title suggests, Signs of Meaning in the Universe by Jesper Hoffmeyer is a wide-ranging survey of the signs and meanings that are embedded in biological organisms. In its roughly 150 pages, Hoffmeyer covers most of the major aspects of the semiosphere that are given to us from biological evolution, proceeding from primitive sign-distinctions through biological codes, neural organizations, and umwelts to self-representation, language, and ethics. The scope of the book is cosmological, with the universal progression from simple to complex evoking echoes of Bergson's Creative Evolution. In both works the major theme involves the formation of ever more autonomous material organizations that gradually lift matter from inert, time-bound reactivity to ever wider realms of spatio-temporal freedom and epistemic autonomy. Hoffmeyer's presentation is necessarily dense in concepts, with a new concept making its appearance about every other page. The tone of the book is light-hearted, playful, witty, and disarming, and the illustrative examples that have been chosen are generally appropriate and insightful. While the fast pace and wide-ranging nature of the ideas is refreshing, as the reader is cheerfully shuttled from one semiotic arena to the next, it is difficult to stop to critically evaluate them. This review will attempt to critically reflect on the major ideas, and to consider some alternative formulations.

Throughout the book, Hoffmeyer addresses two parallel sets of concerns that involve (in characteristically Danish fashion) questions of existence and questions of biosemiotics. The existential questions involve the meaning of life and the various problems we face in coming to terms with our place in the universe. The biosemiotic questions involve how sign systems work, how they are embedded in natural systems, and how they evolve over time. Ultimately Hoffmeyer wants to provide a bridge between the two: between the functional, semiotic organizations that make up the organism, with its capacity for autonomous action and self-reflection, and the organization of the internal, experiential life of the organism. From this linkage he wants to draw insights into our own existential situations. Thus, at the book's outset, a Danish theologian reassures us that we are not insignificant, and existential questions of nothingness, negation, alienation, signification are rapidly introduced. In the middle of the book, questions of self-reference and consciousness come to the fore, leading up to the origins of ethics in the last chapter. At the book's close, the reader is left to contemplate the elusive connection between two distant piers that represent two seemingly incommensurable worlds. It's a hugely ambitious project, and Hoffmeyer largely succeeds at providing an internally-coherent outline of how experiential and semiotic realms might be brought together. One might not necessarily agree with many of the linkages that he proposes, but one has to like Hoffmeyer's basic attitude and style as he tackles these very difficult problems with an open mind that minimizes pomposity and obfuscation. Even if some of its concepts and examples could stand to be more rigorously worked out, with some of the basic premises re-examined, the book opens up new ways of thinking that succeed in intellectually provoking the reader.

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The semiotic organization of life

Appropriately, Hoffmeyer begins his journey through the semiosphere with the drawing of a primitive distinction. Almost ex nihilo, we form distinctions on continuous realms, and confer upon them meaning. How distinctions, meanings, and purposes are created are the fundamental questions that surround the creation of the observer, and these are the general semiotic questions that Hoffmeyer seeks to answer. Hoffmeyer points out that the drawing of a discrete distinction is a "forgetting" process, a positive choice to ignore differences that are extraneous to the distinction. He contrasts the analog, continuous nature of geological processes with the discreteness of genetic inheritance. The Greeks would have recognized this as the problem of continuum vs. number, the one vs. the many.

The interplay of analog and digital processes in the organization of life has been investigated most deeply by biosemioticians, such as Thomas Sebeock, Jesper Hoffmeyer, and Claus Emmeche, and theoretical biologists such as Howard Pattee and Robert Rosen. When the book was written, the two fields were largely unaware of each other, and as a consequence there is no reference in Hoffmeyer's book to the work in theoretical biology. In the last two years, however, there has been much more communication and interaction between the two fields (Emmeche 1994; van de Vijver et al, eds. in press). Pattee and Rosen mainly came from physics backgrounds and were interested in the organizations of material processes that make coding possible. Their ideas provide the outline for a theory of signs that is connected both to the physical processes that subserve sign function and to the epistemic structure of scientific models (Rosen 1978, 1985, 1991; Pattee 1982, 1985, 1995).

Common to both biosemiotics and theoretical biology is the notion that descriptions of physical mechanism and functional organization complement each other. Every sign-function involves the discrete functional distinction and the underlying analog physical processes ('laws') that subserve the making of the distinction. For example, Pattee (1973) analyzed physical and functional descriptions of a material system that implements a switching operation. These descriptions are complementary modes of describing the same underlying material system: description of physical trajectory does not automatically lead one to description of functional organization, and vice versa. This complementarity of descriptive, explanatory modes has been called the 'symbol-matter' distinction by Pattee (1969, 1979, 1982, 1995) and 'code-duality' by Hoffmeyer and Emmeche (1991). The basic idea is an old one that goes back to the hylomorphism of Aristotle, where Aristotle's 'causes' are taken as independent, complementary ways of explaining why a particular material system behaves as it does (Graham 1987).

There is also a natural alliance between biosemiotics and theoretical biology on one hand, and biological cybernetics on the other. The most direct way of understanding the role of information and coding relations in biological organisms is to examine how such processes are organized in artificial devices, i.e. systems whose workings we fully understand because we built them. Perhaps the clearest statement of the central role that symbols play in living organisms is von Neurmann's high-level schematic for a self-reproducing automaton (von Neumann 1987). This was a high level plan for a physical, 'kinematic' robot that could construct itself, given a supply of simple parts. In this framework, there are symbolic plans (in the cell, genes) and the nonsymbolic apparatus for constructing the physical body according to the plans (transcription, translation and much of the rest of the cell). The plans provide a reliable, symbolic, and discrete organizational anchor to the self-reproducing system, while the nonsymbolic, analog construction process provides the richness of dynamics that can be harnessed for self-complexification and the emergence of additional functionalities (Cariani 1989, in press; Emmeche 1994; Rocha 1995, 1996). Within this framework of plans and constructions are the possibilities of self-interpretation, ('semantic closure'), self-modification, and self-production (Pattee 1985, 1995, Umerez 1995, Kampis 1991, 1995).

Is the Peircian triad adequate for biosemiotics?

The genetic code poses peculiar problems for semiotic theory. In his analysis of the genetic code, Hoffmeyer adopts the Peircian triad of object, sign, and interpretant. In realms where there is no dispute about what is being represented, what the sign-vehicles for the representation are, and what interprets these sign-vehicles, this mode of analysis is indispensible. One wonders, though, whether these categories capture the functional essence of genetic sign-relations. DNA, strictly speaking, is not a 'representation' of anything in particular; while the codon sign-vehicles of nucleotide sequences are 'interpeted' by various transcription and translation enzymes, it is a stretch to discuss the manifold ramifications of gene expression solely in terms of 'interpretation.' The genome is more like a plan that guides or constrains the physical construction of a body, such that the action of these genetic-signs is more of a operation of 'physical construction' rather than one of interpretation or description. For construction, the end product is a material system, the phenome, that consists of physical parts and functional arrangements that have symbolic and nonsymbolic effects on the rest of the world. Interpretation, on the other hand, involves the formation and/or switching of decision-states. Similar kinds of difficulties arise when one discusses natural selection as an interpretational process. Hoffmeyer is clearly aware of these as he self-consciously asks aloud whether it makes sense to talk of lineages of organisms interpreting their niches in order to select those signs, DNA sequences, that will persist into the next generation (p.23).

One needs more than just object, sign, and interpretant to deal with semiotic transactions that involve more than reference-relations, that involve actions that cross organism-environment boundaries, and that involve notions of purpose. Emmeche and Hoffmeyer have previously considered such additional relations (Uexküll et al 1993: 14). Especially helpful in biosemiotic and endosemiotic contexts are the complementary relations of Morrisian semiotics: the syntactic, semantic, and pragmatic aspects of signs. The syntactic encompasses rule-governed, coded relations between signs. For the genetic code, the mapping of DNA nucleotide-triplet codons into the amino acids of protein backbones is a purely syntactic operation. The semantic encompasses the many, and often ill-defined, relations between the DNA sign-vehicles and the nonsymbolic world outside the genetic code. On the action side, the semantics of a given gene encompass the many, far-reaching effects of the proteins that are constructed from it. On the informational side, the external semantics of a given gene encompass those nonsymbolic, environmental, contextual conditions that lead to its expression (e.g. the gene is turned on when temperature falls below a given point). The pragmatic involves the usefulness of a given DNA sequence to the continued functioning, survival, and reproduction of the organism.

Addition of Morrisian relations provides a more universal framework within which the functional organizations of scientific models, adaptive devices, and biological organisms can be described. Syntactics cover the analytic, logically-necessary world of forms and rules, semantics the contingent worlds of perception and action, and pragmatics the world of desires, purposes, and values. It then becomes possible to consider fundamentally different kinds of informational, semiotic operations: 'measurement', 'computation', and 'symbolically-directed action.' One can describe operations in scientific models, biological organisms, and adaptive devices in these terms (Cariani 1989, 1992, in press; Pattee 1982, 1985; Rosen 1985, 1991; Kampis 1991). The description of the operational structure of scientific models parallels Cassirer's (1955) discussion of the Herzian commutation relation and Bohr's pragmatist philosophy of science (Murdoch 1987). One then imagines these kinds of 'modeling relations' to be embedded in organisms, with sensory distinctions being the analogues of scientific 'observables,' such that every scientific model realizes its own Uexküllian umwelt (Munevar 1981). My own work in this area has involved how such modeling relations can be embedded in artificial, robotic devices, and how such devices might adaptively alter their sensors and effectors to create new external semantic linkages (Cariani 1989, 1993, in press). In effect, when new categories of perception and action can be adaptively chosen, the organism or device achieves a higher degree of epistemic autonomy.

Problems with paradoxes

The advantage of focusing on the concrete, physical basis of signs and their manipulation is that it forces one to be explicit about what is going on. One really does not understand a process well until one can actually build a device that realizes it. If a symbol is to have external semantics, then it is necessary somehow to physically couple the behavior or appearance of that sign to events that are outside the sign system (e.g. by using a sensor or an effector). For a proposition to be judged true or false (or otherwise) under its own terms, there must be an unambiguous procedure for determining how those terms are to be interpreted and then how the truth value is evaluated given the interpretations.

In the fourth chapter Hoffmeyer delves into problems of self-reference and subjectivity, beginning with logical paradoxes, such as the liar's paradox ('This sentence is false.'). He could stand to be much more wary of the conventional wisdom that surrounds these issues. When one sees a magic show, one should watch the magician's hands, instead of naively believing what the magician claims is going on. Logicians and mathematicians are like magicians – one must watch what they do with their symbols rather than listening to their claims. This is especially true when infinities (Rotman 1993) or self-references are involved. Underlying every paradox are semantic sleights-of-hand: multiple modes of interpretation that invoke different sets of rules to arrive at different outcomes. Russell and Whitehead were able to eliminate paradoxes from their logic by a theory of types, where the type mandates a particular mode of interpretation. Using properly typed languages, paradoxes *can* always be avoided if desired. Computer languages are examples of this sort – in a program one must always explicitly tell the computer how a given string or proposition is to be interpreted. Instead, Hoffmeyer distorts these issues by giving the impression first, that paradoxes cannot be avoided because of the Gödelian arguments, and second, that even if we could eliminate paradoxes, we would not want to, because to do so would ban the kinds of useful self-referential, conversational statements that include the word 'I' in them. We will deal with these two issues in turn.

It is commonly thought that Gödel's undecidability theorems somehow foreclosed type-based solutions to problems of paradoxes, and Hoffmeyer's treatment reflects this opinion. Gödel argued that if one has a finite set of formal operations on symbol-strings that can be indefinitely long (e.g. arithmetic on the infinite set of natural numbers), then one cannot necessarily prove the consistency (absence of contradiction, paradox) of all of the operation-sequences that can be performed within the system. In the eyes of most mathematicians, Gödel's impotency principles refuted any hope that arithmetic on the natural numbers could be proved to be internally consistent. In doing so they demolished Hilbert's program to secure the foundations of mathematics. Unfortunately, Gödel's work is held in such reverence by so many people (there is a minor industry for the production of pop-science books that interpret its wider meaning) that few serious critiques have been formulated and widely debated. Thus, Hoffmeyer is by no means alone in his invocations. Nevertheless, there are deep criticisms that can and should be made of the theorems, if only because of the huge philosophical edifices that have been built upon them. Strong counterarguments to the theorems, on both pragmatic and semantic grounds, cast doubt on the idea that paradox and inconsistency are unavoidable aspects of formal systems.

We need to be most careful to demarcate which formal sign-systems and which aspects of these systems are affected by Gödel's proof, and which ones are not. The Gödelian arguments only apply to those notational systems that have unbounded string lengths (like those that describe the natural numbers), not those that are finite. In the related terms of the famous Halting Problem, while one cannot say within a finite number of steps whether an *arbitrary* Turing machine (i.e. one that may have a potentially-infinite tape) will halt, one *can* always do this if the machine is restricted to a finite-length tape (Beckman 1980: 186). Analogously, we can prove the consistency of small, finite notational systems (such as computer programs) simply by surveying them, by checking the results for contradictions. This is a brute-force strategy for avoiding paradoxes that works for finite notational systems, but not infinite ones. Since it is physically impossible to build machines that can store indefinitely long symbol-strings, all of the notational systems that we actually do use in real life are of the finite variety. It may be difficult for us to prove the consistency of even a moderately large notational system, with its combinatorically large set of possibilities, but this is a matter of finite-but-big rather than inherently-undecidable. It is only when one conflates finite and infinite systems, as Gödel and Turing did, that Gödel's impotency principles hold for arbitrarily-chosen systems in the whole set. If one chooses to distinguish between finite and infinite, then the impotency principles evaporate for the finite systems, but not for the infinite ones. In these excursions, we need to plant our feet firmly on the ground and remember that in practice all that we ever have, in essence, are finitary notations and operations, i.e. machines with finite tapes.

Apart from these purely finitistic, pragmatic objections to Gödel, there are also semantic objections that involve how various symbols are interpreted within the proof. Wittgenstein in his Remarks on the Foundations of Mathematics criticized many of the standard interpretations for the key operations within the proof (Shanker 1987; Shanker 1988: 216-231). Embedded in the theorems' notations are dual interpretations that permit extremely subtle semantic shifts. Once again it is the introduction of multiple modes of interpretation into the notational system that leads to contradictions, paradoxes, and inappropriate conclusions. Consistency and reliability in our formal systems thus *are* possible if we refuse to introduce ill-defined, unrealizable entities (such as potential infinities), and if we stick to one level of interpretation. All of this comes very naturally to constructivist, verificationist, and semiotic approaches to mathematics that 'follow the symbols' themselves rather than being misled by what they are claimed to mean.

If absence of paradox is possible, is it desirable? This, of course, depends on the purpose of our sign-system. If we want to communicate without logical paradox or ambiguity, we can do so if we try hard enough. Even self-referential statements can be made clear if we communicate the level on which such statements are to be interpreted (i.e. exactly, to what aspect of 'self' we are referring). Thus, none of these problems in the foundations of mathematics requires us to banish self-referential ambiguities from our own natural-language-use. And, as Hoffmeyer cheerfully notes, while there are some times when explicitness and clarity are demanded, there are many others when humor, ambiguity, and open-endedness of interpretation are more desirable. We revel in the multiplicity of interpretations that are always available to us for capturing manifold aspects of our world, and this is one of the things that makes us so very different from uninterpreted formal systems and present-day computers.

Self-reference vs. self-production

From logical paradoxes Hoffmeyer moves on to biological and psychological self-reference, but the relationship between self-reference in formal systems and self-reference in organisms is far from clear. There are several possible metaphors for self-reference that depend upon different conceptions of the self, of reference, and the degree to which these are embodied in material processes (cf. Kampis 1995, Rocha 1995, Exteberria in press, Uexküll et al 1993). Among these are the metaphors of the mirror, the symbolic description, and the production cycle.

In the mirror metaphor, an iconic image of the system itself is constructed within the system, and this constitutes a self-description that itself can be analyzed by other parts of the system. In symbolic self-description, the representation is symbolic rather than iconic, with the relational structure of the symbols reductively reflecting relations of processes that are present in the system as a whole. The symbolic representation process can be iterated, to produce additional levels of meta-representations that capture increasingly more abstract relational properties that are thought to constitute a 'self.' This is not far from the notions of self, self-description, and self-reference that prevail in many areas of artificial intelligence, cognitive science and philosophy. Hoffmeyer hopes to base (self-) consciousness in humans on this kind of cognitive self-description.

On the other hand, there is the notion of self-production, in which there are circular, causal loops by which the various processes of a system mutually reinforce each other. A reaction cycle is 'self-referential' if we think of 'reference' more in terms of causal linkages: each member of the cycle is causally linked to all others. Obviously, production relations between the members of reaction cycles are very different from the descriptive, interpretive relations of sentences that refer to themselves. For the reaction cycle, there is a mutual, circular production linkage between the reactants in the cycle, but no coded 'representation' of the reactants. There is thus an alternative, view of self-reference that is based on self-regenerating, self-stabilizing set of material processes rather than series of nested, coded symbolic representations on yet other representations. There is a fairly substantial literature on 'autopoiesis', or self-production systems, that grapples with many of these problems of self-description, self-production, and material embodiment (Maturana 1981; Mingers 1995; Varela 1979). Some rapprochement between the two approaches might be possible if we conceive of mental representations as themselves being self-regenerating and stabilizing sets of neural signal productions (von Foerster 1984, Rocha 1996). Rather than self-reference being seen as a purely symbolic process by which the mind mirrors and re-presents its own form, the self becomes seen as an internally-determined, self-sustaining reverberation pattern in which the materially-embodied representational forms themselves interact. We reach the intersection of the problem of neural coding and the problem of globally integrating neural information processing into a coherent whole (Cariani 1997).

However one thinks about self-reference, the linkages between self-reference, conscious awareness, and self-consciousness are tenuous at best. Hoffmeyer is not very clear on these issues; sometimes he invokes 'swarm intelligence' as a substrate for conscious awareness (pp. 113-128), while at other times more explicit self-description is brought in. A coherent alternative to these accounts is possible. One very general hypothesis holds that conscious awareness is only present when there are coherent, regenerative neural signaling patterns that permit incoming sensory information and ongoing internal thought processes to be integrated together over time. In this view, general anesthetic agents abolish conscious awareness by changing neural membrane properties in such a way so as to undermine the global coherence of the system. Conscious awareness would thus have an organizational basis that is rooted in self-production (global coherence) rather than self-description (the representational activities of some particular population of 'self-consciousness neurons'). The Aristotelian soul, the psyche, is the functional organization of the material system that is the brain, with conscious awareness being one aspect of that organization (Modrak 1987). The structure of our experiences mirrors aspects of the neural organization that subserves it. While much of what Hoffmeyer says is consistent with this alternative perspective, notions of consciousness as 'the body's governer within the brain' (p. 113) or consciousness as 'the body's interpretation of its umwelt' (p. 121) may mislead the reader into thinking of consciousness as an agency separate from the neural substrate (and hence into the kinds of dualisms and disembodiments that Hoffmeyer explicitly disavows).

How qualitatively different is one umwelt from another?

Notions of self have implications for how we view the inner, experiential life of animals. Uexküll's (1926) concept of the umwelt or life-world of animals is a very powerful tool for understanding how there can be very different perspectives on the same meadow. Hoffmeyer's incorporation of Uexküll's umwelts into the biosemiotics of perception and action is a most welcome inclusion. The existence of different umwelts, however, does not imply that these life-worlds have nothing in common. In his discussions, Hoffmeyer follows the contemporary tendency to think of sensory systems as being highly specialized for particular ecological niches, and hence to interpret Uexküll's umwelts as mostly incommensurable perspectives. However, despite the spectacular adaptations that are sometimes observed (e.g. the sonar of the bat), these particular sensory enhancements are invariably built out of ancient body-designs that have been conserved over huge phylogenetic spans. The same evolutionary conservatism may hold for the neural coding strategies that are used in representing and processing sensory information. While the particular experiential textures of things, their qualia, undoubtedly vary across different vertebrates, the basic body-plans, sensory organs and neural representations are roughly similar. We may see in different colors, hear in different frequency registers, and smell different odors, but the basic relational organizations of our percept-spaces in the end may not be so radically different. Birdcalls are almost certainly interpreted by other birds in a manner that is very different from how we interpret them, but there is enough commonality to what we hear to enable us to imitate birdcalls well enough to fool the birds themselves. The same goes for birds listening to and imitating human speech. Such cross-species invariants are not possible without general-purpose sensory and effector mechanisms for both analyzing and producing wide ranges of sounds. It is thus possible for more generalist evolutionary solutions to prevail, especially in the realm of the senses, where appearances change rapidly. For predator and prey alike, one needs general purpose sensory systems that reliably recognize other animals under widely varying conditions.

Even considering our respective evolution-given biological desires, there is great commonality of the kinds of things that produce pleasure and pain. We are all biological adaptive systems with similar basic life-imperatives: breathing, eating, drinking, sleeping, mating. Thus the life-worlds of all animals are partially commensurate by virtue of their common evolution and body design, with a great deal of overlap between them. There is a intersubjective realm within which some limited communication, coordination, and mutual understanding is possible.

To the extent that we conceptualize the self in terms of a lately-evolved capacity for self-description, and we see conscious awareness in these terms, then it becomes difficult to appreciate commonalities between the inner lives of animals and our own; we tend to see (self) consciousness as an evolutionary accident, an epiphenomenon (p. 128). If instead, we think of self in terms of self-production, the linkages and commonalities, together with some degree of inevitability, follow naturally. Differences between our inner lives and those of animals would then involve differences more in the degree of internal complexity and autonomy rather than in some qualitative emergence of completely new processes of self-description.

The evolution of language

We could make similar kinds of arguments for the neural substrates of language. Like most cognitive scientists and linguists, Hoffmeyer believes that language is a very recently evolved and specialized cognitive faculty whose operation is qualitatively different from anything found in animal cognition. The degree to which human language draws on uniquely-human cognitive operations is a difficult issue to resolve, given that we presently understand so little of the operational structure and semantic content of animal communications (particularly for cetaceans).

An alternative and perhaps less parochial view of the evolution of language sees the emergence of language processing abilities as one of many consequences of the extension of general information processing capabilities that were already present in the neocortex. Walker (1983) provides a comprehensive, coherent account of many of these issues that moves in this direction. Evolutionary increases of cortical surface area permitted longer computational loops and deeper nestings of loops that in turn increased the complexity of time sequences that could be neurally represented, analyzed, and produced. This in turn permitted the production and perception of ever longer and more highly structured sequences of phonetic and linguistic elements. It may be evolutionarily easier to increase the surface areas of cortical structures that already exist in this fashion than to evolve qualitatively new kinds of neural circuitry and neural computations.

Such a generalist evolutionary account explains why we are able to perceive and produce complex musical sequences (whose syntactic structure can rival that of spoken language), despite the lack of obvious direct, adaptive advantages. This argument for across-the-board increases in computational power also applies to a host of very complex motor performances of which we are capable (e.g. dance, athletics, musical performance, typing). We may know of no chimpanzee who uses the full power of English syntax, but likewise, we know of no chimpanzee who plays the piano. As in theories of language evolution that assume specialized processing modules, in the generalist computational account there is a coevolution of complex social organization, toolmaking and tool-use, speech production and perception, and language. No doubt that some specific evolutionary adaptations of speech articulators were necessary for rapid and efficient speech communication. On the speech perception side, however, it is certainly plausible that nascent spoken languages simply took advantage of those auditory distinctions that were already salient to the generic mammalian auditory system. This is exactly what we have done when new artificial languages have been developed historically. Incipient sign-languages selected those gestural distinctions that are both relatively easy to produce and to perceive using pre-existing motor and perceptual skills. The effects of such quantitative extensions in cortical processing power coupled with social and technological evolution can lead to the huge, qualitative differences that we see between our own collective communicative and behavioral capabilities and those of other animals.

The evolution of ethics

In the last chapter, Hoffmeyer discusses possible semiotic origins of loneliness and alienation, locating them in the primeval division between discrete genes and analog cell metabolisms. This is then the beginning of a rudimentary mind-body split. I myself find it difficult to make this (cartesian) separation in the first place, let alone invest it with the origins of existential angst. More cogently, he argues that empathy and ethics arise out of a self-consciousness that permits us to build models of others' experiences, and to put ourselves in their places. Our descriptions of the internal lives of others is compared with our description of our own internal life. As our ability to model the world expands, we are increasingly able to understand the thoughts and feelings of others.

This cognitive, descriptive account, by itself, however, does not explain the motivational, emotional aspects of social situations: why we become sad when others mourn, or happy when others rejoice. One possible answer is that with the evolution of denser, more complex social groupings, we depend much more directly on our brethren than do most other animals. We are embedded in a social metabolism of reward and punishment whose circular causal loops extend outwards from each of ourselves through our immediate social group and back to us. To a very great degree, our survival depends upon the survival of our group, so it is not surprising that pleasure and pain should be signalled and felt amongst the group, in a manner that is not altogether dissimilar to what happens in our bodies. In addition to the cognitive, representational dimension here, one needs the dimension of the pragmatic, the motivational, the limbic. Empathy is more than a purely intellectual, mutualized self-reference.

As greater cognitive capacities for planning, foresight, and the retrospective evaluation of consequences evolve, there must be parallel evolution of the motivational systems that evaluate these increasingly complex deliberations. As the scope of our planning increases, and we begin to form more general rules for effective action, we integrate the effects of our actions on others and their subsequent behavior towards us. Over time we form heuristics for action and general rules for conduct that are refined by pleasurable and painful experiences, both present and remembered. We adjust our planning to optimize our expected happiness, and generally develop self-norms of conduct that protect ourselves and those closest to us. The social conditions under which this evolution of cooperation is most favored are those that facilitate continuing face-to-face interactions (Taylor 1976; Axelrod 1984), and perhaps these are the social conditions that best promote the formation of ethical precepts as well. As our social circles widen, the application of these precepts become broadened to span larger and larger social distances. Seen in this way, the evolution of ethics becomes much more similar to the convergence of shared information and purpose that one sees in the evolution of multicellularity, of animal communciation, and of animal societies. Explanations for the origins of ethics thus need not absolutely depend upon the emergence of highly developed, reflective self-conscious awarenesses. Wherever there is a high degree of social interconnection, there lies a propensity for evolutionarily-given and/or experientially-acquired empathies and ethics.

Clearly we are far from exhausting the mysteries and latent possibilities of the semiosphere. It will easily take several lifetimes for us to explore the semiotic worlds that Hoffmeyer has shown us in his insightful and challenging book. Beyond this, who is to say what new realms of meaning await us?

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