[141]

Semiotization of Matter: A Hybrid Zone between Biosemiotics and Material Ecocriticism

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A basic claim of the newly developing field of material ecocriticism appears to be that matter has agency and embodied meanings and that it is possible to decipher this matter in the framework of textual criticism. As Serenella Iovino has put it in her *ISLE* introductory essay on material ecocriticism, "The 'material turn' is the search for new conceptual models apt to theorize the connections between matter and agency on the one side, and the intertwining of bodies, natures, and meanings on the other side" ("Stories" 450). Material ecocriticism, she continues, "comes from the idea that it is possible to merge our interpretive practice into . . . material expressions" (451). Such an approach raises broad philosophical questions, such as the following: In which ways is the agency of matter expressed? How do we interact with material processes? What are the relations between meanings embodied in matter and our representational practices?

Quite similar issues have been addressed within biosemiotics, a discipline that studies semiotic and communicational processes in and between organisms. After all, all biological organisms live in a certain physical location and under certain physical conditions of the environment, which they need to perceive, respond to, and adapt for. Biosemiotics describes such relations as being based on signs and sign exchange by employing concepts such as *codes* and *coding, Umwelt* (the species-specific attachment to the environment, organized by meanings; see J. Uexküll, "The Theory"), and *semiotic niche* (Hoffmeyer, *Biosemiotics* 183), among others.[1] At the same time, there is a crucial difference between material ecocriticism and biosemiotics; whereas the former has taken a critical approach to human social and cultural processes, the latter has not. The common ground between material ecocriticism and biosemiotics, rather, appears to be foremost in their attentiveness to the connections between the physical realm and meaning processes. With this understanding, I wish to consider a biosemiotic view on what can be called the "semiotization" of matter, namely, how human actions change the semiotic properties and signification of matter. I believe this is a preliminary

[142]

step that will increase the potentially fruitful interchanges between biosemiotics and material ecocriticism. This essay includes three subsequent arguments in three sections: a demonstration that matter has the potential to initiate meanings and participate in semiotic processes, a demonstration of different ways that humans and nonhuman animals can make sense of material

1

objects and environments through the process of modeling, and a conclusion that by applying such models back to the material environment, humans semiotize matter by altering it based on human perceptions and understandings.

A challenge for biosemiotics has been to rethink the dualistic distinction between semiotically active humans and a semiotically inactive nature, as overcoming this distinction appears to be a prerequisite for treating nonhuman biological organisms as having semiotic and communicative capacities. In doing this, biosemiotics has relied heavily on the works of Charles S. Peirce, who developed a philosophy and understanding of semiotics based on the principle of continuity as an alternative to both idealism and realism.[2] Although there is a diversity of views present within semiotics, the Peircean interpretation that I am presenting in the first section of this essay shows that material structures are capable of influencing representations and other semiotic processes; this approach could be fruitfully used to consolidate the theoretical framework of material ecocriticism. Adopting a nondualistic philosophy is a precondition of analyzing relations and effects between matter and human-semiotic activities (including the semiotization of matter). Such analysis is carried out in the final sections of this essay.

The second major argument focuses on the concept of modeling, which can be used to describe processes by which living organisms make sense of and relate to the environment. The theory of modeling developed by American semiotician Thomas A. Sebeok, Russian Estonian cultural semiotician Jury Lotman, and other theorists appears to be a useful tool with which to postulate a methodological distinction between "matter" and "model," as well as to demonstrate the relations between them--in other words, between structures and properties of matter, on the one hand, and our interpretations, depictions, and representations, on the other. Distinguishing types and layers of modeling makes it possible to address the issue of the anthropomorphization of the nonhuman semiotic sphere by human culture and science, a topic that has been a serious concern for biosemiotics. It also allows for further distinctions to be made between the way humans and nonhuman animals use their models to change the material environment.

In the third section of this chapter, I will focus on the semiotization of matter by asking what happens if we constantly create models of the material world and subsequently base our actions on these models and interpretations; that is, what if we transform matter according to our human perceptions and understandings? With the help of Jakob von Uexküll's concept of the "functional cycle" (a schema demonstrating the cyclical relations of the subject and the environmen-

[143]

tal object), it is possible to show that an organism's activities of perception and action lead to the semiotization of matter and the growing imprinting of semiotic patterns into matter. We see that because of such feedback loops in the contemporary human-influenced environments, the borders between the material and the semiotic realm become blurred. This could raise practical environmental problems, as matter semiotized by humans contributes to the degradation of the habitats of many endangered species, which are not able to perceive and interpret human-altered environments adequately.

Semiotic Potential of Matter

In order to make material structures and processes the object of a study, it is first necessary to

demonstrate how matter relates to human textual discourses and semiotic practices. This relationship is not self-evident and needs special attention, as there are a number of scholarly traditions, from Berkeleyan idealism to French postmodernism, that diminish the role of material processes for human discourses. Opposite views are presented, for instance, in the philosophy and semiotics of Charles S. Peirce. I am proposing a particular interpretation of Peirce's theory about the relation of matter and signs that reinforces the argument that matter influences meanings and interpretations to a great extent. According to this view, not only human-made artifacts but all natural objects have the potential to direct semiotic processes.

For a theoretical explanation of this assumption, we should turn to the basic concept of semiotics--the sign--and consider the way Peirce understood it. A sign, according to Peirce, is a "triple connection of sign [*representamen*], thing signified [*object*], cognition produced in the mind [*interpretant*]" (*Collected Papers* 1:372).[3] Our interest in this definition lies predominantly in Peirce's conception of the object, which according to him can be further divided into two aspects: the "immediate object," which is the object as it is revealed within the sign itself, and the "dynamical object," which is the object that exists outside the sign. The dynamical object we know by "collateral," that is, through indirect knowledge (Peirce, *Collected Papers* 8:314). For instance, "In the example of animal tracks, the immediate object would be the knowledge of an elk as it appears to us by looking at the tracks, and the dynamic[al] object would be the elk as it is, or the elk as the sum of all other experiences of it" (Maran, "An Ecosemiotic" 83).[4] The crucially important point in Peirce's approach to the object is that it allows us to treat material objects and perceptions of them as being connected to each other.

An important property of the object is its ability to trigger or determine the sign. As Peirce notes, a "sign [is] anything which is so determined by something else, called its Object" (*Semiotic* 80–81).[5] As this definition highlights it, there is a causal aspect of the sign process in any given semiotic universe, or *Umwelt*. The sensation of burning, the temperature indicated on a thermometer, and traffic

[144]

lights, among other signs, force us to make certain types of interpretations, and overcoming the limits of these interpretations, although possible, requires additional interpretive effort. Without this causal aspect, we could hardly talk about "semiotic causation," described by Jesper Hoffmeyer as the "causation of bringing about effects through interpretation . . . , as when, for example, bacterial movements are caused through a process of interpretation based on the historically defined needs of a sensitive system" ("Semiotic" 154). This causal aspect is especially important if we consider the sign's object (*sensu* Peirce) to be an environmental or physical object. There are features of the environment (for example, the physical terrain, gravity, water and weather conditions, open and sheltered areas) that trigger signs and indeed influence interpretations and subsequent behaviors. For instance, the sight of pebbles of a particular size can initiate pecking behavior among waterfowl, as the pebbles are interpreted as being suitable to be swallowed as gastroliths (small stones that help waterfowl to break up the food in their stomachs).

Peirce describes the types of relationships between what is perceived (the sign or *representamen*) and what is referred to (the object) to distinguish between three types of signs: icons, indices, and symbols. This typology is relevant for our discourse in that it positions the symbolic signs used by humans correctly among the other sign types and shows the relation

3

between each sign type and reality. In icons, this relation is present solely because of similarity (for example, the color red signifying blood). In indices, the relation exists because of a physical relation or causation (for example, a higher value in the thermometer signifies a warmer temperature). In symbols, finally, the sign (or *representamen*) is related to its objects because of habit or convention (for example, a national anthem signifies a particular country). Peirce's typology brings out an important theoretical point in regard to the question of whether there are meanings in matter: it demonstrates that the existence and specific features of icons and indices are dependent on the specifics of their objects. Structures and properties of matter direct and constrain our interpretations of them, in cases where we rely on indices or icons for our interpretation, due to the causal relationship between sign and object--based either on qualitative similarity (in icons) or on physical relation (in indices).[6] However, the symbol, the most developed type of sign, can preserve its integrity outside of any particular relation and can thus form the content of a cognition or culture without any reference to what is "out there."

Based on the distinction originally made by Augustine (II: 2, 3), icons and indices could be described as natural signs, which are opposed to conventional signs. A classic example of a natural sign (an index) is smoke as an indication of fire. In this example, the development of the sign is easy to track: from the causal link between fire and smoke to the limited scope of possible interpretations of the smoke as standing for fire. One peculiar feature of natural signs is their rela-

[145]

tive independence from the interpreter. Smoke stands for fire for humans and for numerous other species of mammals, birds, and insects, including bees--this is what makes peat smoke a valuable aid in beekeeping. When handling bees, the beekeeper uses a smoker to puff smoke into the beehive. The smoke is interpreted by the bees as a sign of an approaching forest fire. This sign process prevents the alarm behavior of the colony and keeps the bees busy consuming honey as a precaution for the possible abandonment of the hive.

Peirce's typology of signs demonstrates the important role of environmental properties and material structures for semiotic activities. This understanding may have important outcomes for ecosemiotics (a discipline within biosemiotics that explores the semiotics of environmental relations), as it highlights the interdependence of human cultural processes and the richness and diversity of the environments in which these processes take place (see Maran, "Locality"). A nondualistic view of human culture and nonhuman nature draws attention to the particular properties of an environmental or material substrata, as well as the necessity of having appropriate conceptual tools for describing them. One useful concept in this respect is that of "affordance," as proposed by American perceptual psychologist James J. Gibson. Gibson defines affordances as follows: "The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes,* either for good or ill" (127). He specifies:

> The composition and layout of surfaces *constitute* what they afford. . . . [T]o perceive them is to perceive what they afford. This is a radical hypothesis, for it implies that the "values" and "meanings" of things in the environment can be directly perceived. Moreover, it would explain the sense in which values and meanings are external to the perceiver. (127)

4

Most examples provided by Gibson are related to the physical activities of animals: a surface that affords support, terrain features such as slopes and steps that guide movement, and so on. We can also define affordances in a more specifically semiotic sense as those environmental elements that have a tendency to act as objects of signs. Such elements could be physical areas, such as hybrid zones between biological communities, animal trails in the landscape, water currents, but also temporal events, such as seasonal rains, forest fires, and the melting of the snow. Such elements and events "stand out" from the rest of the environment; they have peculiar or important structural relations with other elements of the environment that allow them to function as "anchor points" for semiotic processes.

Charles S. Peirce's continuity-based philosophy and semiotics give strong support to the view that material objects may initiate meaning. This is not the same as saying that there is a sign process taking place in matter regardless of any reference to living organisms. Rather, the result is that we cannot talk about meaning content without considering the organism in its environmental con-

[146]

text. If material structures are often a precondition of sign processes, then these material structures and sign processes should be studied within the same framework. A common interest between biosemiotics and material ecocriticism could be identifying environmental objects with semiotic potential for living organisms and studying how these objects function in multispecies environments, as well as how they trigger semiotic processes and narrative sequences in human culture. For instance, signs of drought could initiate changes in the behavior of humans and nonhuman animals alike, as well as influence human culture by motivating the creation of mythical narratives, art, and literature; this is especially evident in arid environments (see Pálsson).

Models We Make, Models We Use

Although all living beings are capable of participating in semiotic processes and using signs, there is something uniquely specific to human's semiotic competence as compared to that of other living organisms. Humans are capable of writing and reading poetry, calculating predictions on population growth, and compiling algorithms that allow us to assemble technical equipment. No other animal species displays these kinds of abilities, although they are capable of other marvelous things. Some semioticians have proposed that the Peircean distinction between icons, indices, and symbols could also explain the difference in semiotic competences among different life forms.[7] I would rather leave Peirce's typology of signs aside, to denote the basic building blocks of the semiotic universe, and argue that the difference between humans and other animals lies in the process of modeling.[8] Such an approach would allow us to distinguish and map the semiotic competence of organisms based on the hierarchical complexity of modeling processes and to show later how the process of making sense of the material environment leads to its semiotization. One specific feature of models is that they are created in relation to the object and that they keep their analogy-based linkage and thus can later be applied back to the object.

Modeling in this context has a relatively wide meaning, as a process of making sense of

some process or phenomena, with the help of (internal or external) representations that are at least partly based on analogies (Lotman, "Tezisy" 130). Thomas A. Sebeok and Marcel Danesi define modeling as the use of forms for comprehending and processing perceived information in a species-specific way (5–6). Ladislav Tondl adds that a "model is able to substitute for the original . . . [and] permits some important functions of decision-making or evaluations concerning the original" (85). Models can include analogy-based representations of different complexities: from prototype-based categorical perception and conditioned associations in nonhuman animals to the anthropomorphic descriptions and mathematical models of human discourses. For instance, we can consider a

[147]

migratory bird's mental map, which incorporates inherent and experiential knowledge, the image of certain landmarks, and the position of the sun and the constellations, among other sources of environmental information; this mental map can be thought of as a model of its migratory route. The representations that are created in the course of modeling can remain internal (in the case of mental associations) or can be externalized (writing, artistic works, and other forms of human modeling). Models and modeling are thus broad concepts that allow us to treat human and nonhuman semiotic activities within the same theoretical framework and, in the context of the present arguments, to demonstrate that there are different types of analogy-based interpretations of the material world.

Humans are capable of several layers and types of modeling. According to Thomas A. Sebeok, humans share with other animals the activity of "zoosemiotic modeling," a kind of modeling where signs are distinguished by the organism's species-specific sensory apparatus and are aligned with their behavioral resources and motor events ("In What" 54). This broad description of zoosemiotic modeling is based on Jakob von Uexküll's *Umwelt* concept (understood as a species-specific attachment to an environment that is organized by meanings). The basic associations in animals' *Umwelten* (for example, between signs in the terrain and movement or between signs of food and consumption) can be considered the universal grounds for modeling in animals. We can also think of the processes of recognition and mapping that take place in our immune system and of other centers of biosemiotic competence in our body such as the peripheral nervous system or the endocrine system as forms of unconscious modeling activity. Verbal modeling is a unique capacity of the human species, and it may lead to higher, poetic, artistic, ideological, or religious forms of modeling, denoted as "secondary modeling systems" by the Tartu-Moscow semiotic school (Lotman, "Tezisy" 131). Structural characteristics of the model-object relationship allow for further distinctions between "technical modeling," which relies on strict algorithmic relations,[9] and "artistic modeling," which uses a number of codes to create a poetically organized and complex image.[10]

An important feature of modeling is that a model represents an object not in all aspects but in a certain respect, and the specifics of this relation itself have semiotic significance and meaning. "The model represents a homomorphic representation, i.e. not identical to the original. It means the representation in the sense of the Latin 'pars pro toto,' the part instead of the whole" (Tondl 83). It is in this relation between the original and the model where the specifics of the species, the *Umwelt,* the language, the cultural tradition, the discipline, and so on of the interpreter, become involved and make the difference. In this point the causality of natural signs can be overcome, as the subject can model the sign processes from a certain aspect, based on the specifics of its *Umwelt,* culture, and personal motivation.

[148]

In humans, the ground that has been used to establish the relationship between object and model can also be used to distinguish a number of metaphoric ascriptions--or so-called morphisms. Czech historian of science and philosopher Stanislav Komárek has proposed a typology of such morphisms, including biomorphism, technomorphism, and sociomorphism (108ff). In biomorphism, the bases of meaning transmission are general characteristics of living beings; in technomorphism, the world or any entity of it is described by emphasizing its machinelike properties; in sociomorphism, human society, culture, and economics are taken as a measure with which to describe the rest of nature. Among such analogy-based modeling strategies, anthropomorphism is the most studied and criticized.[11] By using different morphisms, humans are able to model matter as alive, humans as machines, machines as pets, nonhuman animals as humans, and so on.

Different morphisms allow us to comprehend things that are rather unknown to us, based on their analogies to things that are more common. We can, for instance, use humans or other living organisms as bases for metaphoric ascription to make better sense of material processes, or to give to these processes a human or at least an animate dimension. It is quite clear that matter itself does not model. Matter might have history, it might save traces and even produce copies of objects--as mud reproduces the image of the foot, for example--but it does not model in the sense of using forms to produce a representation of specific aspects of the object. Therefore, if we are talking about inanimate matter as having semiotic capacities or competences, we are executing biomorphism or anthropomorphism. In other words, we are describing material nature by making analogies with living organisms or humans. This process is, in fact, a widely occurring cognitive strategy that can be exemplified by the expression "sleeping volcano," used to describe volcanic mountains that have been inactive in their recent history, or "the calm that precedes the storm," used to refer to the kind of dense silence that anticipates a rapid change in the weather. Indeed, we can interpret meteorological signs almost as an expression of intentionality, as a silence standing for the unwillingness of the emitter to participate in the communication, therefore implying a secrecy, a concealed plan or revenge of the natural force. Herman Melville's words in *Moby-Dick* exemplify this human tendency: "As the profound calm which only apparently precedes and prophesies of the storm, is perhaps more awful than the storm itself; for, indeed, the calm is but the wrapper and envelope of the storm; and contains it in itself, as the seemingly harmless rifle holds the fatal powder, and the ball, and the explosion" (254).

Modeling is also a powerful tool in scientific research, as it allows for the making of generalizations and predictions. We should, however, be aware of the grounds of our models and of the fact that this ground is never neutral (as it is selected consciously or unconsciously by us). For instance, if we depict material

[149]

processes based on a narrative logic, then our depiction belongs to the sphere of anthropomorphic modeling. Narrative assumes the involvement of language, since the description of a sequence of events requires syntactic elements.[12] Such a modeling approach could be beneficial, as it accumulates and highlights the causality of the process (for instance, human involvement in environmental degradation) and may introduce empathy in humans for understanding and appreciating environmental processes. At the same time, it should be recognized that narrative description is a part of symbolic interpretation and therefore alien to the

material world. As we will observe in the next section, such interpretations, if incorporated into policies and applied back to the environment, may bring along a semiotization of the environment itself. Attentiveness to modeling in culture and in science and the importance of distinguishing this activity from the agency of matter and its semiotic potential appear to be critical issues for the researchers both of biosemiotics and of material ecocriticism.

Matter Becomes Semiotized

Though conceptually and typologically indispensable, the distinction between matter (which may afford natural signs, *sensu* Gibson) and the semiotic realm (which may have an effect on matter) has become increasingly blurred and unstable within contemporary, human-influenced environments. To gain a clearer picture of this, what is needed is a tool with which to describe the dynamic relationship between the material structures of the world and the subjects that are capable of modeling and executing models. To describe these relationships between a semiotic subject and a given environmental object, Jakob von Uexküll has provided a basic schema called the "functional cycle" (*Funktionskreis*). In simple terms, the functional cycle represents the relationship between a subject and an object by considering the processes of perception and action (or effect). Uexküll's schema distinguishes perceptual signs and organs from effectual signs and organs and also the subject's inner world (*Innenwelt*) from the objective environmental structure. Together, the activities of perception and action form a closed feedback cycle ("The Theory" 31–33). Ecosemiotic elaborations of this model demonstrate that all organisms perceive and alter their environment based on their modeling and interpretations.[13] Accordingly, it is in principle possible to distinguish between different types of environmental change, based on the different types of modeling and interpretations that a certain species is capable of making--from the simple recognition of a resource to the complex structuring of human culture (for example, planning and designing gardens and parks).

All living organisms alter their environment, but in some cases the environment is changed in a way that would intentionally make it more suitable for a par

[150]

ticular organism. This process is called "niche construction," and it is common in beavers, social insects, ground-living rodents, and humans, among others.[14] Niche construction may result in a situation that is called "extended organism." In this case, the energy and matter moving among the ecological cycles that the animal belongs to do not accumulate in the animal's body (Turner). Rather, the surrounding environmental structures are manipulated in order to store energy and matter in a way that is profitable for the animal (the digging of burrows, the storing of seeds, and so on). The basic claim of my discourse in this chapter is that processes of environmental alteration, such as *niche construction,* are based on modeling and that these processes result in the semiotization of matter through the animal's execution of mental or externalized models.[15] In this sense, *niche construction* is simultaneously a meaning creation. By manipulating the environment for its aims, an organism transfers its modeling activities back to the environment; it changes the environment in a way that makes more sense to it and corresponds to the semiotic resources (sign systems) used by the organism. When we look at the products of such modeling activities, we recognize how matter has become semiotized: for instance, a pile of willow twigs, all with the same thickness and length, gathered by a European beaver. In this case, the length of the beaver's body and the reach of its front legs become a model that the animal uses to measure

and modify its environment, and the pile of identically sized sticks is the semiotized, material result of its activities. The pile retains the semiotic imprint left by the beaver, even when the beaver is gone and the pile is happened upon by another organism.

Humans' ability to reorganize the environment on a large scale based on modeling and interpretation is well known. In the previous section of this chapter we distinguished between different types of modeling. Among humans, accordingly, we can talk about the practical results of applying functional and technical models to the environment (for example, roads and transportation networks) or the products of applying artistic models, where inner rhythms, proportions, and shapes are decisive features. The material products of modeling can also far outlive the cultures that created them. The Nazca Lines in southern Peru, for instance, stand today as a symbol of a largely unknown culture. Some examples of matter semiotized by contemporary humans include modified genetic material that has escaped into nature, sunken ships at the bottoms of oceans, and the geometrical lines of the gigantic wind turbines that are spread over our landscape; many of these have a good chance of outliving our civilization.

A good example of the specifics of human modeling and its effects on the environment is mapping and map usage. A map represents an actual landscape approximately. Smooth transitions are represented by straight lines; a diversity of biological communities is reduced to a few symbols. Some affordances (*sensu* Gibson) of the landscape are represented, others ignored (most often those that

[151]

have meanings to species or social groups other than those that the mapmaker belongs to). Later, when the map is used by humans as a guide for practical activities within the landscape, the map users tend to imprint the distinctions and forms used in the mapping onto the real landscape. The map-based modeling cycle is at work in various human activities, from forestry and real estate development to military strategizing and action.

In addition to the modeling that is conscious and intentional in regard to its products, there is a kind of unconscious modeling that takes place at various levels of biological organization. The complexity of human culture and society entails various cycles of remodeling and reuse, during which conscious modeling can initially result in products that alter the environment without any conscious awareness or intention. For instance, when considering the life cycle of human-made buildings, initial planning and construction are intentional activities, as are later reconstructions and renovations. The use of abandoned buildings by animals and destitute people as well as the decomposition and breakdown of the buildings, however, are mostly unintended results. In the analysis of the semiotization of matter, it is thus possible to distinguish between conscious and unconscious modeling as well as the intentional and unintentional uses of models. These differentiations may be useful for rationalizing the model-specificity and reach of environmental alterations. For instance, one could compare the use of pesticide in a farm field, which is an intentional, local, and regulated activity, with the accumulation of pharmaceuticals and other biochemical substances in sewage systems and water ecosystems, which are much more unconscious and undirected phenomena. In both cases, the modeling activity that makes use of the correspondence between biological (plants, human bodies) and chemical agencies is traceable, but in the second case the causal connections and specific effects of human activities are much more difficult to describe or regulate.

In regard to the semiotization of matter, the main issue from a biosemiotic viewpoint is

9

that because the modeling is not neutral, neither is the semiotized matter. Through its shape, structure, patterns, and other properties, semiotized matter embodies the imprint of the organism or culture that has created it. Its inner semiotic potential remains, waiting to be launched into new semiotic and communicative relations. It can be assumed that the semiotized matter is not fully accessible or decodable without the human codes used in its creation, but nevertheless the semiotized matter has its own semiotic potential, which can creatively or distractively interact with new semiotic processes or debar them. Jury Lotman and Aleksander Pjatigorskij noticed this, describing how "fragments of phrases and texts brought from another culture, inscriptions left by a population that has already disappeared from a region, ruins of buildings of unknown purpose, or statements introduced from another closed social group" (129) can become sources of new textual meanings in a culture. The ability of semiotized matter to be in-

[152]

cluded in new semiotic relations is definitely not restricted to the human species. Bowerbirds (Ptilonorhynchidae), who in their natural habitat decorate their courtship grounds with colorful blossoms, stones, nuts, and other debris, often make use of human-made artifacts, such as bottle caps, drinking straws, or small and colorful pieces of plastic waste. Using transformed matter can also bring along deadly results, such as waterfowl pecking leaden shots instead of pebbles or seabirds ingesting the plastic litter that floats on the ocean's surface. These, too, are semiotic phenomena--caused by the inability of an organism to recognize and correctly categorize the matter semiotized by other species, in this occurrence by humans. From the semiotic viewpoint, we can describe such cases as conflicts between species-specific modeling, on the one hand, and the causality of natural signs replaced by human-semiotized matter, on the other.

Given the extent to which matter is semiotized by human culture, as well as the longevity of concrete, plastic, radioactive waste, and other human-made substances, there is an apparent need to review the main typological distinction between inert matter and the semiotic realm. This necessity arises when applying ecosemiotic methods to human-altered environments, where matter is, rather, a mix of residues from different modeling activities, partly fragmented, and in different stages of disintegration. Quite probably, the semiotized matter is more standardized; it includes stricter relations; it is more self-sufficient and resistant to decomposition. For instance, the amount of measures and relations that correspond to full integer numbers is quite probably higher in human waste compared to any other biological debris. Most important, human semiotic modeling and semiotization of matter tend to bring along increased unification and a loss of diversity of semiotic codes and regulations in the environment.[16] Although semiotized matter is not capable of conducting modeling itself, it could well include imprints and traces of models, which is potential likely to be launched into new semiotic interactions. In the contemporary world, the material environment is more and more a mixture of material objects that afford natural sign relations, on the one hand, and human semiotized matter, which embodies latent human agency, on the other, as well as many intermediate and hybrid types.

In hybrid environments, a semiotic approach could be used to study the ways in which matter changed by human modeling differs from matter organized by physical or biological processes (for example, one could compare the semiotic potential of human landfills and natural sediments). One could examine how matter semiotized by humans impedes matter's own ability to initiate natural signs and to afford (*sensu* Gibson) semiotic processes (figure 9.1). Further questions would arise about the effects of such change on different animals interacting with the matter and about the way these other species relate to said matter. This perspective is based on

the understanding that semiotic affordances and natural signs

[153]

have an important role in the healthy existence of both human cultures and nonhuman animals (see the argumentation on affordances and natural signs in the first section). At the same time, it is important to recognize that the ways other species interact with matter semiotized by humans may be complex and require case-specific analyses. For instance, in European towns, herring gulls (*Larus argentatus*) have been successful in adopting roofs of apartment houses as nesting grounds. At the same time, they are often not able to perceive and recognize the glass walls of modern buildings, and by flying into this glass they make a mistake with often lethal consequences. Questions to be raised in future research include the following: In which ways do traces of human semiotic activities embodied in matter influence the sign activities of other animals? To what extent are organisms able to decompose this matter according to their own semiotic organization? What are the possible conflicts between the modeling activities of different species?
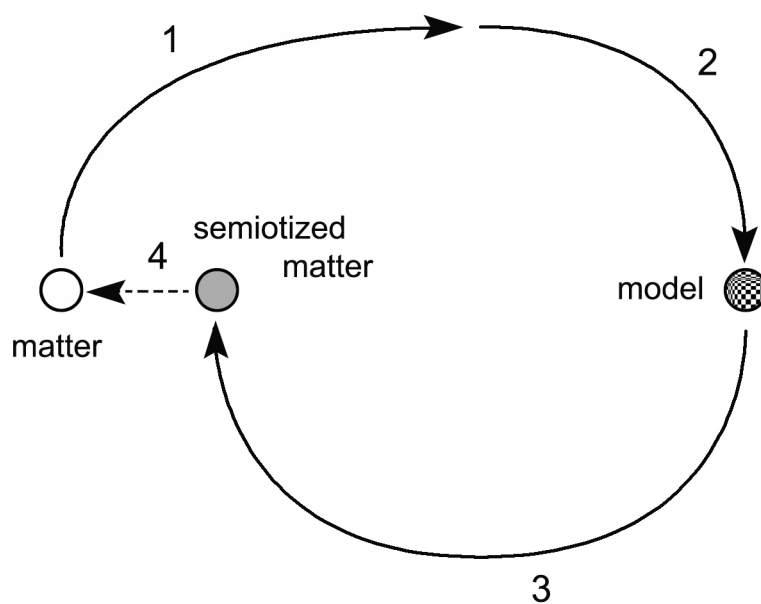
Figure 1. The cycle of the semiotization of matter. 1. Affordances and semiotic processes involving natural signs; 2. Creating models; 3. Executing models to semiotize matter; 4. Hybridization and degradation of semiotized matter. Elaborated from J. Uexküll "The Theory of Meaning", 32; Kull "Semiotic ecology", 357.

The Hybrid Zone

The potential of matter to trigger sign processes appears to be a common ground on which to initiate a dialogue between biosemiotics and material ecocriticism. This said, biosemiotics holds the understanding that there is a typological difference between the semiotic

capacities of matter, plants, animals, and humans. In analyzing contemporary, human-altered environments, however, these distinctions

[154]

have become blurred and unreliable. There appear to be two interlinked processes by which matter could become meaningful for human culture: biomorphic or anthropomorphic modeling and the semiotization of the matter. We should develop awareness of the first of these, due to the cyclical feedback loop between human culture and the environment. The semiotization of matter, however, both as a process and as a serious environmental problem, could well become a joint research topic for biosemiotics and material ecocriticism. Understanding the causes and motives for why humans semiotize matter also requires critical analysis of human cultural and social processes. Material ecocriticism appears to be well equipped for carrying out such analysis. Such a project would also likely result in a flourishing of new knowledge for biosemiotics regarding the semiotization of matter.

Notes

[1] For more information on biosemiotics, see Hoffmeyer, *Biosemiotics;* Favareau, *Essential;* Emmeche and Kull.

[2] An alternative approach for overcoming the dichotomy between material and the semiotic is proposed by Donna Haraway, "The promises." Her approach to material-semiotic structures makes use of A. J. Greimas's semiotic square and its elaborations.

[3] Peirce's terms for the sign's components added in square brackets by the author.

[4] For the sake of clarity, we should note that "object" in Peirce's terminology includes not just physical objects but also thoughts and ideas (*Collected Papers* 5:283–87).

[5] Peirce makes it rather clear that this is a dynamical object, that is, the real object, that determines the sign: "Dynamical Object . . . is the Reality which by some means contrives to determine the Sign" (*Collected Papers* 4:536).

[6] Peirce goes further on this point, specifying that without the specific relations, the signs would lose their existence: "An icon is a sign which would possess the character which renders it significant, even though its object had no existence. . . . An index is a sign which would, at once, lose the character which makes it a sign if its object were removed, but would not lose that character if there were no interpretant. . . . A symbol is a sign which would lose the character which renders it a sign if there were no interpretant" (*Collected Papers* 2:302).

[7] On this point, see T. Uexküll; Deacon, *The Symbolic;* Kull, "Vegetative, Animal."

[8] This interpretation follows Sebeok, "Signs"; Sebeok and Danesi; Bateson, *Steps* 279–308.

[9] See Rosen 85ff.

[10] On this point, see Lotman, "Struktura" 203ff. Based on their structural characteristics, we can also distinguish between more specific types of modeling. Sebeok and Danesi, for example, differentiate between "singularized" (that is, using unitary reference), "composite" (textual), "cohesive" (code-based), and "connective" (metaphoric) modeling (3).

[11] See, for example, R. W. Mitchell et al.; Guthrie; Daston and Mitman.

[12] On this point, see Maran and Kull.

[13] See Kull, "Semiotic"; Maran and Kull.

[14] On this point, see Odling-Smee et al.

[15] Kalevi Kull ("Semiotic") has refered to this process as the creation of "second nature."

[16] On this point, see Kull, "Semiotic" 356.

[In a reference section]

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