A biosemiotic note on organisms, animals, machines, cyborgs, and the quasi-autonomy of robots*

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It is argued in this paper that robots are just quasi-autonomous beings, which must be understood, within an emergent systems view, as intrinsically linked to and presupposing human beings as societal creatures within a technologically mediated world. Biosemiotics is introduced as a perspective on living systems that is based upon contemporary biology but reinterpreted through a qualitative organicist tradition in biology. This allows for emphasizing the differences between (1) an organism as a general semiotic system with vegetative and self-reproductive capacities, (2) an animal body also with sentience and phenomenal states, and (3) higher forms of anthroposemiotic systems such as humans, machines and robots. On all three levels, representations (or sign action) are crucial processes. The “representationalism” invoked by critiques of cognitive science and robotics tends to focus only on simplistic notions of representation, and must be distinguished from a Peircean or biosemiotic notion of representation. Implications for theorizing about the physical, biological, animate, phenomenal and social body and their forms of autonomy are discussed.

Keywords: biosemiotics, autonomy, organicism, representationalism, robots, levels of reality

1. Introduction

If the body is a living organism, the science of the body should be biology, as one might envision this “science of life” as being able to account for the nature of human bodies and the embodiment of human existence. Biology cannot really be a science of living bodies. It is a science of organisms and their parts and relations...
within systems of organisms and environments, and these two domains of inquiry, living bodies and organisms, are not co-extensive. Naïvely I had previously had the idea that biology, because of its generality, simply subsumed humans as a species, just as physics subsumed biological processes in the sense that any biological theory of these processes has to conform to physical laws. Embodiment had to be seen as a biological phenomenon, I thought. This stance was naïve for two reasons. The epistemic reason is that each science in an important sense actively constitutes is own paradigmatic objects of investigation, and thus body and embodiment in biology are different from body and embodiment in anthropology. In fact, embodiment is usually neither considered a technical term nor a theoretical issue within biology. The ontological reason why embodiment (how to be a body, have a body, use and express one’s body) is not simply a biological phenomenon is that the human body in every specific concrete context is a far more complex and multi-level\textsuperscript{2} phenomenon than any single scientific perspective can account for.

To understand the full implications of embodiment for autonomy, also in the field of robotics, one has to grasp at least the distinction between the concept of an organism and the concept of a body. This distinction matches the distinction between biology and sociology (roughly speaking, leaving out animals for a moment). Of course, being an organism is a precondition for having a living body which is neither a thing nor a corpse. We could not, as humans, be embodied — that is, be material creatures co-evolving with an existential-phenomenal world of situated activity involving emotional experiences, feelings, cognitive processes, perception and action, a specific perspective, placed in historical and biographic time regimens — if we were not rooted in an organic world by our very being, that is, if we were not biological creatures. Some AI researchers, cognitive psychologists and philosophers might consider that bio-chauvinism if the intended implication is the impossibility of “intrinsic” machine intentionality and autonomy. However, machines should not be reified as something outside a human sociocultural context. Machine intentionality might be possible, but the action of signs and interpretation (i.e., semiosis) in machines must be considered as tightly bound to their sociocultural context. Machines are extensions of human capacities and intrinsic parts of human sociocultural systems; they do not originate \textit{ex nihilo} or fall readymade from heaven (Marx 1867; Ziemke and Sharkey 2001).

So humans are organisms, rooted in an organic world. Yet in significant ways we transcend our biological form of existence by producing, through culture, language and social institutions, specific dynamic modes or patterns in which our organic and animate existence is realized. In what follows, we shall bring together some perspectives upon the body that may help increase theoretical sensitivity to our (minimally double) existence as belonging both to a first biological nature bound by animate and metabolic processes, and a second social and semiotic nature
in which the significance of the organism’s forms of movement can only be comprehended if seen as formed by the norms, social roles and institutions of a human society. ‘Social’ can be said to mean concerning human actions within a community (as studied by sociology, the science of social processes). ‘Semiotic’ is here taken to mean concerning sign production, information transmission, communication and interpretation within some system (as studied by semiotics, the general science of sign action and interpretation, as founded by the philosopher and scientist C. S. Peirce). The word ‘nature’ has several meanings but here I rely on my reader as a competent language user.

However, we shall circumvent the all too common dualism of seeing these modes as exclusive, or seeing, as often expressed within the humanities, meaning and significance as an exclusively human social phenomenon, implying non-human nature to be either merely an abstraction or a boundary concept denoting forms of materiality devoid of any intrinsic meaning or significance. First, the modes of existence of embodiment are inclusive; briefly, the human body includes the biological organism (cf. Emmeche, Køppe, and Stjernfelt 1997). Secondly, the organism as our “first” biological nature is not something non-semiotic. On the contrary, the roots of processes involving communication, information, signs and interpretation (in one word: semiosis) — and more specifically, human forms of sign action and interpretation (anthroposemiosis) — must be found within an evolutionary framework. This should not, however, simply be standard neo-Darwinism (as this paradigm unfortunately has become dominated by a physicalist metaphysics), but supplemented with a biosemiotic perspective. Below we will briefly introduce biosemiotics as one useful resource to sketch a framework for an overall understanding of embodiment in its material, processual, externalist, as well as internalist aspects.

A brief comment on the current interest in the phenomena of embodiment may be adequate to discern the specific message of biosemiotics. The concern with embodiment has several sources: (1) the study of human cognition, especially criticisms of the classical functionalism of traditional cognitive science and AI, alternatives like “enactive cognitive science” (Varela, Thompson, and Rosch 1991) or ideas of “situated and embodied robots” (Brook 2002), which have led to a radical questioning of the need for representations in cognitive science (Riegler, Peschl, and Stein 1999); (2) the study of human language, especially critiques of modeling language as a disembodied abstract module, and the alternative movement in cognitive semantics that sees basic metaphoric forms of language as rooted in the organization of human bodily action, and claims these unconscious metaphors are based on common bodily experiences (Lakoff and Johnson 1999); and (3) a widespread interest, within the human sciences and interdisciplinary cultural studies, in the transformation of the body, in which “the new body” is seen no longer as a
“fixed, material entity subject to the empirical rules of biological science” (Csordas 1996: 55). Instead, the “new body” is seen as a body with a history, behaving “in new ways at particular historical moments” (ibid.), characterized by indeterminacy, flux, self-creating processes. This has lead to a deep questioning of a set of supposedly basic boundaries, namely the boundaries of corporeality itself, and the boundaries between physical and non-physical, animal and human, and between organic bodies and machines (cf. Hayles 1999).

Now, what is biosemiotics about? It is an attempt to study life not only by chemical approaches seeing cells and organisms as assemblies of molecules, but from the perspective of semiotics, seeing those same molecules (correctly described by chemistry and molecular biology) as sign vehicles for information and interpretation processes.

One main concern of biosemiotics is thus to see the phenomena of significance, meaning and interpretation in the human sphere as rooted in and to some extent continuous with the same very general kind of phenomena in the non-human sphere. We can take the words of the Peirce scholar T. L. Short (1982: 298) to be emblematic of this evolutionary yet non-reductionist perspective of biosemiotics:

Of course human speech is unique: it consists of the ability to replicate legisigns in ever new patterns, as well as in the ability to create new legisigns, not by the slow process of evolution, but within the lifetime of individuals, and by their own volition. The point, rather, is that the distinctive power of human speech is not a supernatural gift, but is a remarkable development of basic principles found elsewhere in nature.

From a biosemiotic point of view, more than one approach to embodiment is needed, since the above intellectual movements (1) and (2) may lead too hastily to radical anti-representationalist stances, while (3), within post-human or post-modern discourse, may risk simply to dissolve real boundaries between the categories of body and machine, human and animal, or nature and culture, instead of analyzing their dynamics, inclusion relations, or how they are being contested. Biosemiotics is critical about these implications; it builds on a more adequate notion of representation (namely that of Peirce; see below) than classical cognitive science; and it allows for keeping fundamental distinctions while seeing these in a dynamic evolutionary perspective which involves a modest dialectics of continuity and emergence. Yet as a scientific perspective, biosemiotics has a limited area of validity, corresponding more or less to the subject matter of contemporary biology, and it cannot fully capture the specificities of human embodiment.

The idea in this paper is in some respects a very simple one of emergent levels of embodiment: A human body — e.g., the body of a child, a soccer player, or a
diplomat — includes (in the sense specified above) an organism, but is also something more, transcending the mere set of organismic properties (like metabolism, growth, homeostasis, reproduction), just as, if we go down one step to a lower level of integration, an organism is a physical system, yet it transcends the basic physics of that system. “Transcending” here does not imply some transcendentalism or metaphysical dualism. The expression “Z transcends Y” has two aspects. (a) One aspect is epistemic, i.e., “Z’s description cannot adequately be given in terms of a theory generally accounting for Y, even though this Z-description in no way contradicts a description of the Y-aspects of Z”. (b) The other aspect is ontological, i.e., “crucial properties and processes of Z are of a completely different category than the ones of Y, even though they may presuppose and depend on Y”. (Both emergence and variants of supervenience have been suggested as candidates for an ontological dependence relation, but we need not enter the debate on these technicalities). The organism is a material, physical processual entity with a form of movement so specific that physics alone (as a science) cannot account for that entity. The organism is a very special type of physical being, as it includes certain purposeful (functional) part-whole relations, based upon genuine sign systems of which the genetic code is the most well-known but not the only example.

It is time to give a very brief introduction to Peircean semiotics (cf. Peirce 1931–1958) in order to remember that, even though the notion of representation as often used in cognitive science can be criticized for being narrow, mentalistic, or even preformationist (i.e., as if the content of a representation is a pre-formed fixed informational structure), other notions of representation are not only possible, but also theoretically more satisfying and general, such as the Peircean one, in which to represent means ‘to relate to something in that specific triadic way in which a sign relates to its object and its interpretant’. Here, a sign is anything that can stand for something (an object) for some interpreting system (e.g., a cell, an animal, a legal court), where “standing for” means “mediating a significant effect” (called the interpretant) upon that system. Thus, semiosis, or sign action, always involves an irreducibly triadic process between sign, object and interpretant. Just as in chemistry we see the world from the perspective of molecules, in semiotics (as a general logic of sign action) we see the world from the perspective of sign action, process, mediation, purposefulness, interpretation, generality. Those are not reducible to a dyadic mode of mechanical action-reaction, or merely efficient causality.3 Thus, organisms are certainly composed of molecules, but these should be seen as sign vehicles having functional roles in mediating sign action of, e.g., genotype and environment, upon the phenotype.

Biological organization is emergent from physical order, i.e., the organism includes its physical processes (for instance, one can break a leg) but from the point of view of physics some of its processual forms are radically new, unpredictable and
realizing forms of sign-based self-organizing processes (e.g., self-reproduction) that are not strictly deducible from properties or self-organizing processes found in the non-biological realm. However, discussing embodiment, one cannot limit oneself to the gross primary levels of reality including the physical, the biological and the social level of embodiment; one has to do a more fine-grained analysis of various biological forms of organismic existence before one can make sense of a distinction between biological and human embodiment. To this end biosemiotics is valuable although it cannot alone account for human embodiment.

2. Biosemiotics: A qualitative organicist account of embodiment

Biosemiotics is a growing field that studies the production, action and interpretation of very different types of signs (such as sounds, objects, smells, movements, but also signs on molecular scales normally not perceived by an organism) in the physical and biological realm, in an attempt to integrate the findings of biology and semiotics. One goal of biosemiotics is to form a new view of life and meaning as immanent features of the natural world, rather than seeing life and meaning as epiphenomena, however complex they might be. Early pioneers of biosemiotics include Charles S. Peirce (1839–1914), Jakob von Uexküll (1864–1944), Charles Morris (1901–1979), Thure von Uexküll (b. 1908), Heini Hediger (1908–1992), Thomas A. Sebeok (1920–2001), and Giorgio Prodi (1928–1987). Contemporary scholars who have contributed to the field or commented extensively include, among others, biologists Jesper Hoffmeyer, Kalevi Kull, Alexei Sharov, Anton Markos, Marcello Barbieri, Charbel Niño El-Hani and Søren Brier, and semioticians Walther A. Koch, Floyd Merrell, John Deely, Frederik Stjernfelt, João Queiroz, Winfried Nöth and Lucia Santaella (for a historical introduction, see Kull 1999).

One of the central characteristics of living systems is the highly organized nature of their physical and chemical processes. These processes are based, in part, on the informational and molecular properties of what came to be known in the 1960s as the genetic code. Biologists such as Ernst Mayr (1982) have viewed these program-like properties of the genetic code as distinguishing life from anything else in the physical world, except computers. However, although the informational teleology (or goal-directedness based upon a stored informational code) of a computer program is not an original form of teleology because the program is designed by humans to achieve specific goals, the teleology and informational characteristics of organisms are intrinsic, as they evolved naturally through self-organized evolutionary processes. Traditional biology (at least in popular and textbook versions) and mainstream philosophy of biology have regarded such informational processes as in the end purely physical. Unfortunately, they also adopt a restricted
notion of the physical as having to do with only efficient causation. This is true as well of some radical critiques of the information and program metaphors in molecular biology, such as the ‘Developmental Systems Approach’ of Susan Oyama et al. (2001), questioning the primacy of genetic causation (we agree with this critique of genocentric causality, but we have chosen an alternative interpretation of information metaphors, see below). These traditions, i.e., mainstream biology, philosophy of biology and developmental systems theory, have often aimed at a “naturalization” of teleology (of, e.g., genetic information) and intentionality (of cognitive information). The admirable purpose of this attempt to naturalize teleology and intentionality is making these phenomena continuous with the rest of nature, and accounting for them in a manner acceptable to physical science. Contemporary science, however, is often prejudiced as the only legitimate basis of judgments on the nature of Nature. Taking the animal or human mind and its teleological and intentional processes to be embodied is often perceived, within biology and cognitive science, as implying a search for reductive explanations of mental phenomena in terms of, e.g., neural information processing, or dynamical systems approaches continuous with the kind of explanations given for non-linear complex systems within physics. This is the case even for some of the search for other notions of embodiment (e.g., “radical embodiment”, Clark 1999). In many programmatic naturalization strategies, the “natural” seems to be reduced beforehand to restricted metaphysical versions of nature as only involving certain kinds of properties or causal processes, like, as said, classical efficient causation.4

Drawing upon the insights of Peirce who founded semiotics as a logic and scientific study of dynamic sign action in human and non-human nature, biosemiotics attempts to use semiotic concepts to investigate questions about the biological and evolutionary emergence of meaning, intentionality and a psychic6 world which are difficult if not impossible to answer within a mechanist or physicalist framework.6 Biosemiotics sees the evolution of life and the evolution of semiotic systems as two aspects of the same process. The main tenet of biosemiotics is the belief that the scientific approach to the origin and evolution of life has given us highly valuable accounts of the external aspects of these processes, but has overlooked the “inner”, qualitative and significant aspects of sign action, thus leading to a reduced picture of causality (cf. Santaella Braga 1999).

Complex self-organized living systems are governed by formal and final causality (Van de Vijver, Salthe, and Delpo 1998). They are mereologically governed by formal causality in the sense of a non-temporal “downward causation” (Andersen et al. 2000) “from” a whole structure (such as the organism) “to” its individual molecules, constraining their action but also endowing them with functional meanings in relation to the whole metabolism. They are governed by final causality in the sense of their tendency to take habits (find new attractors in phase

Particular scientific fields like molecular biology, cognitive ethology, cognitive science, robotics and neurobiology deal with information processes at various levels and thus — in that minimal sense of biosemiosis as informational processes in living organisms — spontaneously contribute to knowledge about biosemiosis and living sign action, even though these findings are not framed within a theory of biosemiotics. However, biosemiotics is not so much a specific disciplinary research programme as a general scientific perspective on living systems. It attempts to integrate and re-interpret empirical findings, and to build a new foundation for biology that acknowledges the genetic “information talk” of codes, messenger molecules, translation etc., as being not simply problematic metaphors but a symptom of real organic semiosis, emphasizing that a notion of “information processing” can be provided that is theoretically richer than standard notions of information processing in contemporary cognitive science. What is this alternative notion of information and representation?

According to biosemiotics, the cognitive system is not a dual system of hardware (a physical brain) and software (an algorithmic symbolic system), and similarly the organism is not a dual system of “information and flesh”, with a DNA code as governor of all bodily processes. Sign processes are active components of the overall physiology of the organism, and accordingly everything which may become “a difference that makes a difference” to the organism (to use Bateson’s cybernetic definition of information; Bateson 1972) is acting as a sign. Just as the mind is not a computer program, DNA is not the central governor of the body, and genes are not preformed descriptions of phenotypic characters with a privileged causal status in every cell, as often assumed in standard genetics and molecular biology. It is possible to use Peircean semiotics to analyze sign processes not only in protein synthesis but in any significant process within and between cells. Though not identical, the notions of sign action sensu Peirce and of information sensu Bateson are intersecting and not conflicting, if interpreted correctly. Both notions generally denote processes of production, transmission and interpretation of something of significance for some interpreting system (like a body, an organism, a cell), and the important aspects of both notions are relational and semiotic. If information is a difference that makes a difference (implied is “to an organism” or “to some interpreting system”), then by Peircean terminology this can be restated more precisely in a semiotic definition of information as a triadic process we may formulate as follows:

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Information is a process in which a sign (representamen), simple or composite, makes a difference (interpretant) to some system (the interpreter) by making the interpretant (the effect of the sign as a difference) stand in a similar relation to something else (the object of the sign) as that to which the representamen stands or refers, thus mediating object and interpretant, i.e., conveying to the interpretant a dynamic form that signifies the object. This definition can be exemplified on the level of both molecular biology and cognitive ethology. Fine-grained analysis of genes and protein synthesis as semiotic processes can be made (El-Hani, Queiroz, and Emmeche 2005) as well as analyses of, for instance, the alarm system in vervet monkeys (Queiroz and Ribeiro 2002). Here one has to remember the very general character of the formal sign definition in Peirce, of which the proposed definition is a variant that emphasizes the processual character. That the meaning of the sign is its causal effects (i.e., the interpretant) implies that these effects have to be physically, biologically, or culturally embodied in an interpreting system (or in the dialogic process between such systems; see Petrilli 1999) to the extent that we are dealing with material systems of a physical, biological or cultural kind. In philosophical jargon, meaning is supervenient on the physics of the system, not reducible to physics, yet dependent upon a material basis.

Furthermore, biosemiotics helps to resolve some remnants of Cartesian dualism that still haunt philosophers and scientists. It provides an alternative to the implicit Cartesian metaphysics in evolutionary biology that tends to reduce organisms to non-sentient mechanical beings, a reduction that makes it almost impossible to conceive of a satisfying evolutionary account of the qualitative aspects of consciousness (Emmeche 2004a). By subscribing to a process rather than substance metaphysics, and by describing the continuity between matter and mind, biosemiotics may also help to understand higher embodied forms of mind and the evolutionary roots of cultural phenomena.

In a historical account of “embodiment”, Keller (2003: 255) comments upon the tendency of science writers and journalists to articulate both a quasi-religious awe when facing the structure of the genetic code or the human genome, seeing it as “the word becoming flesh”, but also repeating, by such expressions, a dualist framework that has been operative since the foundation of modern science: “The body as a machine, as a closed system, to which spirit, mind and God, if they exist, were posited as external agents, dominated the western imagination until the twentieth century”. Even though Keller locates this new “gospel of genetics” in a culture-historical trend towards more inclusive senses of embodiment (deriving not only from the process theology of Alfred North Whitehead, but also from feminist and ecological movements) and thus sees it as contributing to re-opening the closed system of the body as a machine, these very rhetorical figures of popular
genetics tend to reinforce the dualisms between mind and body; information and flesh. Here, biosemiotics may function as one of the resources for critical study of mind/body dualism in Western science and religion.

The biosemiotic account of embodiment is a form of organicism, an important tradition in biological thought. The resolution of the debate between vitalism and mechanicism in the history of biology looks on the face of it as a victory for mechanicism. However, it was really a compromise, a sort of mainstream organicism, exemplified by the writings of such well-known biologists as J. Needham, P. Weiss, C. H. Waddington, J. Woodger, E. Mayr, R. C. Lewontin, R. Levins and S. J. Gould (see also Gilbert and Sarkar 2000), and functioning more or less tacitly as a background philosophy of biology (Emmeche 2001). Organicism takes the complexity and physical uniqueness of the organism as a symptom of the distinctiveness of biology as a natural science sui generis. As a compromise, although often framed within a naturalist evolutionary perspective, it was anticipated by Kant's more critical (non-naturalist) notion of a living organism as an organized product of nature in which every part is reciprocally purpose (end) and means (cf. Van de Vijver, Van Speybroeck, and Vandevyvere 2003). However, within mainstream organicism this teleology is interpreted as a more or less “mechanical” teleonomy being the result of the forces of blind variation and natural selection, plus eventually some additional “order for free” or physical self-organization (Kauffman 2000). Mainstream organicism is thus non-vitalist, ontologically non-reductionist (methodologically allowing for reductionist research strategies though) and emergentist. What is studied as emergent properties are common material structures and processes within several levels of living systems (developmental systems, evolution, self-organizing properties, etc.), all of which are treated in the usual way as objects with no intrinsic experiential properties.

In contrast, qualitative organicism represents a more colored view of living beings; it emphasizes not only the ontological reality of biological higher level properties or entities (such as systems of self-reproducing organisms being parts of the species’ historical lineage), but also the existence of phenomenological or qualitative aspects of at least some higher level properties. When sensing light or colors, an organism is not merely performing a detection of some external signals which then are processed internally (described in terms of neurochemistry or “information processing”). Something additional is part of the story, at least if we want the full story, namely the organism’s own experience of the light, and this experience is seen as something very real. As a scientific position qualitative organicism is concerned with qualities which are not only of the famous category of “primary” qualities (roughly corresponding to the scientifically measurable quanta) including shape, magnitude and number. It is also concerned with the “secondary” qualities of color, taste, sound, feeling, etc. Neither qualitative nor mainstream organicism
are fully coherent stances, theories or paradigms; many authors cannot be consistently categorized as belonging to either one or the other position exclusively; the important thing is to recognize that in fact two different conceptions of life are at stake. To the extent that biosemiotics is based in a Peircean logic of signs of varying levels of complexity, it is a form of qualitative organicism. We leave it to others to develop a taxonomy of the variants of qualitative organicism. Here we will concentrate on its biosemiotic brand instead.

Biosemiotics recognizes not only the external effects of signs upon their interpreters, forming new interpretants (remember that the interpretant, being an effect of the sign, need not be the interpreter, i.e., the whole interpreting organism), but also the internalist and phenomenal aspects of this process. The phenomenology of basic biological (“vegetative”) processes of life is not yet developed, and we shall primarily focus on the animal level of biosemiosis. A living being that is not simply an organism but is also an animal, is emphatically “animated”, that is, it realizes a specific form of movement which is not reducible to pure physical change or basic biologic processes (like metabolism). Movement, understood as living change and as semiotic, when realized by self-moving organisms (i.e., animals), crucially depends on mediating all the elements of quality, physical force and interpretation — three general ontological aspects of every semiotic process that correspond to the triadic structure of categories in Peirce. Single cells, plants and animals are all, so to speak, semiotic machines (the machine metaphor is not implying any mechanicism here, cf. Nöth 2003), nodes in complex webs of sign interpretation processes.

Every process, even in non-living nature, has an aspect of (i) “tone” (i.e., possibility, chance and phenomenal quality), (ii) “token” (existence, force, here-and-now), and (iii) “type” (generality, being governed by a general law). This is true for sign processes as well. The characteristic level of sign interpretation processes in plants are intra- and inter-cellular, with molecular signs representing the immediate environment and long-term morphogenetic changes (processes like metabolism, growth, differentiation and reproduction).

A plant’s body is the result of an organism’s vegetative interpreting systems, and irritability is a crucial component of vegetative embodiment. Irritability is used here in the sense of a general semiotic capacity to feel and interpret stimuli so as to adapt to changes in the environment or in other parts of the organism. Compare the term’s original denotation, viz. the capacity of certain parts of the body to contract when stimulated, as introduced by the English physician Francis Glisson (ca. 1597–1677) who saw it as a property of all the body’s fibers independent of consciousness and the nervous system (cf. Lawrence 1981). It has played an important role in the debate between mechanicists and vitalists over the basic definition of life.
Animate embodiment is different. Although it includes the vegetative form of embodiment (thus an animal’s skin may indeed get irritated, its growth may be disturbed, etc.), it is a form of embodiment where self-movement is a crucial new development of the general biological self-control one finds in plants and single cells. In self-movement, animal agency emerges as a temporary structure of bodily sign action processes. Animate agency is semiotic, meaning that it mediates the three dimensions of (i) a qualitative phenomenal feeling, i.e., the “inner” side of the sign considered not in relation to anything else (thus, a form of Firstness in Peirce); (ii) the here-and-nowness of signs or stimuli (the “haecceity” of a stimulus being an example of Secondness) that can have an environmental or bodily proprioceptive origin, but whose being is existent and thus simply consists in their immediate effects, action-reaction, their “actually acting and being acted on” (Peirce, CP. 6.318); and (iii) the cybernetically organized cycles of organism-environment interaction, the “functional cycle” of Jakob von Uexküll’s biology, describing how the environmental stimuli are integrated and interpreted in the Umwelt of the organism — this integrative mediating process involves emotional and proprioceptive interpretation systems that mediate the past and present Umwelt into anticipatory schemes for further action and habit-formation (i.e., the mediative and future-directed category of Thirdness). Animal embodiment, accordingly, is the graceful integration, accomplished by a living animal body, of physical change, biologic-metabolic processes (neural as well as general physiological), and the emerging interpretative Umwelt relation (of a body within its specific perceived and acted upon environment) representing the animal’s own detailed movements in an ever-changing flux of environmental and bodily stimuli.

3. Triadic representations vs. representationalism

It is important to note that a biosemiotic notion of animal embodied cognition is not committed to the same kind of functionalist representationalism often criticized by “new AI” or cognitive semantics, i.e., the notion that cognition and language consist of rule-governed manipulation of a distinct preformed set of symbolic representations inside an organism referring to an outside world (cf. Riegler and Stein 1999; Ziemke and Sharkey 2001). The representationalism of classical cognitive science, like the physical symbol system hypothesis of functionalism, has a dyadic notion of representation (tending to disregard the open-ended and processual character of interpretation) and an atomistic concept of symbol, in strong contrast to the triadic, general and evolutionary nature of sign processes and causality involved in a Peircean conception of representation. On the level of general semiotics, signs are forms of mediation (i.e., generals embodied as relational
tokens) that are embedded within a network of local processes of ongoing generation of new interpretants; this applies to cellular “vegetal” signs as well as cognitive “animate” ones. Embodiment in this basic sense is a sine qua non for all sign action in nature and culture, and here, the term “embody” designates a general metaphysical aspect of semiosis: A sign must, so to speak, materially incarnate its meaning; this is a physical precondition for signification. It is on this level of generality, we might call it semiotic embodiment, that one must answer the question whether embodiment is necessary or sufficient for meaning or mind. From the point of view of semiotics, meaning and mind are all-pervasive phenomena; meaning always has to be embodied in signs, but need not be confined to organic bodies.

Although Peirce’s own semiotics is embedded within his broader views on the nature of reality, evolution and thought, contemporary Peircean semiotics and biosemiotics need not subscribe to the total of Peirce’s fascinating blend of pragmaticist philosophy of science, evolutionary cosmology and metaphysics, although these inform our understanding of his notion of logic as tightly connected to semiotics. What is real is not merely what is existing, because the existing “here and now” individual events (their Secondness) are always, on the one hand, embedded within the generalities of law, tendencies, habit formation and thought, that is, the general logic of things (the category of mediation, Thirdness), and on the other, influenced by genuine chance, random deviations from lawfulness, spontaneous generation of new possibilities (belonging to the category of Firstness). Thus, any existing sign, such as this word hand, is only understandable as a sign of something to some interpreter, by being a token (Peirce called it a sinsign) of some general type of sign (a legisign), namely the kind of word just mentioned. As Santaella states, “The legisign depends on individual cases to be actualized. The symbolic legisign” — here, the word hand — “is embodied in individual cases. In this same act of embodiment the individual cases are conformed to the symbol’s domain. The symbol functions as a rule for the formation of a certain sub class of sinsigns which are called replicas. The rules for the formation of the replicas also involve the interpretative rules of these replicas. Hence, the replica of a symbol is a special kind of index which acts to apply the general rule or habit of action or expectation associated to the symbol to a something particular” (Santaella 2003: 57; cf. Short 1988). Also symbolic representations are embedded ongoing processes, and thus we see that the notion of symbol in semiotics is very different from the notion of symbol within classical cognitive science. Regarding the specific human form of embodiment, the symbol attains a specific role accounting for the social nature of human consciousness.
4. The body within evolutionary emergent levels

As we have seen, the animate body as a self-moving organism transcends the simpler category of an organism realizing the vegetative functions of growth and reproduction. Already at this stage biosemiotics provides not only an alternative (non-physicalist) “naturalization” of semiotic processes in general, but also a framework for distinguishing between levels of embodiment corresponding to different degrees of complexity involved in sign interpretation processes. To clarify the structure of the present argument for a multiplicity of phenomena of embodiment, a simple schematic list of levels of embodiment may help. The full meaning of the scheme’s concepts will be explained in the following. Here is the scheme (adapted from Emmeche 2002a):

3. The body of zoology: The animal as an autonomous, self-moving organism. *Intentionality* and *consciousness*.
   (b) The body of sociology: A “cybody”, i.e., a societal body dependent upon technology, embedded in a civilization. *Cosmopolitics*, *hybridicity*, *posthumanity*.

The scheme indicates ordering relations between some forms of embodiment. Their epistemic dimension is mentioned first, by organizing those forms according to different domains of science each constituting its own objects; their ontic dimension is implied by an underlying ontology of levels of organization in Nature. Four such levels are mentioned. The point is not the exact number of levels (these are contingent upon a historically relative state of science) but the fact that irreducible levels do exist. E.g., the animal as a phenomenon includes an organism, yet the animal form of embodiment transcends (in the sense explained above) the vegetative form of embodiment; that of a cell or a plant. No distinction is made between embeddedness and situatedness, but between their vegetative, animate and sociocultural forms: *Organismic embodiment*: The organism is situated in its ecological niche. *Animate embodiment*: The animal is additionally embedded in a complementarly subjective Umwelt (see below). *Anthropic embodiment*: A sociocultural Umwelt constitutes a lifeworld enacting social roles and expectations (histrionics) as well as conscience.

Thus, different notions of embodiment are partly constituted by different areas of science; yet from a point of view of “semiotic realism”, science can indeed
capture true aspects of “the joints of nature”. Those joints are inclusive, in the above sense that being a blackbird includes being a bird, which in turn includes being a vertebrate (and so forth), and more generally, being an animal includes being an organism, and this in turn includes being physical. The modes of human embodiment are also inclusive: The point of calling non-living entities “bodies” and talking about “the body of physics” is that we only get a more complete comprehension of even non-living matter when we realize that it can evolve into higher forms of organization whose properties transcend mere physical properties. Such properties are emergent, though still depending on physical processes. This, of course, have implications for a notion of autonomy (and autonomous robots), because, although any system (say, from a particle to a society) can be seen, on the one hand, as being to some degree autonomous in the sense of semi-stable in relation to its super-system or surrounding system (environment in case of organisms), and on the other hand, in interdependent and continuous interaction with its surroundings, any specific kind of system realizes special modes of this dynamic stability and interdependence that must be distinguished, and analyzed also in terms of those systems’ semiotic properties. As we shall see below, although robots mimic animals’ dynamic stability or autonomy for brief intervals of time, their developmental dynamics are very different (typically lacking growth and true self-reproduction). So, let us return to these levels:

Physical embodiment. Classical as well as modern physics deal with three kinds of objects; first, general forces in nature, particles, general bodies (matter in bulk), and the principles (“laws”) governing their action; second, more specifically the structural dynamics of self-organized bodies (galaxies, planets, solid matter clusters, etc.); third, physical aspects of machines (artifacts produced by human societies and thus only fully explainable also by use of social sciences, like history of technology). In the history of science one has often seen attempts to reduce all of physics to a formalism equivalent to some formal model of a machine, but there are strong arguments against the completeness of this program (Rosen 1991), i.e., mechanical aspects of the physical world are only in some respects analogous to a machine. Some of the general properties of bodies studied in physics have a teleonomic character (a kind of directedness or finality); in the scheme, this is called “thermo-teleology”, since this phenomenon of directedness is most known from the second law of thermodynamics (a directedness towards disorder), as well as the opposing self-organizing tendencies in far from equilibrium dissipative systems. “Final causation” indeed is a pervasive aspect of purely physical processes (Hulswitt 2002).

Organismic embodiment. A biological notion of function, that for which a part works in order to sustain a living whole (cf. Emmeche 2002b), is not yet present in physics, while it is crucial for all biology. Biofunctionality is not possible
unless the living system is self-organizing in a specific way, based upon a memory of how to make components of the system that meet the requirement of a functional metabolism of a high specificity. For Earthly creatures this principle is instantiated as a code-plurality between a “digital” code of DNA, a dynamic regulatory code of RNA (and other factors as well, partly digital partly analogic), and a dynamic mode of metabolism involving molecular recognition networks of proteins and other components. This establishes a basic form of living embodiment, the single cell (as a simple organism) in its ecological niche, which presupposes the workings of “the physical body” as a thermodynamic system in non-equilibrium, yet transcends that form by its systematic “memory” of organism components and organism-environment relations. Biosemiotics posits that organismic embodiment is the first genuine form of embodiment in which a system becomes an autonomous agent “acting on its own behalf” (cf. Kauffman 2000), i.e., taking action to secure access to available resources necessary for continued living.15

It is often overlooked that the subject-object structure of this active agent is mediated not only energetically by a structured entropy difference between organism and environment, but also by signs of this difference; signs of food, signs of the niche, signs of where to be, what to eat, and how to trigger the right internal processes of production of organismic components the right time. It is often forgotten that the active responsiveness of the agent’s organism (based upon observable molecular signs) has, as an “inner” dimension, a quality of feeling, implied here by what is called irritability at the level of a single cell. Irritability is probably real, logically in accordance with a basic evolutionary matter-mind continuity, and rationally conceivable, though impossible for humans to sense or perceive “from within” or empathetically know “what it feels like”, say, for an amoeba or an E.coli. The concept of “feeling” is not quite the same as “qualia” in contemporary philosophy of mind, but closer to its use in Peirce’s phaneroscopy (e.g., CP. 1.306–311). “Inner” does not refer to a separation between brain states and bodily or environmental states (which is problematic, cf. Thompson and Varela 2001: 422) but to an ontological category of possibility and quality. As Thompson and Varela do not distinguish organismic from animate embodiment, the first of their three dimensions of embodiment, ‘organismic regulation’ (including “sentience” or ”the feeling of being alive”, ibid., 424) is a mixture of feeling on this basic organismic level and “primal” or “core” consciousness at the level of animate embodiment.

Animate embodiment. As the reader might have guessed, the biosemiotic idea is that when we consider the realm of animal mind, the intentionality of an animal presupposes the simpler forms of feelings and irritability we stipulate in single cells (including the “primitive” free-living animals, such as protozoa, lacking, e.g., a nervous system), yet transcends these forms by the phenomenal qualities of the perceptual spaces that emerge in functional perception-action cycles as the
animal’s Umwelt. As already mentioned, proprioceptive semiosis is a crucial element of phenomenal as well as functional properties (cf. Sheets-Johnstone 1998). More generally (and less controversially), the animal body is a highly complex and specific kind of a multi-cellular organism, a kind that builds upon the simpler systems of embodiment on the level of biology, such as physiological and embryogenetic regulation of the growth of specific organ systems, including the nervous system. These regulatory systems are semiotic in nature, and rely on several levels of coded communications within the body and their dynamic interpretations (for details, see Hoffmeyer 1996; Barbieri 2001; Markos 2002). The expression “the body of zoology” in the schematic list is used to emphasize both its distinctness as a level of embodiment, and the fact that zoology instead of being simply part of an old-fashioned division of the sciences should be the study of animated movement, including its phenomenal (“mental”) qualities.

**Anthropic embodiment.** Two forms of human (anthropic) embodiment should be distinguished: (a) *social embodiment* universally characteristic of humans as beings forming distinct language-dependent sociocultural groups; (b) *societal embodiment*, forming “cyborg bodies” (Emmeche 2004b), or cybodies. The later is a special form of (a) in which a socio-cultural body is embedded in a society with several social subsystems (e.g., economy-work, education, politics, law, economy, love-reproduction-consumption, health-care, art, science, media), i.e., a civilization, and where the body’s animate mode of being is intrinsically connected to technology (e.g., medico-technology) dissolving sharp body/machine boundaries; see Section 6 below. First let us concentrate on the anthropic body of a person as a *societal* being, that is, not simply social in the sense of being a social animal, but emphatically “human-social”, being part of a society with division of labor, institutional subsystems, social roles, culture, etc.; as Aristotle said, a political animal. It is beyond the scope of this paper to develop the specific senses in which humans (i) are embedded within a society, (ii) embody distinct social systems with all their peculiarities, (iii) have their minds constituted by institutional habits, which they (iv) internalize during socialization. The “habitus” *sensu* Bourdieu (Jenkins 1992) of a human being in a social field is the implicit way his or her process of socialization has enacted a semiotic system of embodied habits, some of which have even physically formed the very animate body of the person — juxtaposing people from different times and classes; an attritioned third world coal miner, a North American teenager, or a 17th Century French noblewoman, may serve as illustration. No doubt, other theoretical notions in sociology could express culturally specific forms of human embodiment, but Bourdieu’s concept of *habitus* suffices here, as it represents a set of class-specific dispositions generating specific practices and patterns of perception; it is embodied in individuals, and at
the same time, it is a collective and homogeneous phenomenon, mutually adjusted for and by a social group or class.

Using the concept of habitus should make the distinction between animate and anthropic forms of embodiment clear. However, one could ask (a) what is embodied in what; (b) what is not embodied, and (c) if “embodied” could simply be replaced by “physical”, “situated” or “embedded”. As for (a), sociocultural history is embodied in social institutions, and the norms and rules of an institution are again embodied in a person functioning within such an institution. Thus, a person in some role incarnates a part of sociocultural history. Sometimes but far from always, forms of anthropic embodiment imprint their marks on the animate body of a person. Question (b) is like asking “what is not cultural?” when dealing with sociocultural systems. The answer depends on the purpose of the analysis (are we interested in the pervasiveness of cultural processes in a human lifeworld, or, e.g., in delimiting borders between a civil society and a state as distinct spheres of influence?). The answer to (b) depends on the purpose, focus and conceptual tools of any specific analysis. Regarding (c), similar remarks apply (cf. the schematic list). The distinct levels of organismic, animate, and sociocultural embodiment imply distinct forms of embedment and situatedness.

Thus, on this genuinely anthroposemiotic level, biosemiotics as an approach does not suffice to capture the complexities and specificities of human embodiment. Animals have various needs and appetites, including sexual ones, whereas human desire, though developmentally presupposing appetites, cannot be reduced to them. Furthermore, consciousness in animals like apes and monkeys can exhibit quite complex forms of social cognition (Bekoff, Allen, and Burghardt 2002), but without a linguistic system (for symbolic representation of abstract structures) and a societal consciousness (of different language games, social roles, institutions and normative systems) even animal social consciousness is not that form of societal consciousness we find among humans, together with self-consciousness in its more complex forms. One of those forms is conscience, internalized culture-specific schemata of right and wrong relations between self and other. Histrionics, normally a name for dramatic art, is used in the schematic list to signify the intimate relation of human embodiment and socio-cultural situatedness: “The naked animal” is not really human unless it realizes itself as a histrion, an actress on a social scene, a person mediating — as if by a social “mask”16 — a general status in the social field “in front of the mask” and a narratively structured unique self-consciousness “behind the mask” (cf. Welker 2000).
5. Causality and emergent levels of interpretation

The above levels of embodiment can be located within an evolutionary macrohistory and further differentiated in detail. The attempts to characterize more precisely what notions of causality should be necessary to account for the whole series of levels would lead into technicalities we will eschew here (see, e.g., El-Hani and Emmmeche 2000). Instead, let us briefly describe the intuitions and demands that such a notion of causality should conform to. The idea from emergence theory (cf. review by Pihlström 2002) is that once a new emergent level is formed, it implies both new properties and other principles than those found on the previous level, but also has an effect to constrain the possibilities of processes and actions on the level below. This “downward” influence (Andersen et al. 2000; Thompson and Varela 2001) may be seen as a formative, structuring cause, not to be mixed up with the efficient cause of classical physics. Thus, a biosemiotic perspective demands a “Non-standard Neo-Aristotelian Pluralist notion of Causation” (nnpc), that allows for dealing with a complex system of several levels. Within a nnpc, the classical notion of a temporal dyadic cause-effect relationship is just one element (often to be used for within-level explanations) of a more complete set of causes. These also include material causes (as answers to question about composition), formal causes (corresponding to structural constraints of a higher level upon its components), and final causes (that may take a level-specific form, and thus may be interpreted either as the enactment of anticipatory purposeful behavior within a cybernetic system, or more generally — and in a Peircean sense — as a pervasive form of structural causation of which the physical laws of nature are just an example).

For the notion of inclusive levels of embodiment this means: (i) for the physics-biology border, that for instance the metabolic regularities of organismic embodiment of a grass constrain the physics of protein action within its leaves; (ii) for the biology-zoology border, that the cognitive action-reaction cycles of an animal’s perception and movement constrain the formation of interpretants within its nervous system; and (iii) for the zoology-anthropology border, that even societal structures like a market economy in specific ways may have constraining effects upon the embodiment of not just human freedom and action, but also the very animal existence of human beings.

Another important distinction is the one between, on the one hand, a general ontological principle of embodiment stating that general forms have to be incarnated or realized in particular instances and can hardly exist disembodied as platonic forms (the general type needs its individual tokens to exist), and on the other, system-specific embodiment, i.e., embodiment holding for particular phenomena of mind, consciousness, meaning and significance, as these phenomena are embodied in particular system types (therefore the general principle that the mind is
materially embodied must be specified). We have already seen the first principle exemplified by what we called semiotic embodiment: A particular general sign, such as a symbol, needs particular instances to embody it. The second principle was illustrated by the explanation of the scheme of levels of embodiment. Seeing different forms of embodiment, both in a semiotic perspective and as evolutionarily emergent, amounts to viewing them as involving emergent levels of interpretation and understanding. One could learn all physiological facts about, say, the effects of iron nails against the skin of a person — e.g., perhaps useful for learning surgery — yet without getting to the essence of the phenomenon. Also the biology of wound healing and the neurophysiology of pain experiences may not satisfy our inquiry. The question is, what is the phenomenon? Developmental psychology may be closer to revealing fragments of that mystery, but at this stage we also have to ask questions about the specific sociocultural context: Are we talking about skin piercing as a fashion of youth culture, or crucifixion as a tool for torturing political prisoners or an alleged messiah?

6. The cyborg nature of human embodiment

From the reflections on system-specific forms of embodiment thus far it transpires that biosemiotics is not enough to account for the characteristics of human embodiment. Some of these, such as the capacity to handle language and language-dependent societal processes, have often been seen as disembodied, almost Platonic forms. But what may seem to be disembodied societal structures, like a state’s constitution, a moral principle, or the spoken language, are always specific historical products that indeed have to be realized in specific social fields and systems to be real. Thus the general metaphysical principle of embodiment holds also for the societal level.

The human animal was from its beginning societal, language-based, technical and political, but not all these determinations were equally developed. Let us briefly look at the technological dimension that only became fully realized in the industrial phases of civilization, when we discover what we can call the intrinsic cyborg nature of humans, as techno-culturally embedded beings within a space of meanings that are not only symbolic, but argumentative and culturally empowered by different kinds of social systems. Often, in cyber-punk and science fiction literature, the cyborg is seen either as the idea of a “melding of human and machine” and a “new era of participant evolution”, or as a person modified mechanically to perform specific tasks or redesigned to work in an alien environment (Stableford 1999). By a strangely familiar kind of reification, the machine is seen as something alien to the human body, and the melding of body
and machine is then perceived as threatening human dignity or the ‘essence’ of being a human subject.\textsuperscript{18}

The anti-essentialist threat of the possibility, afforded by biotechnology, of a complete “hybridization” of a human organism and a machine has been used critically within feminist thinking (Haraway 1991; Hayles 1999; Flanagan and Booth 2002), which in turn has inspired phenomenological approaches to technology (Ihde 2002). We will only use these sources to emphasize that the machine is not any “alien” entity. Though usually made of inorganic materials, any machine is a product of human work and its societal network of skills, ideas, thought, institutions, etc., and thus, we reify or blackbox the machine when we see it as a non-human entity. (This does not mean that there are no crucial differences between organismic and robotic forms of embodiment, as the work of Tom Ziemke 2003 clearly shows.) Marx was probably the first historian to make this point which is also a point about embodiment. On the level of human embodiment, tools, technical artifacts, machines, and thus robots, all embody human co-operative division of labor, and of course, in our society, knowledge-intensive machines embody societal forms specific for a “post-industrial,” “late capitalist,” “risk” or “knowledge” society.

One should note that the levels of embodiment discussed here are partly dependent upon the epistemic interest and analytical perspective; this applies also for the above mentioned (a) social and (b) societal forms of anthropic embodiment. The kind of “social embodiment” reviewed in Barsalou et al. (2003) corresponds to (a), although some of the research reviewed tends to assume that, e.g., facial and bodily responses (exemplifying social embodiment), are cross-cultural universals. Barsalou’s theory, especially the notion of simulators, is interesting (in spite of its metaphorical view of the brain as a computer) but raises this question: To what extent are simulators (e.g., “the simulator for the social category face”; Barsalou et al. 2003: 67) specific for social embodiment in humans? Could the theory also apply to, say, social embodiment in a herd of wolves? And if so, in which sense is it a theory specifically explaining social embodiment in humans, in contrast to more general animal-based cognitive capacities?

Today the use of computers (“thinking machines”) as well as robots has become widespread, and we should beware of the ease of blackboxing or reifying the semiotic processes involved in their interpretation. In current Western society, it is an aspect of the cyborg nature of human existence that machines both embody and hide complex social relations. This somehow make us forget the distributedness of processes like meaning and cognition, as we are led to commit fallacies of misplaced concreteness when we localize thought either in a single machine or in a single brain. Our cyborg nature implies that technical artifacts, as one of the conditions of existence of the human form of life, embody human thought processes.
This applies also to simple artifacts as part of the anthroposemiotic network of tools, as Peirce noticed:

A psychologist cuts out a lobe of my brain (*nihil animale me alienum puto*) and then, when I find I cannot express myself, he says, “You see your faculty of language was localized in that lobe. “ No doubt it was; and so, if he had filched my inkstand, I should not have been able to continue my discussion until I had got another. Yea, the very thoughts would not come to me. So my faculty of discussion is equally localized in my inkstand. It is localization in a sense in which a thing may be in two places at once. On the theory that the distinction between psychical and physical phenomena is the distinction between final and efficient causation, it is plain enough that the inkstand and the brain-lobe have the same general relation to the functions of the mind (Peirce, CP 7.366; see also Nöth 2003; Skagestad 1999).

As an anonymous referee noted, Peirce’s remarks have a critical edge: Peirce is challenging some features of the still fashionable tendency to locate certain human faculties exclusively in distinct regions of the brain, by noting that one might equally well, equally absurdly, suppose that our discursive faculties reside in the ink-wells indispensable to his own discursive practices (or reside in a single isolated individual, one could add). This critical observation about the interdependence between simple artifacts or techniques and human discourse can inspire one to look for other forms of extension of our faculties beyond those of local culture or local techniques, on a wider, more global scale.

When human communities arrive at a phase of civilization, in which the societal form of human embodiment within different social systems, such as the health care system, the educational system, the economic system, etc., has made individuals existentially connected to the corresponding systems of technoscience that these social systems rely on (this process being very unequally expressed for different social classes), our cyborg nature takes on a double form. In a basic dimension, we continue to be that kind of animal, who can only survive in its present form by being interconnected to a global techno-societal system. On a supervening dimension, historically specific for a modern risk society, this interconnected existence changes our very animal bodily appearance by the possibility of, e.g., prolonging life, exchanging body parts because of ageing or desire to be forever young, transforming us into the cyborgs of science fiction — what has been called "the post-human condition" (see Fukuyama 2002; see also Hayles 1999). Due to the inclusiveness of the forms of embodiment, however, the term ‘post-human’ is misleading, since it is only now, as we come to consider ourselves to be beyond human nature, that our nature is revealed to us as at once human and cyborgian. To paraphrase Marx, the anatomy of the cyborg is the key to the anatomy of humans. We are already cyborgs, hooked-up to our fellow beings — and fellow robots — by
tools and technology, and in late modernity, for the priviledged classes, also via the technoscientific health care system.

Human cyborg embodiment can take many forms, not all equally desirable, and will continue to be a contested issue in the biopolitics of the present century. Robots, though not ‘autonomous’ in the sense of organisms, but as quasi-autonomous beings — i.e., hooked-up in socio-technical networks, including human technicians to keep them functioning (just like cars) and limit their fragility by continuous monitoring of breakdowns and replacing broken parts for new prefabricated ones, as happens with any other piece of complex technology. These creatures may certainly meet us in, e.g., the future cyborg system of health care service. We may then black-box their machine-character and be tempted to take their form of autonomy as animate or even human, and forget their multifaceted preconditions of societal embodiment.

To conclude and summarize some points of the present investigation: When we reflect upon such notions as mechanicism and autonomy and their role in understanding human embodied cognition, we should remember to specify their pragmatic significance on specific distinct levels of embodiment. We have pointed out the complexity involved in delimiting various levels of embodiment and their relations of interdependence and inclusiveness, as well as the possibilities and limitations of biosemiotics as a version of qualitative organicism that supplies a richer ontological framework for dealing with causality and cognitive sign-interpretation. A useful notion of mechanicism has to be organicist, transcending the classical mechanicist restriction of causality to just effective causality. And autonomy should be specified according to the level of embodiment at which one is analyzing the ‘autonomous agent’ (whether animal, human being, or robot) without reifying or blackboxing its history of activity.

Notes

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1. Peirce (1931–1958, CP 7.366 [1902]).

2. “Multi-level” means including at least a physical, a general biological-organismic, a specific animate-zoological, and a human-sociocultural level. There is a one-way relation of inclusion between the levels (cf. the notion of a “specification hierarchy” in Salthe 1989). The biological
level includes the zoological — being an animal implies being an organism — but not the other way around. However, even though humans are animals, zoology as a science is not adequate because too unspecific to account for all there is to say about the cultural life of Homo sapiens, a being socialized in a human society.

3. The details of this argument are more complex in the sense that the distinction final/efficient causation and organismic/physical processes are not co-extensive, and thus, the irreducibility of final (teleologic) causation to efficient causation (sensu Peirce) is not necessarily the same as the irreducibility of organismic processes to physical processes, as for Peirce, every lawful process has an element of finality (see Hulswitt 2002).

4. Partly based on mathematical arguments, Scott (2004) convincingly shows that a reductionist notion of causality is not even defensible for many non-linear complex systems in physics.

5. Allow me to use “psychic” instead of “mental”, as the former word has less Cartesian connotations than the latter and is rooted in a realist, neo-Aristotelian and Peircean philosophical tradition. Intentionality is used here not according to Brentano’s dualist metaphysics but in a way inspired by Peirce to designate both the representational “aboutness” aspect of animate sign processes, and their qualitative, psychic, phenomenal aspects.


7. El-Hani, Queiroz and Emmeche (2005). Cf. one of Peirce’s own definitions: “A Sign, or Representamen, is a First which stands in such a genuine triadic relation to a Second, called its Object, as to be capable of determining a Third, called its Interpretant, to assume the same triadic relation to its Object in which it stands itself to the same Object” (CP 2.274 [1902]; emphasis in the original). Peirce distinguished between several kinds of signs, objects, and interpretants, which may be used to develop further the informational variant of the sign definition.

8. This is the case in Jakob von Uexküll’s biology (see von Uexküll 1982), as well as in Peirce’s synechism, i.e., his philosophy of mind/matter continuity (see Santaella Braga 1999).

9. Peirce was not satisfied with a standard type/token distinction which only operates with Thirdness (type, a form of generality) and Secondness (token, existence), so he added “tone” (quality) to represent Firstness. It is not possible in a footnote to explain his three basic categories, so I only can offer my reader these hints (see also Hausman 1993; Hulswitt 2002; Peirce 1931–1958; see especially Peirce’s later statements in 1.284–353, 5.41–92, 7.524–552, 8.264–269, 8.327–331).

10. The Umwelt is the species-specific subjective universe, or phenomenal world, of an organism; the part of the environment of a subject that it selects with its species-specific sense organs according to its organization and biological needs. Everything in the Umwelt is labeled with perceptual cues and effector cues of the subject. According to J. von Uexküll, every subject is the constructor of its Umwelt; cf. J. von Uexküll (1940 [1982]), with a good introduction by his son Thure von Uexküll (1982). See also the volume edited by Kull (2001).

11. Sign action is mediation, and as such requires a material medium for this process, as well as energy, at least under normal thermodynamic conditions; it is well-known that information processing has physical limits and that it costs energy. See Zurek (1989).
12. “Thought is not necessarily connected with a brain. It appears in the work of bees, of crystals, and throughout the purely physical world; and one can no more deny that it is really there, than that the colors, the shapes, etc., of objects are really there. Not only is thought in the organic world, but it develops there. But as there cannot be a General without Instances embodying it, so there cannot be thought without Signs. We must here give “Sign” a very wide sense, no doubt, but not too wide a sense to come within our definition” (Peirce, CP 4.551). The reader should notice that this view (that meaning as embodied in signs need not to be confined to organic bodies) is a consequence of the formal, broad, and logic-semiotic approach of Peirce, and stands in contrast to a view of co-extensionality of life and meaning often found in biosemiotics (e.g., Hoffmeyer 1996). I thank Jordan Zlatev for making me aware of the fact that a co-extentionality view can also be reasonably upheld by other considerations (see Zlatev 2002).

13. This point is reminiscent of Marx’s use of Hegel’s philosophy. Recall Marx’ aphorism: “The anatomy of man is a key to the anatomy of the ape” (from Introduction to Grundrisse). This should be understood within a frame of a radically reconstructive historical approach as opposed to a naively constructive chronological historiography (see Stahl 1975: 59–62).

14. This memory is often described as “genetic information” but it includes other forms of memory as well, i.e., stable inheritance systems located within the organism (but outside DNA), or within the ecological habitat of the organism (Jablonka 2001).

15. Organismic embodiment is a concept very similar to the one denoted by the same term in Ziemke (2003), who bases his term ‘organismic embodiment’ on J. von Uexküll and the notion of autopoiesis. However, Ziemke’s “organismic embodiment of autopoietic, living systems” (2003: 1306) does not distinguish, as we do here, between the body of biology and the body of zoology and thus lacks a specific notion of animate embodiment which is characterized by not only vegetative autopoiesis but also animate, proprioceptive, perception-motor-coupling based movement.

16. Cf. the Latin persona, a mask used by an actor.

17. There is an unsolved question here about the relation between a Peircean conception of causality operating with efficient and formal causation and an even more pluralist notion as the nnpc. See also Hulswitt (2002); Emmeche (2004a); Andersen et al. (2000).

18. Thus, one tends to forget that “the body in a contemporary society is already a cyborg body (a partly scientific-technologically governed body) as we are dependent, from birth to death, on the blessings of present-day medical science” (Emmeche 2002a: 155; see also Clark 2003).

References


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