Entropy **2010**, *12*, 1902-1920; doi:10.3390/e12081902

OPEN ACCESS

entropy

ISSN 1099-4300

www.mdpi.com/journal/entropy

Article

Cybersemiotics: An Evolutionary World View Going Beyond Entropy and Information into the Question of Meaning

Søren Brier

Department of International Studies of Culture and Communication, Copenhagen Business School, Dalgas Have 15, DK-2000 Frederiksberg, Denmark; E-Mail: sb.ikk@cbs.dk

Received: 31 May 2010 / Accepted: 27 July 2010 / Published: 9 August 2010

Abstract: What makes Cybersemiotics different from other approaches attempting to produce a transdisciplinary theory of information, cognition and communication is its absolute naturalism, which forces us to view life, consciousness and cultural meaning all as a part of nature and evolution. It thus opposes a number of orthodoxies: 1. The physico-chemical scientific paradigm based on third person objective empirical knowledge and mathematical theory, but with no conceptions of experiental life, meaning and first person embodied consciousness and therefore meaningful linguistic intersubjectivity; 2. The biological and natural historical science approach understood as the combination of genetic evolutionary theory with an ecological and thermodynamic view based on the evolution of experiental living systems as the ground fact and engaged in a search for empirical truth, yet doing so without a theory of meaning and first person embodied consciousness and thereby linguistic meaningful intersubjectivity; 3. The linguistic-cultural-social structuralist constructivism that sees all knowledge as constructions of meaning produced by the intersubjective web of language, cultural mentality and power, but with no concept of empirical truth, life, evolution, ecology and a very weak concept of subjective embodied first person consciousness even while taking conscious intersubjective communication and knowledge processes as the basic fact to study (the linguistic turn); 4. Any approach which takes the qualitative distinction between subject and object as the ground fact, on which all meaningful knowledge is based, considering all result of the sciences including linguistics and embodiment of consciousness as secondary knowledge, as opposed to a phenomenological (Husserl) or actually phaneroscopic (Peirce) first person point of view considering conscious meaningful experiences in advance of the subject/object distinction. The phaneroscopic semiotics includes an intersubjective base as Peirce considers all knowledge as intersubjectively produced through signs and view emotions and qualia as Firstness. The integrative transdisciplinary synthesis of Cybersemiotics starts by accepting

two major, but not fully explanatory, and very different transdisciplinary paradigms: 1. The second order cybernetic and autopoietic approach united in Luhmann's triple autopoietic system theory of social communication; 2. The Peircean phaneroscopic, triadic, pragmaticistic, evolutionary, semiotic approach to meaning, which has led to modern biosemiotics, based in a phenomenological intersubjective world of partly self-organizing triadic sign processes in an experiental meaningful world. The two are integrated by inserting the modern development of information theory and self-organizing emergent chemico-biological phenomena as an aspect of a general semiotic evolution in the Peircean framework. This creates the Cybersemiotic framework, where evolutionary experiental and intersubjective sign processes become the ground reality, on which our conceptions of ourselves, action, meaning and the word are built. None of the results from exact science, biology, humanities or social sciences are considered more fundamental than the others. They contribute on an equal footing to our intersubjective semiotics knowing process of ourselves and the world.

Keywords: cybersemiotics; semiotics; informationalism; absolute naturalism; phenomenology; phaneroscopy; autopoiesis; computationalism; intentional sciences; cenoscopic science; transdisciplinarity

1. Introduction: The Need for Going Beyond Common Sense

The present paper is supposed to set the framework for this whole special issue *Cybersemiotics—Integration of the informational and semiotic paradigms of cognition and communication*. I will primarily focus on discussing the limits of a pure or pan-negentropic informational world view combined with a pan-computational view. A common view among information theorists is that information integrated with entropy in some way is a basic structure of the World. Computation is the process of the dynamic change of information. In order for anything to exist for an individual, she must get information on it by means of perception or by re-organization of the existing information into new patterns. This cybernetic-computational-informational view is based on a universal and un-embodied conception of information and computation, which is the deep foundation of "the information processing paradigm". This paradigm is vital for most versions of cognitive science and its latest developments into brain function and linguistic research. Taken to its full metaphysical scope this paradigm views the universe as a computer, humans as dynamic systems producing and guided by computational functioning. Language is seen as a sort of culturally developed algorithmic program for social information processing.

What seems to be lacking is knowledge of the nature and role of embodied first person experience, qualia, meaning and signification in the evolution and development of cognition and language communication among self-conscious social beings and formed by the grammatical structure and dynamics of language and mentality. This article argues that a transdisciplinary paradigm of information, cognition and communication science needs, within its theory, to engage the role of first person conscious embodied social awareness in producing signification from percepts and meaning

from communication in any attempt to build a transdisciplinary theoretical framework for information, cognition, signification and meaningful communication. It has to embrace what Peirce calls *cenoscopic science* or, to use a modern phrase: *intentional sciences*. If it does not do so, but bases itself on physicalism, including physicalistic forms of informationalism such as info-computationalist naturalism, it is going to be difficult to make any real progress in the understanding of the relation between humans, nature, computation and cultural meaning through an integrated information, cognition and communication science.

I argue that a theory of signification and how meaning is produced through signs is needed to connect human consciousness with a theory of nature and information. For this we need to enlarge the picture by superimposing and integrating an even broader foundation such as Charles Sanders Peirce's pragmaticistic semiotics in its modern development as biosemiotics. The first ground work to explain why and how such a combinatory framework of semiotics and cybernetics makes it possible to make an evolutionary based transdisciplinary theory of information, cognition, consciousness, meaning and communication can be found in my book *Cybersemiotics: Why Information is not enough* [1] and the subsequent papers written after the book manuscript was finished [2-6].

The call for papers to this special issue has been to invite further work on these problems by researchers who have seen the necessity of combining information, cybernetics and semiotic theory. In the present article I am going to explain the idea of Cybersemiotics further and give an extended argument for its view of the human being and the knowledge it produces through the social endeavor we call science. As I cannot present the whole Cybersemiotic theory in this one paper I refer the interested reader that has not acquainted himself with the book to read the summary of Cybersemiotic theory in Nedergaard Thomsens's article: "From Talking Heads to Communicating bodies: Cybersemiotics and Total Communication." in the present special issue [7]. Here he further integrates Cybersemiotics with functional discourse grammar in an inventive way which enlarges its scope.

2. Science-Meaningful Intersubjective Knowledge

The impetus for developing Cybersemiotics was that one of the present limits of science is that it does not have a theory of the self same conscious experiental meaningful intersubjective knowledge that is the basis from which science itself has developed. I find eliminative materialism (for instance Dennett [8] and Churchland [9]), which promotes it and which does not give any causality to experiental mind, to be self-contradictory. This is because it is a fact that the methodological ideals of science, as well as the actual practise of science, are cultural products made by human minds linked by meaningful language communication in a society with a cultural horizon of meaning. Thus meaningful perception, cognition and communication are a prerequisite for science. But science as such does not yet have a theory of how that experiental and cognitive production of meaningful knowledge of conscious human beings, which constitutes culture, arises or emerges from evolution. But evolution of the Cosmos, the Earth, Life and Culture is one of the major meta-narrative theories in the sciences. It is not clear how a physicalistic theory of evolution based on the concepts of matter, energy, force and objective information in the form of neg-entropy as Wiener [10] and Schödinger [11] defined it or later pan-computionalist theories should be able to produce a theory of how experiental first person consciousness with qualia and the ability for meaningful cognition and communication evolved.

The ontological approaches in information science are usually based on the definition of a bit. The bit is usually understood as a primary binary distinction. This view leads to the "it from bit" theory of evolution in a digital universe. In a Wienerian cybernetic context inspired by Schrödinger the information term is based on entropy considerations. Entropy is complementary to information understood as negentropy and is viewed as configurational or organizational information, as opposed to the pure, probabilistic-based information concept of Shannon. The negentropy (physical information) should then be measured in entropy units as joules per degree Kelvin. This then is the average energy per degree of freedom. As such, information and entropy can be seen as pure numbers with dimensions of degrees of freedom. We can then get information in units of degrees of freedom as both are expressed as pure numbers. Boltzman's constant relates this to energy measures and other physical values. Thus this is an integrated entropic and informational theoretical concept based on non-equilibrium thermodynamics. From this foundation a theoretical model can be created of how dissipative structures can emerge and then support the chemical evolution of the foundations of life in the ability to produce macromolecules such as the DNA, RNA and enzymatic working proteins with autocatalytic abilities. But, my main critical point is that from this type of theory we still have a no clue as to how the dissipative structures of Prigogine [12] or the auto-catalytic agents of Kauffman [13] or other self-organizing or autopoietic phenomena could produce those sense experience, conscious awareness and that ability to produce meaningful interpretation, which lies as one of the core foundations of our ability to produce science.

After working about 30 years within cybernetics and systems and their concepts of information and emergent evolution my main critique is that they have not managed theoretically to integrate a phenomenological first person and intersubjective consciousness approach [1-6] into their transdisciplinary theory of goal-directed systems, not even in the weak form of just having the ability to have those sense-experiences that all living systems seem to possess and robots seem unable to have. Thus, as far as a transdisciplinary theory of information, cognition, communication and interpretation ought to go in connection with our present social abilities to our evolutionary physical origins in nature, we are not able "to make ends meet" in an internal and external consistent way.

This makes the natural sciences a knowledge system that is unable to explain its own basis. Of course this also goes for the social sciences as well as the humanities when they are ignoring the evolutionary origins of human cognitive and communicative abilities As such their theory cannot be all encompassing, unless you place the observer and his or her meaningful cognition in a special world outside the universe, as for instance Descartes did, but it is generally accepted in science and philosophy today that Descartes' dualism is not a satisfying ontology for solving our present attempt to understand the role and function of information, cognition, consciousness and communication in our universe.

The most well-known book criticising Descartes theory for cognitive research is probably Antonio R. Damasio's *Descartes' Error: Emotion, Reason, and the Human Brain* [14]. Science cannot in accordance with its own nature work with super or supra-natural worlds that affect the physical universe yet are inaccessible to scientific measurement. Some kind of monism is then sought after instead. But since the most common known ontology is the scientific world view, in which the qualia of first person conscious awareness is not a part, we easily end up in self-contradicting eliminative materialism like Dennett's and Churchland's mentioned above or supplemented with supervenience

theories where first person awareness has unexplained existence by emergent processes, but without any "downward" causal influence on the material body. The view is that brains 'get conscious' when they work, like machines get warm. It has no influence on what they originally set out to accomplish unless they are overheated so they destroy their own functions. It is obvious that such a scientistic and reductionistic view of nature - often in one or the other form of physicalism - is insufficient to explain the self-same science that produces the theories. One of the most well-known physicalistic philosophers Kim [15], points out the weaknesses of present physicalism in these matters. This lack of consistence is an embarrassment of science, when it claims to be able to explain both the outer nature of the world and the subjective conscious awareness as well as the intersubjective communicative knowledge from which science itself emerges.

But then, this kind of arguments is often discarded as "just philosophical" by scientists. That is fine when you only want to do empirical science, but it is not sufficient when engaged in the present endeavour of a transdisciplinary cognitive science of brain, consciousness, meaning and communication. Thus, this is the major embarrassment that forces us to search for another and grander transdisciplinary perspective than a fundamentalistic scientific one, if we are going to produce a theory that integrates first, second and third person knowledge.

In accordance with the critique of dualism my choice is to base my theory on a *total naturali*sm in the form that Fink [16] argues for in his development of McDowell's work on broad naturalism [17]. Both argue that a *scientistic definition of nature alone* is inadequate as a basis for a theory of the human and its embodied language-borne self-consciousness. As I will argue, below, we therefore have to develop another foundation for our theory of knowledge, meaning and communication.

3. A Foundation of Total Naturalism

To insist that the explanation of conscious experience as well as simple sense experience have to be included in an evolutionary explanation of information and communication does not imply that there is anything wrong with the sciences and their contribution to our understanding of ourselves, the universe, culture and society as such. But it does argue that there is no reason to believe that the theories and results of the exact natural sciences in any way exhausts what we can know about nature, mind, consciousness, feeling, meaning, culture and communication. This is rather obvious because to establish the exact sciences, certain ontological postulations about reality have to be made and, initially, the "world" under study did not include the observer or observing subject. Actually sciences actively excluded the observer, which makes it paradoxical that the exact sciences' fundamental theory of the world of its investigation which is the world without the knowing subject reflects back to try to explain that subject. Alternatively, it claims to have been investigating the whole world without finding any conscious subjects influencing the causal relations of this world and therefore declares that it makes most sense to eliminate subjective experience and will from causal theories of the world. But, how can empirical science function without sense experience and meaningful reasoning?

Thus, on the other hand, we must hold on to the important point that consciousness, meaning and communication are also natural phenomena. There is nothing supernatural about them. Culture is not outside nature and neither is the mind. Thus the" inside and the outside worlds" of human beings if I may formulate it in this way that is not mine are both natural and, as such, part of nature. Thus none of these phenomena as, different as they must appear, are absolute or completely qualitatively different.

They are all connected in one and the same field of being. *Synechism* is what C.S. Peirce [18] calls this kind of connectedness between mind and matter and therefore also nature and culture in his writings. Mind and matter are on each end of the same thing; the nature of which it is not the task alone of the sciences to determine.

Roy Bhaskar develops a very similar point in his writings about *non-duality* and its consequences for our world view [19]. Also Cantwell-Smith [20] points out that we are not outside the world when we scientifically investigate some of its aspects. Therefore our intentionality as well as meaning production is part of the same self world. Thus, we also need some kind of *intentional sciences*, *as* he calls them, to deal with that aspect of reality. We both have a world of *matter* and a world of *mattering* about meaning and experience, he points out. There is no way we can uphold a theory of science on the first aspect only and ignore the second one. This is the point I am arguing for here. It is also the fundamental point in Gadamer's *Truth and Method* [21], where he argues for a philosophy of humanistic "qualitative science", where rigorous methods are not enough to get to the truth about the world, because the qualitative deliberations not at least on epistemology and ontology necessarily come before one can perform any kind of empirical method and measurement. Concepts must be tied to an ontological and epistemological framework to give practical meaning, as also Kuhn [22] has argued so convincingly. He furthermore shows that science is also based on certain values such as for instance simplicity, symmetry, logic and mathematical consistency, functionality and predictability to be able to choose between.competing theories. As this is before science, the choices cannot be based on pure logical or mathematical empirically based rationality.

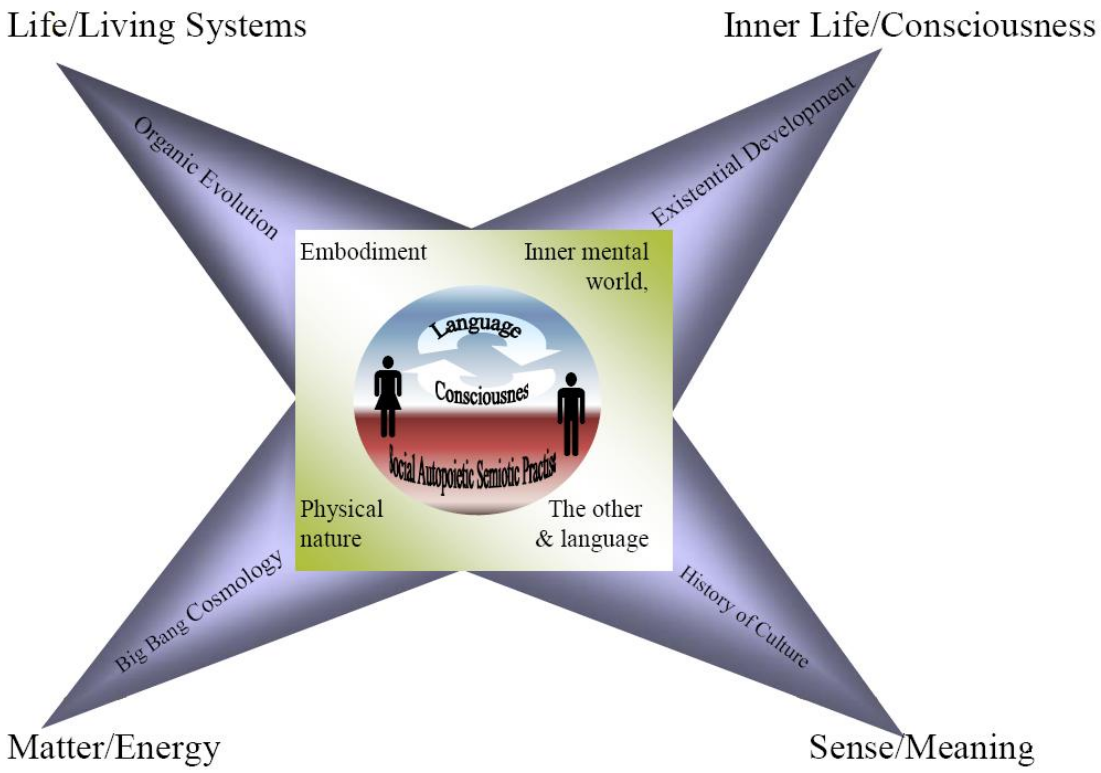
Another way to put it is to point out that all the unquestionable results of the sciences so far do not necessarily mean that consciousness, feelings, experience, qualia and meaningful communication can be explained in any complete way by the set of approximate physical laws the natural science have uncovered and by which they have made mathematical models that can be run by algorithms in a computer's programs. It is a well-established fact in science and philosophy of science that data are always theoretically undetermined, so there are several theories possible that can fit the data we have. In short: Nature is bigger than what science has described so far and may well continue to be so for eons! Science and its results is part of knowledge, but is not all of knowledge. This argumentation goes for the humanities and the social sciences as well as all three viewed together in a transdisciplinary view the Germans calls *wissencshaft* and the Danes *videnskab*, which is not implying a positivistic unity of science but only that the humanities, and social as well as natural sciences, have something in common that distinguishes them from other knowledge systems like religion, political ideology and embodied praxis. Thus the point is that *even Wissenschaft* is only one of several human knowledge systems developing from human social communicative and linguistic interaction in sign and language games. Furthermore it is uncertain to what extent the different kinds of Wissenschaft can be integrated into one grand (evolutionary) story to explain human kind's conscious behaviour and production of meaningful knowledge, such as science.

4. The Four Views in the Cybersemiotics Star

My theory and philosophy of science is, then, that in a total naturalism we have four different approaches to the understanding of cognition, communication, meaning and consciousness: the exact natural sciences, from the life sciences, from phenomenological-hermeneutic interpretational

humanities and from the sociological discursive-linguistic view, which are all equally important and have to be united in a transdisciplinary theory of information, semiotics, first person consciousness and an intersubjective cultural social-communicative approach. The model in Figure 1, called the *Cybersemiotic star*, illustrates this and from the model a few other points can be made, too. The model is based on the prerequisites of producing intersubjective knowledge such as Wissenschaft that we have discussed so far. To be a realist about the possibility of science giving us usable knowledge about reality is to accept the reality of language, autopoietic embodied minds, culture and non-cultural environment. The discussion about transdisciplinary knowledge is executed in a semiotic-linguistic discourse with other embodied and linguistically informed consciousnesses in a common praxis in non-cultural and cultural signification sphere (the part of reality which we can meaningfully perceive). From this interaction springs four main spheres of knowledge interest. But first, let us start in the middle whence the process of knowing flows.

Figure 1. The Cybersemiotic star: A diagram of how the communicative social system of embodied minds' four main areas of knowledge arises. Physical nature is usually explained as originating in energy and matter, sometimes also information, living systems as emerging from the development of life processes (such as the first cell). Social culture is explained as founded on the development of meaning and power in language and practical habits, and, finally, our inner mental world is explained as deriving from the development of our individual life world and consciousness, in spiritual and religious framework often ultimately from an objective transcendental spirit or as a soul coming from a personal creator God.



In the first person but intersubjective approach which we here with Pierce will call phaneroscopic, we deal with conscious impressions and expressions as the processes of sense experience and thinking in a state before sciences has divided the world into subjects and objects but still within a triadic semiotics. It is the subjective and intersubjectively shared first person experiential consciousness, as its own first cause, which is for Peirce semiotically based. In a Peircean semiotics, phaneroscophy becomes an intersubjective signification sphere. When we are studying socio-communication and acting from the point of language, we are acting in meaningful language studying other meaningful language. As Wittgenstein [23] argues, then, there are no private languages or language games and we can add there are no private sign games either and all knowledge comes through signs. These are emerging from the center of the Cybersemiotic Star as productions of embodied conscious pesons in language and sign games. Knowledge is born within the frame of an unrestricted absolute naturalism. This makes it impossible for any of the other specialized approaches to knowledge (in the four arms of the star) to claim that they make a model of all of nature. All perception is embedded in consciousness from the most rudimentary form as pure feeling in Firstness to human linguistic self-consciousness. For a basic transdisciplinary theory there is no theoretical interest in looking for something more original (material) "behind" the semiotic sense experience in a reality of potential signs. To do so one has to redefine the world by splitting it into a subjective and an objective aspect and then concentrate one's investigations on the objective site. This is what the sciences do, represented as one of the arms of the star and in its endeavour it tends to forget the unity, from which it started its epistemological project. In eliminative materialism as well as eliminative informationalism it even denies this original (triadic) unity (or life world), from which it sprang. That is the basic problematic inconsistency.

We are thus immersed in conscious communication forms be they verbal or non-verbal. As the linguistic turn argues, we cannot get out of language and thereby culture and power. Even science becomes a social construction, which is historically true, as there as been longer times in culture where we did not have science, than there has been with science. Empirical and mathematically grounded science is a rather modern invention that really started in the Renaissance. Scientific knowledge has formed our rationality and cultural outlook on the world up to the global discussion these days about the reality of global warming.

The other arm of socio-communicative "sciences", which is often based on the basic belief that all knowledge is created through intersubjective discourses in a culture with no attendance to evolutionary origins of body hood. This view has spawned social constructivistic paradigms believing that what we more or less creates nature and our view of our self through our discontinuous developing discourses. Structuralism and Marxism or the neo-combinations of them, for instance, consider the human subjects as having very little causal effect on human practise that is primarily seen as guided by social and cultural-linguistic patterns and forces.

The first person knowledge interest of the origin and function of mind and subjectivity in personal life is in the West mostly investigated in the phenomenological paradigm conceptualized as investigation of the *life world*. Phenomenology starts from conscious experience as it is also collectively shared with others in intersubjectivity. It views our experiental world as the basic reality from which all other things appear before language and science divides the world into subjects and object. It is opposed to the idea that reality is somehow something that is behind our experience or even the cause of our experience. Thus it considers itself as producing knowledge more foundational

than science, and underlines that conscious experience, in both its subjective and intersubjective versions, is before science and is therefore not something that is in need of scientific (materialistic or informationalistic) explanations. I think that no one has in a short form expressed it clearer than Merleau-Ponty in the following quote:

> *"Science has not and never will have, by its nature, the same significance qua form of being as the world which we perceive, for the simple reason that it is a rationale or explanation of that world. I am, not a 'living creature' nor even a 'man', nor again even 'a consciousness' endowed with all the characteristics which zoology, social anatomy or inductive psychology recognize in these various products of the natural or historical process I am the absolute source, my existence does not stem from my antecedents, from my physical and social environment; instead it moves out towards them and sustains them, for I alone bring into being for myself …the tradition which I elect to carry on,"* [24].

It is especially Husserlian phenomenology, which is the tradition upon which Merleau-Ponty draws, that puts the life world as more fundamental than scientific knowledge [25]. Consciousness is not viewed as a product of the brain or of culture and language in Husserl [26].

Peirce's semiotics has in common with Critical Rationalism and Critical Realism that it understands that humans create knowledge together in an integrated mixture of language and praxis. But it is not a pure constructivism as it recognises the importance of empirical testing of theories. It further recognizes our own roots through evolution in the self-same reality we are investigating and this fact does have considerable influence on forming our scientific knowledge. It is a kind of double realism, which Peircean pragmaticism presents since it believes in a (from the observer, partly independent) reality and at the same time that the embodied observer is a product of this same reality, which thus anchors the result of scientific investigations in a realist evolutionary framework. Our ability to carry out scientific measurement and inferential theory construction is based on the basic cognitive abilities the species has developed in the phenotypic body through millions of years of evolutionary selection!

Looking at the Cybersemiotic start we see that there are four forms of historical explanations going on: 1. The cosmological, 2. The biological, 3. The historical, and 4. The personal life history. The natural sciences work towards making one grand historical explanation; but so far we have not cracked the problem of the emergence of life and consciousness in evolution, I have argued here. Thus we might have to accept that an all-encompassing explanation of the conscious meaningful human communication process cannot be provided from any of the corners of the model. We cannot so far reduce our scientific explanations to one grand story; but, instead, have to juggle with all four at the same time as long as they have the present paradigmatic foundations.

How radical the shift from classical mechanical physics to quantum mechanics and quantum field theory is and to what degree it can create a new foundation with a new understanding of logic (quantum logic) has been intensely debated especially from the 1960s and on to the present. See for instance Stapp [27] for a summing up of how the new physics' ontological and epistemological framework is not independent of the observing mind, but includes it as a foundational aspect of choice in quantum physics, for instance, in the collapse of the probability wave function. Davies and Gribbin [28] conclude in their book *The Matter Myth* that Gilbert Ryle was right in asserting that there is not "ghost in the machine", but for the wrong reason. What modern physics reveals is that there is

no machine! Stapp and Davies and Gribbin all mention John Archibald Wheeler's theory of the "participatory universe" as being one of the more radical attempts to make a whole new framework for the sciences based on his interpretation of Bohr's complementarity view of quantum mechanics. The only problem is that although physics needs the observer, it does not have a theory of what the observer is that goes further than computation and information [28]. Meaning, experience, qualia and will are still outside that paradigmatic foundation of physics which, through chemistry, leads into general cell and body physiology. That foundation also leads, in the end, to the neuro and brain physiology from which we, in the paradigm of cognitive science, want to explain conscious sense experience and cognitive activity on which the social knowledge processes of science are founded.

5. The Significance of the Evolutionary Perspective

Thus, in evolutionary cognitive science and semiotics we have to invent models of how first person experiental consciousness and intersubjective meaning through communication emerge in living material (but at least now they are not mechanical) systems. Brain studies are not enough! An evolutionary theory has to be produced. Terrance Deacon's book *The Symbolic Species* [29] and Tomasello's [30] books are well-known attempts to cope with this challenge by way of close empirical descriptions of the evolution of mind and symbolic thinking. But none of them really develops a broader form of evolutionary theory that can explain how living systems come to have sense experiences and the ability to order them in meaningful ways. Deacon is the only exception in that he attempts to a certain degree to integrate C.S. Peirce's evolutionary semiotics into his biological theory development. Contrary to this, the journal *Cybernetics & Human Knowing* recently published an issue on these matters at the end of 2009 [31], where Göran Sonesson and Jordan Zlatev attempted to make a phenomenologically founded semiotic understanding of the development of human communication at the level of language and Winfried Nöth; in the same issue argued for the self-organizational abilities of signs in the Peircean semiotic paradigm and pointed out that these signs' ability to develop and self-organize in activity is crucial to Peirce's semioitcs. In the foreword to that issue I analyze some of the difficulties still ahead of us, not least that of how to integrate phenomenological and scientific evolutionary knowledge in one theory considering that Husserl never thought in terms of evolution.

I think that one of the reasons that these topics are still unresolved has to do with the fact that the original frameworks of two cultures of natural sciences and the humanities were established before Darwin proposed his evolutionary theory and before it slowly became widespread in scientific explanations. Thus neither the classical physical and chemical sciences nor the social sciences and humanities were prepared for theoretical evolutionary thinking in their foundational frames and concepts and it is well-known that the deep roots of paradigms are very difficult to change; not least because they are often hidden to many of those who do empirical research in a well-established framework that does not have a philosophy of science style reflection built into it.

Thus it was a shock for the humanities on the one hand to have to consider the evolutionary biological foundations of cognition, meaning and communication and a shock on the other hand for the natural sciences to have to include the evolution of motivation, intentionality, qualia, emotion and first person awareness as having survival value. Konrad Lorenz [32] tried and failed to integrate the inner

phenomenal world with the new biological behavioural science of ethology, as Hinde pointed out [33]. Biology has yet not been able to produce a concept of qualia or intentionality.

Thus, the humanities felt dominated by biologistic scientists or information and computer science-based cognitivistic explanations of human social coordination and communication. Natural science was confronted with the linguistic turn and various forms of constructivism, from solipsistic radical ones to softer social constructivisms, but all undermining the objective authority of science's explanations of how the world works. This ignited what has so often been called the 'science wars' of which nothing good emerged other than a realization from some researchers of the necessity to construct a new integrating transdisciplinary framework, in which all can work together in a fruitful way!

It is therefore my view that in moving from the information society to the knowledge society; we are forced to supersede the old version of the cognitive science based on the use of the model of physical information science and develop theories that can take us a level beyond it to living, feeling and willing systems with spontaneous cognition. The aim is to develop a broader, transdisciplinary, and more evolutionary framework for studying the development of cognition, communication and knowledge in the human life-world. This is necessary to integrate knowledge from the sciences with knowledge produced in the humanities and social sciences about communication, meaning and language in order to gain a deeper understanding of the social production of knowledge and rationality. The narrative and emotional aspect of knowledge has, since logical positivism, for too long been banned in information science, engineering, economics and knowledge management.

Thus it is necessary to develop a broader evolutionary and ecological understanding of embodied knowledge and forms of meaning as the foundation for spoken cognition and communication through written and spoken language as well as through embodied gestures and signs, and through pictures.

6. The Connection Between Life and Experience

In his *Critique of Practical Judgment* [34] Kant realized that on the basis of a mechanical science of nature such as that of Newton, a proper theory of life could not be developed. Living beings must, in Kant's view, rather be understood as self-organized autonomous systems. Kant never really drew the consequences of his discoveries for the rest of his philosophy. First-person experience, awareness, the production of meaning and signification still remain outside the scope of mechanicism as it has developed since Newton. Prigogine and Stengers [35] argued convincingly that the mechanical science of physics and chemistry is not concerned with explaining us as experiental, conscious, meaningful creatures in time. Prigogine and Stengers therefore wanted to remove mechanical deterministic science with its reversible time as foundational for the natural sciences and replace it with a science of complexity and irreversible time in which the mechanical systems we only a special class of closed equilibrium systems. But, even if that move paved the way for a grand evolutionary theory with self-organization and emergence, it did not even get started on solving the problem of experiential awareness and the faculty of sensory experience and cognition of living systems. The problem is most famously formulated in Nagel's article "What does it feel like to be a bat" [36]. Awareness makes it feel like something to exist! The world feels like something through sense-experience, which also makes the body feel like something. Different qualities of sense experience (qualia), pleasure, pain, happiness and sorrow become possible.

The development of information theory and science, originally as a part of cybernetics and systems science, has been an attempt to model these aspects of reality. In order to accommodate the developing scientific perspectives, including statistical mechanics, modern evolutionary theory, and even quantum and black hole physics, many concepts of "information" were developed by researchers from Boltzmann to Shannon, Szilard, Wiener, Schrödinger and Bateson and have been invoked at a level complementary to matter and energy.

The scientific approach has mostly chosen a bottom up physicalist approach, enlarged with a theory or science of information asking questions like: in non biotic, proto semiotic systems, what is the nature and operation of "information content" or "information processing"? In evolutionary theory, they ask where and when do information storage and processing first occur? What does it mean, if anything, to store, process, or transmit information in natural, living, mechanical, cultural and human systems? It is a bottom up approach attempting to explain all these various types of systems. See for instance Gordana Dodig-Crnkovic's article [37] in this special issue for this type of thinking.

A top down approach on the other hand brings us to consider how meaning is connected to the subjective experience of the world entangled in the intersubjectivity of communication and the culturally developed knowledge embedded in language. Consciousness introduces the first person perspective as well as the second person intersubjective experience of meaning, neither of which are reducible to the third person perspective of the sciences. The notion of meaning has to take into account concepts like the experience of "what is it like to be a bat?" [38] or even, "what is it like to be me?". Thereby the existential problem is seen as foundational and, with that, the problem of good and bad, truth and meaning, open not only for philosophy within a social context of cultural order, but also for spiritual, religious as well as politic ideological systems of knowledge. An embodied conscious being is necessary. Searle [39] is of the opinion that the origin of meaning is in the biology or aspects of living systems that we have not managed to understand yet. The development of Peircean biosemiotics is an attempt to provide such a complementary theory to molecular biology that can introduce life, meaning and awareness at a fundamental level through a basic phenomenological approach which Piece calls phaneroscophy.

Thus I want to make clear that "a far from equilibrium status" diagnosis of a system is not enough to define it as living. It only defines a chemical aspect of living system as well as many other non-living systems. Our problem is that something about life evades our present scientific attempts to find a scientific model to describe it, because meaning is not a scientific concept and neither is first person consciousness, even if we include the largest thinkable informational and computational paradigms and combine them, as long as it is ontologically based on matter, energy and objective information only.

As far as we know, biological systems are the only ones capable of producing experience and feeling. In the last 20 years or so a growing acknowledgement of the importance of embodiment, emotions and feelings for the production of conscious knowledge has been developed. I have already pointed to Damasio's early work, but his later work [39,40] goes deeper into the necessity of emotions and feeling for the cognitive apparatus. His *somatic-marker hypothesis* proposes a mechanism by which emotional processes can guide behaviour, not least relevant for decision-making. He shows that previously experienced situational emotions guide attention towards a situation connected with good experiences by drawing on a register of all reward and punishment associated experiences stored in the

memory of the brain. This theory is progress into the cognitive roles of emotions, though it still does not explain how brains can produce feelings.

Behaviourism, different forms of eliminative materialism, information science, cognitive science and now the information processing paradigm developed into 'grand narratives' in order to attempt to explain human communication from outside, without respecting the phenomenological and hermeneutical aspects of existence. Something important with respect to human "nature" is missing in these systems and the technologies developed on their basis. Life, as human embodiment, is fundamental to the understanding of human understanding.

There seems to be a general agreement that the relation between DNA, RNA, ribosomes and amino acids involves information and coding in order to produce viable proteins that are useful for the cell and can be send out as sign molecules like hormones and transmitter molecules. Thus we might evolutionary want to start by understanding how cells can produce agency and signification. But, on the other hand, meaning is a top-dawn concept developed from human intersubjective communication in culture allowing us to reason about information. The scientific concepts of information cannot explain meaning from a bottom up approach. *The meaning of information is not information and the information of meaning is not meaning,* when we only use the term information physicalistic. The meaning of some information is defined by the difference somebody experience by it. Meaning is a term concerning sign perception and understanding of communication. Meaning is the difference that a sign makes in the world to somebody as standing for something in some aspect or other. In his review of my book *Cybersemiotics: Why information is not enough!* Wolfgang Hoffkirschner [41] discusses why I have to integrate the two approaches of information and semiotics (from Peirce), He asks why I chose to define information without meaning. If I had included meaning in information then I would have been over that problem and could form a transdisciplinary "Foundation for Information Science". This is the name of the transdisciplinary group (FIS), of which we have both been central members for many years. My answer is that information is defined in the natural and technical sciences by Shannon and Weaver and by Wiener and Schrödinger. Here it has a rather precise mathematical definition. Shannon's definition incorporates the notion that information is a quantitative concept that can be measured. Shannon wrote his famous definition: "We have represented a discrete information source as a Markoff process. Can we define a quantity, which will measure, in some sense, how much information is 'produced' by such a process, or better, at what rate information is produced?" [42] Shannon underlined that his definition of information is not connected to meaning. He writes: "The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem." (Shannon [42], p. 379). Shannon also suggested that information in the form of a message often contains meaning, but that meaning is not a necessary condition for defining information. Information may describe a pattern, but patterns in themselves as such have nothing to do with meaning. They have to be interpreted together with the situation by a living system. This of cause raises the problem of whether it is possible to have information without meaning or if information is always an aspect of meaning? I have discussed that in [43].

Shannon's theory of information is actually the notion of information for communications engineering and not for a basic scientific grounding of a general information theory for the world as such. One could argue that the notion of imagining information as something independent of its meaning or context would be like looking at a figure isolated from its ground. But the meaning emerges among other things from the relation between ground and figure. Thus, if you change one of them, the whole relationship changes and thereby the possible meanings on can interpret from their relation. If you change the ground then you also change the meaning of the figure. Actually the way we look at the relationship between ground and figure seems to be imbedded in the structure of language. Chinese people seem to be looking at the ground first and the figure later. Americans tends to do the opposite, writes Nisbett [44].

Shannon's job was to solve an engineering problem to quantify human communication over telephone cables. As such, he took meaning for granted. Why else would people want to speak to each other, if they did not find it meaningful? Why build technology for something that the human does not find meaningful and would not pay for? Actually, Donald MacKay wrote [45] that "Information is a distinction that makes a difference" suggesting that information should be defined as "the change in a receiver's mind-set, and thus with meaning" and not just the sender's signal. It seems that the basic mistake in modern information science was to go from a definition of information as a technical aspect of meaningful communication to making it an independent foundational and meaningless aspect of reality from which one can then attempt to build a whole world view. Gregory Bateson [46] later attempted on a cybernetic basis, to reintegrate this information definition into the ecology of mind of all living systems be defining information as "a difference that makes a difference". It made many people think that Bateson meant for a subject or a consciousness, but actually he meant for a cybernetic mind of circulating differences. It also lead Bateson to suggest, inspired by Wiener's "information is information, neither matter nor energy", that the informational world is a partly independent aspect of the physical world [46].

In [1] I suggest that it is the combination of the physical and the informational world that gives rise to the chemical world. Thus one of my conclusions is that *there is a field of information in the cybernetic world, but there is no field of meaning*, as cybernetics and autopoiesis theory do not have a theoretical definition of first person consciousness as part of their paradigm. So, when Hoffkirschner asks, why not information all the way (down or up) instead of needing to supplement a transdisciplinary theory of information, cognition and communication with semiotics? My answer is that semiotics pertains to meaning and how it is related to living beings and later living conscious beings. *The meaning of information is not informational, but semiotic in the Peircean sense and meaning is therefore not comprehensible to information science*!

Thus I have argued that the problem is that even if you enlarge your ontological basis from matter and energy to include (Wienerian) information, it is not enough to explain life, consciousness and meaning production. My point is that any informational theory based on probability theory and or algorithms including Chaitin's, which Dodig-Crnkovic [36] builds on, is unable to solve the problem of how or where the experiental awareness, which is the basis of sense experience and consciousness, arises in nature, if that is what it does.

Not even if you develop a concept of natural computing and a more general information theory does it lead the way to experiental awareness and meaning. It rather leads to a computational view of the

world including nature, human mind, society, language and culture. This can easily lead to not a eliminative materialistic, but an *eliminative informationalism*. As you can see in Nedergaard Thomsen's article in this issue [7], Cybersemiotics combined with functional discourse grammar suggests another way based on C.S. Peirce's phaneroscopic intersubjective and evolutionary semiotics. But it is of cause possible to work with an information theory that is based on human communication and then work with formal, semantic and pragmatic aspects as, for instance, Küppers [47] does.

But there is a more systemic and organismic strategy, which is to use the information concept all the way up to meaningful language communication and all the way down to the physical level and then talk about physical, chemical, biological, psychological and communicational information, which is quite a common strategy by the members of the Foundation of Information Science group and many others that want to stay "scientific". At the bottom we then have information without meaning; in the middle, coded information with some kind of biological functional meaning; and at the top, human conscious intentional communicative meaning in language. The information concept seems to connect them all and meaning is introduced by emergence in evolution often by using a general systems holistic view. But this still places, in my view, information and meaning as two separate things, where information is there all the time but meaning emerges later on in evolution. Further I do not consider emergence and supervenience theories to be solutions to the question of the creation of meaning and conscious awareness, but rather concepts attached to an unsolved problem because they do not seem to explain how the qualitative difference comes into existence, at least as long as they only work with one level of existence. This is the reason I have made my model in the shape of a star and not a causal hierarchy in time and complexity, where the more complex levels emerge from the less complex because the space of probability is there to explore. Such a view of the attractive force of emptiness or the negative may on the level of non-equilibrium thermodynamics explain how more complex systems evolve and are stabilized through a stream of matter and energy by means of them transporting entropy out of the system. But the ability of having sense-experience and awareness is not just a new level of complexity. It is something qualitatively new.

It is also unclear to me what the ontological assumption about the world and its fundamental constituencies are in organicistic system theory. I have shown that those who base themselves on Prigogine's non-equilibrium thermodynamics in combination with Wiener's neg-entropic information concept cannot claim that they have explained the ability to have sense-experiences in living systems as such. Placing Bateson's cybernetic mind on top of that does not solve the problem, as Bateson's concept of mind is purely cybernetic [4]. Even adding the theory of autopoiesis of Maturana and Varela on top of this does not give us a theory of first person awareness as I have argued in [5,6]. Though Maturana does introduce autonomy into second order cybernetics, he has not developed a theory of the evolution from dead matter to living systems and further self-conscious communicating aware systems like humans. And I am rather sure that this is not the type of explanatory system he finds it relevant to construct. Maturana does not explain life in an ordinary scientific way based on a physicalistic ontology. He starts with life as foundational and develops a theory of its self-organizing dynamics, but does not develop a theory of how conscious awareness develops out of life. Rather he seems to take it for granted or a foundational aspect of life, which he does not intend to explain objectively from physics and chemistry as he is arguing against the self same scientism. Maturana's theory deals primarily with cognition and communication from a biologically self-organized

autonomous point of view. It seems that his theory does take some level of awareness as given in all living systems, but as I have argued [1], he does not develop a phenomenology in the style of neither Husserl or Peirce, but one maybe call his work a sort of behavioral bio-phenomenology.

Thus a phenomenological or phaneroscopic view is not included in cybernetic theory, not even in its second order form from von Foerster or in the form of the autopoiesis theory of Maturana and Varela [1]. Luhmann, who takes over the autopoietic theory from Maturana and Varela and, despite their protests, generalizes it, realizes this and he borrows from Husserl the first person phenomenological approach to meaning and turns it into an interpersonal field in which a difference can make a meaningful difference, as I have described in [2]. But here I also argue that it is not clear to me how Luhmann connects phenomenology and that evolutionary thinking, which is part of the general systems theory that he is using as the foundational paradigm. But it fits well with his using a generalized form of autopoiesis to develop a general evolutionary system theory with three levels of autopoiesis (biological, psychological and socio-communicative). But how we come from biological autopoiesis to psychological autopoiesis is not dealt with theoretically in his paradigm of system theory. Luhmann defines the psychological autopoietic and the communicative autopoietic systems as working in the medium of meaning and the biological autopoietic system as working in the field of life. He builds his system theory on autopoiesis theory and second order cybernetics plus general system theory and tries to combine it with an interpretation of Husserlian phenomenology [2] that I find difficult to take seriously. He rips out the heart of phenomenology and transplants it into second order cybernetic systems theory, where I do not think it can survive, because the system will reject it as foreign. In any case, the field of meaning somehow becomes the third world.

7. The Incompatibly of the Epistemologies of the Four Approaches

My theory and philosophy of science is that all the four approaches from physics, from biology, from phenomenological awareness and intentionality, and from the sociolinguistic view are all equally important and therefore have to be united in a transdisciplinary theory of information, semiotics, first person consciousness and an intersubjective cultural social-communicative approach. The Cybersemiotic star model illustrates this; while at the same time pointing to the fact that the discussion about transdisciplinary knowledge is conducted in a linguistic discourse with other embodied and linguistically-informed consciousnesses in both a natural and cultural Umwelt.

Each of the four corners of the star represents different kinds of epistemologies. In science we have - as prerequisite outside the theory- several living embodies conscious subjects linked by knowledge sharing in language confronting one or more objects. The first person living consciousnesses of the subject(s) as observers are considered to be outside the world they observe. In the biological sciences the observers share the life experience with their objects that are also living and therefore experiencing. It is sadly often forgotten in molecular definitions of life that it is a basic and common trait of all life that it senses and experiences, a fact not easily explainable from a molecular level. We can kill the life we investigate to find out the molecular structure, but then we are returned to physico-chemical approaches as the life and the agency of the living is gone. But when studying living beings in the state of being alive, sensing their surroundings and creating their own Umwelt, we are in a qualitatively new situation, as we have to accept that the living systems experience the environment

in a specific manner, which will most often be partly different from ours. Thus we are in a second order situation, where we are observing observation.

As a natural scientist I have wondered, since the early days of my study of biology, why scientific explanations of life were so inadequate and why biology had problem of being recognized as a real natural science side by side with physics and chemistry. In the end, the solution of adapting biology to the received view of science turned out only to favour molecular biology as the 'core' of biology and gave up the task of explaining the experiential aspect of life and living experience in a scientific manner.

The next two steps in the development of modern molecular biology were to accept the genetic characteristics of the DNA molecule and then to link it to the RNA molecules and again to the sequences of amino acids in the construction of proteins. This functional connection is then viewed as a 'code' and is therefore claimed to contain 'information'. Some researchers even call it 'biological information'. This is a bit strange since a "code" is usually something a conscious purposeful being - like a human - constructs, either for the use of communication or to connect some part of information with material forms and processes. *How can a code be constructed from below so to speak,* meaning from a molecular level without purpose, interpretation and consciousness?

The next step in this type of scientific explanatory strategy was Dawkins [48] explanation of life as constituted by 'selfish genes'. It looks very scientific mechanistic, but in the end what people like Richard Dawkins have done, is to transfer agency to the genes without admitting it. In the present special issue, Alexei Sharov in his article [49] attempts to define agency in a more basic way at the foundational level in a theory of nature. But one cannot hide the problem of experiential awareness' nature and role in the evolution of natural systems and how, in the form of that subjectivity, which is what we normally take as the model of agency, it influences the informational, energetic and material aspects nature. While these models have worked fine for many purposes, one of them being development of technology and more control over nature I argue that they are too reductionist to explain the rise of experiential agency in the living system through evolution, which was an important part of the original puzzle. I have analysed and discussed this in much further detail in [1-6]. Thus a biosemitics based on Peirce's transdisciplinary semiotic philosophy (5) seems a fruitful way to complement the present dominant view of life in the sciences.

References and Notes

1. Brier, S. *Cybersemiotics: Why Information is not Enough!* University of Toronto Press: Toronto, Canada, 2008.
2. Brier, S. Applying Luhmann's system theory as part of a transdisciplinary frame for communication science. *Cybe. Huma. Know.* **2007**, *14*, 29–65.
3. Brier, S. The Peircean paradigm for biosemiotics. *Signs* **2008**, 30–81.
4. Brier, S. Bateson and Peirce on the pattern that connects and the sacred. In *A Legacy for Living Systems: Gregory Bateson as Precursor to Biosemiotics*; Hoffmeyer, J., Ed.; Springer Verlag: London, UK, 2008; Chapter 12, pp. 229–255.
5. Brier, S. Cybersemiotic pragmaticism and constructivism. *Cons. Foun.* **2009**, *5*, 19–38.
6. Brier, S. Levels of Cybersemiotics: possible ontologies of signification. *Cogn Semi*. **2009**, *4*, 28–62.

7. Thomsen, O.N. From talking heads to communicating bodies: Cybersemiotics and total communication. *Entropy* **2010**, *12*, 390–419.
8. Dennett, D.C. *Consciousness Explained*; Back Bay Book: New York, NY, USA, 1991.
9. Churchland, P.S. *Neurophilosophy; Toward a Unified Science of the Mind/Brain*; MIT Press: Cambridge, MA, USA, 1986.
10. Wiener, N. *Cybernetics or Control and Communication in the Animal and the Machine*, 2nd ed.; John Wiley & Sons/The MIT Press: New York, NY, USA, 1948.
11. Schrödinger, E. *What is Life*? Cambridge University Press: Cambridge, UK, 1967.
12. Prigogine, I. *The End of Certainty. Time, Chaos, and the New Laws of Nature*; The Free Press: New York, NY, USA, 1996.
13. Kauffman, S. *At Home in the Universe*; Oxford University Press: Oxford, UK, 1995.
14. Damasio, A.R. *Descartes' Error: Emotion, Reason, and the Human Brain*; Putnam Publishing: New York, NY, USA, 1994.
15. Kim, J. *Physicalism, or Something Near Enough*; Princeton University Press: Princeton, NJ, USA, 2005.
16. Fink, H. Three sorts of naturalism. *Euro. Phil*. **2006**, *14*, 202–221.
17. McDowell, J. *Mind, Value and Reality*; Harvard University Press: Cambridge, MA, USA, 1998.
18. Peirce, C.S. *The Collected Papers of Charles Sanders Peirce, vol. I-VIII.*; Harvard University Press: Cambridge, MA, USA, 1931–1958.
19. Bhaskar, R. *Meta-Reality: The philosophy of meta-Reality*; Sage Press: New Delhi, India/London, UK, 2002; Volume 1.
20. Smith, B.C. *God, Approximately 4*. Available online: http://www.ageofsignificance.org/people/bcsmith/print/smith-godapprox4.pdf (accessed on March 16, 2010).
21. Gadamer, H.G. *Truth and Method*; Seabury Press: New York, NY, USA, 1975.
22. Kuhn, T. *The Structure of Scientific Revolutions*, 2nd ed.; The University of Chicago Press: Chicago, IL, USA, 1970.
23. Wittgenstein, L. *Philosophical Investigations*; Macmillan Press: New York, NY, USA, 1958.
24. Merleau-Ponty, M. *Phenomenology of Perception*; Translated by C. Smith. Routledge & Kegan Paul: London, UK, 2002. Originally published as *Phenomenologie de la Perception*; Callimard: Paris, France, 1945, English 1962.
25. Heelan, P.A. Husserl's later philosophy of natural science. *Phil. Sci*. **1987**, *53*, 368–390.
26. Husserl, E. *The Crisis of European Science and Transcendental Phenomenology*; Northwestern University Press: Evanston, IL, USA, 1970.
27. Stapp, H.P. *Mindful Universe: Quantum Mechanics and the Participatory Observer*; Berlin, Heidelberg. Springer-Verlag: New York, NY, USA, 2007.
28. Davies, P; Gribbin, J. *The Matter Myth: beyond Chaos and Complexity*; Penguin Books: London, UK, 1991.
29. Deacon, T.W. *The Symbolic Species: The Co-evolution of Language and the Brain*; Norton: New York, NY, USA, 1997.
30. Tomasello, M. *Origins of Human Communication*; MIT Press: Cambridge, MA, USA, 2008.
31. Brier, S.; Guddemi, P.; Bunnell, P.; Bopry, J. The transdisciplinary development of cybernetics and cybersemiotic. *Cybern. Hum. Knowing* **2009**, *16*, 3–4.

32. Lorenz, L. *Studies in Animal and Human Behaviour I and II*; Harvard University Press: Cambridge, MA, USA, 1970.
33. Hinde, R. *Animal Behaviour: A Synthesis of Ethology and Comparative Behavior*; McGraw-Hill: Tokyo, Japan, 1970.
34. Kant, E. *Critique of Practical Reason*; Forgotten Books: online, 2008, (original version: 1788). Available online: http://books.google.dk/books?id=N549zroUaaUC&printsec=frontcover&dq=Kant+Critique+of+practical+reason&source=bl&ots=W9f5vD01CW&sig=rrKWmCxNCaRUW5l8Wx7eve4RyOA&hl=da&ei=6TPwS5vPEMKLON7xvacI&sa=X&oi=book_result&ct=result&resnum=3&ved=0CCMQ6AEwAg#v=onepage&q&f=false (accessed on 22 May 2010).
35. Prigogine, I.; Stengers, I. *Order Out of Chaos: Man's New Dialogue with Nature*; Bantam Books: New York, NY, USA, 1984.
36. Nagel, T. What is it like to be a bat? *Phil. Rev.* **1974**, *83*, 435–450.
37. Dodig-Crnkovic, G. The cybersemiotics and info-computationalist research programmes as platforms for knowledge production in organisms and machines. *Entropy* **2010**, *12*, 878–901.
38. Searle, J. *Minds, Brains and Science*; Penguin Books: London, UK, 1989.
39. Damasio, A.R. *The Feeling of What Happens. Body and Emotion in the Making of Consciousness*; Harcourt-Brace & Company: New York, NY, USA, 1999.
40. Damasio, A.R. *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain*; Harcourt: New York, NY, USA, 2003.
41. Hoffkirschner, W.; Larsen, S.N. Two reviews of cybersemiotics: Why information is not enough. *Cybe. Huma. Know. J.* **2009**, *16*, 179–191.
42. Shannon, C. A mathematical theory of communication. *Bell. Syst. Tech. J.* **1948**, *27*, 379–423, 623–656.
43. Brier, S. Cybersemiotics and the question of knowledge. In *Information and Computation*; Dodig-Crnkovic, G., Burgin, M., Eds.; World Scientific Publishing Co.: in press.
44. Nisbett, R. *The Geography of Thought: How Asians and* Westerners *think differently and why*; Free Press: New York, NY, USA/London, UK/Toronto, Canada/Sydney, Australia, 2003.
45. MacKay, D.M. *Information, Mechanism and Meaning*; MIT Press: Cambridge, MA, USA, 1969.
46. Bateson, G. *Steps to an Ecology of Mind*; Paladin: London, UK/New York, NY, USA, 1973.
47. Küppers, B.O. *Information and the Origin of Life*; The MIT Press: Cambridge, MA, USA/London, UK, 1990.
48. Dawkins, R. *The Selfish Gene*; Oxford University Press: Oxford, UK, 1999, pp. 352.
49. Sharov A.A. Functional information: towards synthesis of biosemiotics and cybernetics. *Entropy* **2010**, *12*, 1050–1070.