

## IJSSS Editorial Board

<b>Editors-in-Chief:</b>	Angelo Loula, State U. of Feira de Santana, Brazil João Queiroz, Federal U. of Juiz de Fora, Brazil
<b>Associate Editors:</b>	Angelo Cangelosi, U. of Plymouth, UK Peter Cariani, Harvard Medical School, USA Rodney J. Clarke, The U. of Wollongong, Australia Claus Emmeche, U. of Copenhagen, Denmark James Fetzer, U. of Minnesota, USA Ricardo Gudwin, State U. of Campinas, Brazil Ahti-Veikko J. Pietarinen, U. of Helsinki, Finland Sidarta Ribeiro, International Neuroscience Institute of Natal, Brazil Solomon Marcus, U. of Bucharest, Romania Mihai Nadin, The U. of Texas at Dallas, USA Luis Mateus Rocha, Indiana U., USA Frederik Stjernfelt, U. of Aarhus, Denmark Jon Umerez, U. of the Basque Country, Spain
<b>IGI Editorial:</b>	Heather A. Probst, Senior Editorial Director Jamie M. Wilson, Director of Journal Publications Chris Hrobak, Journal Production Manger Christen Croley, Journal Production Assistant

### Editorial Review Board

Atocha Aliseda, Universidad Nacional Autónoma de Mexico, Mexico  
Eugenio Andrade, National U. of Colombia, Colombia  
Argyris Arnellos, U. of the Basque Country (UPV/EHU), Spain  
Anthony Chemero, Franklin and Marshall College, USA  
Robert Clowes, U. of Sussex, UK  
Vincent Colapietro, Pennsylvania State U., USA  
John Collier, U. of KwaZulu-Natal, South Africa  
Silvia Coradeschi, Orebro U., Sweden  
Marcel Danesi, U. of Toronto, Canada  
Gerd Doeben-Henisch, U. of Applied Sciences, Frankfurt am Main, Germany  
Charbel El-Hani, Federal U. of Bahia, Brazil  
Donald Favareau, National U. of Singapore, Singapore  
Tom Froese, U. of Tokyo, Japan  
Bruno Galantucci, Yeshiva U., USA  
Tao Gong, U. of Hong Kong, China  
Maria Eunice Gonzalez, U. of São Paulo State, Brasil  
Patrick Grim, State U. of New York at Stony Brook, USA  
Risto Hilpinen, U. of Miami, USA

Wolfgang Hofkirchner, U. of Salzburg, Austria  
Lorenzo Magnani, U. of Pavia, Italy  
Koichiro Matsuno, Nagaoka U. of Technology, Japan  
Alexander Mehler, Goethe-Universität Frankfurt am Main, Germany  
James H. Moor, Dartmouth College, USA  
David Myers, Loyola U. New Orleans, USA  
Chrystopher L. Nehaniv, U. of Hertfordshire, UK  
Sami Paavola, U. of Helsinki, Finland  
Leonid Perlovsky, Air Force Research Laboratory, USA  
Roberto Poli, U. of Trento, Italy  
Robert Port, Indiana U., USA  
Alexander Riegler, Vrije Universiteit Brussel, Belgium  
Stanley N. Salthé, Binghamton U., USA  
João Sequeira, Instituto Superior Técnico, Portugal  
Chris Sinha, Lund U., Sweden  
Göran Sonesson, Lund U., Sweden  
Maria Patrizia Violi, U. of Bologna, Italy  
Paul Vogt, Tilburg U., The Netherlands  
Wolfgang Wildgen, U. of Bremen, Germany



IGI PUBLISHING  
WWW.IGI-GLOBAL.COM

# CALL FOR ARTICLES

## International Journal of Signs and Semiotic Systems

*An official publication of the Information Resources Management Association*

The Editor-in-Chief of the *International Journal of Signs and Semiotic Systems* (IJSSS) would like to invite you to consider submitting a manuscript for inclusion in this scholarly journal.

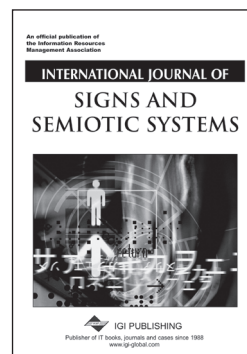
### MISSION:

The mission of the *International Journal of Signs and Semiotic Systems* (IJSSS) is to provide a forum for comparative, evolutionary, theoretical, and empirical perspectives on computational modeling of semiotic systems and processes, and to present formal and synthetic simulation, implementation, and realization of computer machines and robots involved in these systems and processes. This journal offers a collaborative approach to innovative research geared toward a deeper understanding of semiotic processes and an integrated vision of synthesis in artificial systems. As an integral reference for community researchers in the field, this publication explores recent developments in neurocognitive science, cognitive ethology, second order cybernetics, cognitive semantics, pragmatic linguistics, theoretical semiotics, biosemiotics, and evolutionary biology.

### COVERAGE:

Topics to be discussed in this journal include (but are not limited to) the following:

- Adaptive advantage of iconic, indexical, and symbolic systems and processes
- Biologically inspired models of semiotic systems
- Collaborative semiotic processes and applications
- Embodied and situated semiotic processes
- Emergence and evolution of semiotic processes
- Evolution of information interpretation systems
- Meaning
- Meaningful text mining
- Semiotic dynamics and complexity
- Semiotic systems
- Sign and symbol grounding
- Sign production, computing, interpretation, and communication
- Societal and organisational semiotic processes
- Technological semiotic artifacts
- Umwelt, semiotic landscapes, and niches



ISSN 2155-5028

eISSN 2155-5036

Published semi-annually

All submissions should be emailed to:  
Angelo Loula & Joao Queiroz, Editors-in-Chief  
[ijsss@artificial.eng.br](mailto:ijsss@artificial.eng.br)

Ideas for special theme issues may be submitted to the Editor-in-Chief.

**Please recommend this publication to your librarian. For a convenient easy-to-use library recommendation form, please visit:  
<http://www.igi-global.com/ijsss>**

# INTERNATIONAL JOURNAL OF SIGNS AND SEMIOTIC SYSTEMS

January-June 2012, Vol. 2, No. 1

## Table of Contents

### EDITORIAL PREFACE

- i** *Angelo Loula, State University of Feira de Santana, Brazil*  
*João Queiroz, Federal University of Juiz de Fora, Brazil*

### RESEARCH ARTICLES

- 1** **Reassessing the Foundations of Semiotics: Preliminaries**  
*Mihai Nadin, University of Texas at Dallas, USA, and Hanse Institute for Advanced Study, Germany*
- 32** **Semiotic Systems, Computers, and the Mind: How Cognition Could Be Computing**  
*William J. Rapaport, University at Buffalo, The State University of New York, USA*
- 73** **The Concept of Exaptation Between Biology and Semiotics**  
*Davide Weible, Tartu University, Estonia*

## EDITORIAL PREFACE

*Angelo Loula, State University of Feira de Santana, Brazil*

*João Queiroz, Federal University of Juiz de Fora, Brazil*

The primary objective of the *International Journal of Signs and Semiotic Systems* (IJSSS) is to bring together multidisciplinary efforts in computational, empirical, theoretical and formal approaches in modelling semiotic processes, especially those that contribute to the design and synthesis of semiotic systems, such as biological evidences or evolutionary and philosophical frameworks. The frameworks and theories explored take into account recent developments from neurocognitive science, cognitive ethology, second order cybernetics, artificial life, biosemiotics, and evolutionary biology.

This is the first journal profoundly devoted to the modeling of semiotic systems and process. The journal offers a space of intense collaboration from empirical studies and theoretical frameworks toward a deeper understanding of semiotic process and an integrated vision of its synthesis in artificial systems. In establishing this journal, we encourage collaborative approaches regarding semiotic systems and processes, ranging from biological and empirical modelling to formal-theoretical studies.

In this first issue of 2012 we have the participation of authors from different areas of expertise. As the reader can notice, each author provides a different perspective of semiotic processes, endorsing the multidisciplinary proposal of IJSSS. Mihai Nadin discusses the foundations of semiotics, examining its definitions, history and methodology, and arguing on the necessity and relevance of semiotics. William Rapaport replies to James Fetzer's paper on the first issue of IJSSS and argues that cognition is computable and that both humans and computers are semiotic systems. Davide Weible discusses the biological concept of exaptation, pointing out point its history, its use in other fields, with specific focus on semiotics and biosemiotics.

We invite authors from all fields to continue this multidisciplinary talk and contribute with different views and perspectives on semiotic systems and processes.

*Angelo Loula  
João Queiroz  
Editors-in-Chief  
IJSSS*

*Angelo Loula is a professor of Computer Engineering at the State University of Feira de Santana (UEFS, Bahia, Brazil). He is a PhD candidate at the Department of Computer Engineering and Industrial Automation, School of Electrical and Computing Engineering (FEEC), State University of Campinas (UNICAMP). He received his MSc in electrical engineering from FEEC, UNICAMP, his BSc in electrical engineering from the Federal University of Bahia and a technologist degree in computing from Ruy Barbosa Faculty. He is Director of the Group for Research on Artificial Cognition and of the Group for Basic and Applied Research in Intelligent Systems, both at UEFS. In addition, he is an associate researcher of the Computational Semiotics Group (UNICAMP). He has edited books on artificial cognition and on semiotics, organized scientific events in these topics and is the author of several journal papers, book chapters and conference papers. His research interests include artificial cognition, semiotic and meaning processes, communication, language evolution and acquisition, artificial life, adaptive behavior, complex systems and self-organization and embodied and situated cognition.*

*João Queiroz is a professor at the Institute of Arts and Design and at the Graduate Studies Program in Communication, Federal University of Juiz de Fora (Minas Gerais, Brazil). He earned a PhD in communication and semiotics from the Catholic University of Sao Paulo (PUC-SP) and a post-doc fellowship in intelligent systems at the School of Electrical and Computer Engineering (FEEC-DCA), State University of Campinas (Unicamp, Brazil) and in philosophy of biology at the Institute of Biology, Federal University of Bahia (UFBA). He is author and co-editor of several books and special issues, as well as numerous articles on the emergence and evolution of semiotic complexity in biological and artificial systems. He is the director of the Group for Research in Cognitive Science and Semiotics (UFJF), Group for Research on Artificial Cognition (UEFS), an associate researcher of the Research Group on History, Philosophy and Biology Teaching (UFBA) and a member of the Institute for Research on Anticipatory Systems (The University of Texas at Dallas). His research interests include evolution of semiotic complexity, emergence of symbolic-based communication, artifacts and cognitive technologies, complexity studies and C.S. Peirce's semiotic and pragmatism.*

# Reassessing the Foundations of Semiotics: Preliminaries

Mihai Nadin, University of Texas at Dallas, USA, and Hanse Institute for Advanced Study,  
Germany

---

## ABSTRACT

*What justifies a discipline is its grounding in practical activities. Documentary evidence is a necessary, but not sufficient, condition for viability. This applies to semiotics as it applies to mathematics, physics, chemistry, computer science, and all other forms of questioning the world. While all forms of knowledge testify to the circularity of the epistemological effort, semiotics knowledge is doubly cursed. There is no knowledge that can be expressed otherwise than in semiotic form; knowledge of semiotics is itself expressed semiotically. Semiotics defined around the notion of the sign bears the burden of unsettled questions prompted by the never-ending attempt to define signs. This indeterminate condition is characteristic of all epistemological constructs, whether in reference to specific knowledge domains or semiotics. The alternative is to associate the knowledge domain of semiotics with the meta-level, i.e., inquiry of what makes semiotics necessary. In a world of action-reaction, corresponding to a rather poor form of causality, semiotics is not necessary. Only in acknowledging the anticipatory condition of the living can grounding for semiotics be found. This perspective becomes critical in the context of a semiotized civilization in which the object level of human effort is progressively replaced by representations (and their associated interpretations).*

*Keywords:* Anticipation, Interaction, Interpretation, Representation, Semiosis

---

## 1. INTRODUCTION

The foundation of semiotics around the notion of the sign explains its accomplishments. Nobody with knowledge in this domain can discard or exaggerate them. But it explains even more the failure of the discipline to become the backbone of modern sciences and humanities. In a certain way, the intention of this study is to argue that semiotics could fulfill such a function. Indeed, not living up to its possibilities

affects not just its own credibility as a specific knowledge domain. Relevant is the fact that the sciences and the humanities are becoming more and more fragmented in the absence of an integrating coherent semiotic theory. Actually, we are trying to make a case for the necessity of such a theory against the background of interest in the emergence and evolution of semiotic questions in respect to the sciences and the humanities embodied and situated in semiotic process; biologically inspired semiotic models; and symbol grounding (to name a few current themes).

DOI: 10.4018/ijsss.2012010101

You cannot practice physics or even chemistry, economics, cognitive science, etc., without mathematics—this is something everyone active in these disciplines knows. Only when semiotics acquires the same degree of necessity will conditions be created for complementing the obsession with depth (specialized knowledge) with an understanding of breadth, corresponding to an integrated view of the world.

Many attempts have been made to write a history (or histories) of semiotics: biographies of semioticians, history of semantics, history of symptomatology, anthologies of texts relevant to semiotics, and the like. Few would argue against the perception that we have much better histories of semiotics (and semioticians) than contributions to semiotics as such. What can be learned from the ambitious projects of the past is that semiotic concerns can be identified along the entire history of human activity. This is what prompted some authors (Eco, 1976; Lotman, 1990) to consider culture as the subject matter of semiotics. Initially, semiotic activity was difficult to distinguish from actions and activities related to survival. Over time, semiotic concerns (especially related to language) constituted a distinct awareness of what is needed to succeed in what we do and, furthermore, to be successful.

The aim being the grounding of semiotics, we will examine the variety of angles from which its domain knowledge was defined. In parallel to the criticism of conceptions that have led to the unsatisfactory condition of semiotics in our time, we will submit a hypothesis regarding a foundation different from that resulting from an agenda of inquiry limited to the sign. Finally, we will argue that the semiotics of semiotics (embodied in, for instance, in the organization dedicated to its further development) deserves more attention, given the significance of “organized labor” to the success of the endeavor. While the grounding of semiotics in the dynamics of phenomena characteristic of a threshold of complexity associated with the living will be ascertained (Figure 1), the more elaborate grounding in anticipation remains a subject for a future contribution.

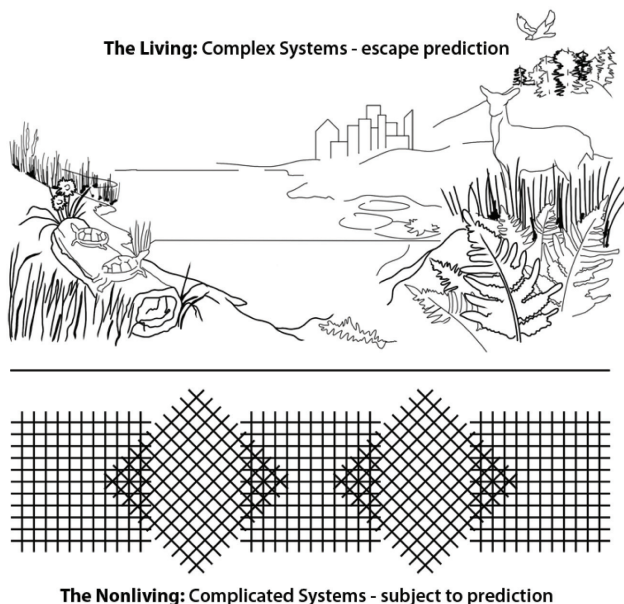
## 2. HUMANNESS

Regardless of which semiotic perspective the reader has adopted, it should not be too difficult to settle on some very simple preliminary observations regarding what is of semiotic significance in the self-making of humankind. Furthermore, we can easily agree that prediction, as an expression of understanding dynamics, has led to the affirmation of humanity’s dominant role in nature. To refer to the human being’s domination over the rest of the living realm might not be politically correct, but it describes a matter of fact. The associated fact is the role of semiotics. Awareness of the semiotic nature of human activity is implicit in science and in the humanities. Semiotics empowered the human being to the detriment of the rest of reality.

We don’t really need an agreement on what the subject of semiotics is, or what a sign is, in order to realize that the underlying element of any human interaction, as well as interaction with the world, is semiotic in nature. Interaction takes place through an intermediary. Signs or not, semiotics is about the *in-between*, about *mediation*, about guessing what others do, how nature will behave. Even two human beings touching each other is more than the physical act. In addition to the immediate, material, energetic aspect, the gesture entails a sense of duration, immaterial suggestions, something that eventually will give it meaning. It is a selection (who/what is touched) in a given situation (context). And it prompts a continuation.

But there is more to this preliminary observation. Just as a detail, to be further discussed (as the line of argument requires), the following observation from brain imaging: The three most developed active brain regions—one in the prefrontal cortex, one in the parietal and temporal cortices are specifically dedicated to the task of understanding the goings-on of other people’s minds (cf. Mitchell, 2009). This in itself suggests semiotic activity related to anticipation. Actions, our own and of others, are “internalized,” i.e., understood and represented in terms of what neurobiology calls *mental states*. So are intentions. In this respect, Gallese (2001) wrote

Figure 1. Semiotics at the threshold of complexity defining the living



about mind-reading and associated this faculty with mirror neurons. From this perspective, the semiotics of intentions, desires, and beliefs no longer relies on signs, but on representations embodied in cognitive states.

It would be presumptuous, to say the least, to rehash here the detailed account of how the human species defined itself, in its own making, through the qualifier *zoon semiotikon* (Nadin, 1997, pp. 197, 226, 532, 805), i.e., semiotic animal. Felix Hausdorff, concerned that his reputation as a mathematician would suffer, published, under the pseudonym Paul Mongré, a text entitled *Sant' Ilario. Thoughts from Zarathustra's Landscape* (1897). A short quote illustrates the idea:

*"The human being is a semiotic animal; his humanness consists of the fact that instead of a natural expression of his needs and gratification, he acquired a conventional, symbolic language that is understandable only through the intermediary of signs. He pays in nominal values, in paper, while the animal in real, direct*

*values [...] The animal acts in Yes and No. The human being says Yes and No and thus attains his happiness or unhappiness abstractly and bathetically. Ratio and oratio are a tremendous simplification of life."* (p.7) [Translation mine]

Through semiotic means, grounded in anticipatory processes (attainment of happiness, for instance), individuals aggregate physical and cognitive capabilities in their effort. Indeed, group efforts make possible accomplishments that the individual could not obtain.

Obviously, this perspective is much more comprehensive than the foundation of semiotics on the confusing notion of the sign. In what I described, there is no sign to identify, rather a process of understanding, of reciprocal "reading" and "interpreting." The decisive aspect is the process; the representation is the unfolding of the process defining cognitive states. This view has the added advantage of explaining, though indirectly, the major cause why semiotics as the discipline of signs continues to remain more a promise than the "universal science" that



Morris (1938) chose to qualify it. A discipline dependent upon a concept (on which no agreement is possible) is much less productive than a discipline associated with activities: What do semioticians do? If we know what they do, we know what it is—provided that we do not fall in a circular manner of reasoning.

## 2.1. Constructing the Language of Phenomena

We have access to a large body of shared knowledge on the evolution of humankind, in particular on the role of various forms of interaction among individuals and within communities. Also documented is the interaction between the human being and the rest of the world. This knowledge is available for persons seeking an understanding of semiotics in connection to practical activities. This is not different from the situation of mathematics. Let us recall only that geometry originates in activities related to sharing space, and eventually to laying claim to portions of the surroundings, to ownership and exchange, to production and market processes. There are no triangles in the world, as there are no numbers in the world, or lines. To measure a surface, i.e., to introduce a scale, is related to practical tasks. Such tasks become more creative as improved means for qualifying the characteristics of the area are conceived and deployed. To measure is to facilitate the substitution of the real (the measured entity) with the measurement, i.e., representation of what is measured. To travel, to orient oneself, to navigate are all “children of geometry,” extended from the immediacy of one’s place to its representation. This is where semiotics shows up. The experiences of watching stars and of observing repetitive patterns in the environment translate into constructs, which are integrated in patterns of activity. Rosen (1985, p. 201) took note of “shepherds [who] idly trace out a scorpion in the stars. . .” (the subject of interest being “relations among components”). He also brought up the issue of observation: “Early man . . . could see the rotation of the Earth every evening just by watching the sky”

(p. 201). In the spirit of Hausdorff’s definition of the semiotic animal, Rosen’s suggestion is that inference from observations to comprehension is not automatic: An early observer “could not understand what he was seeing,” as “we have been unable to understand what every organism is telling us,” (p. 201). The “language” in which phenomena (astronomic or biological) “talk” to the human being is that of semiotics; the human being constructs its “vocabulary” and “grammar.” This applies to our entire knowledge, from the most concrete to the most abstract.

Mathematics, in its more comprehensive condition as an expression of abstract knowledge, is a view of the world as it changes. It is expressed in descriptions such as points, lines, and intersections; in formal entities, such as circle, square, volume, etc. It is expressed numerically, e.g., in proportions, which means analytically, through observations of how things change or remain the same over time. It can as well be expressed synthetically, that is, how we would like to change what is given into something else that we can describe as a goal (using numbers, drawings, diagrams, etc.).

## 2.2. Making Reality as We Observe It

Informed by mathematics, we gain an intuitive understanding of how humans, in making themselves, also make their comprehension of the world part of their own reality. The perspective from which we observe reality is itself definitory for what we “see” and “hear,” for our perceptions, and for our reasoning. This should help in realizing that the foundation of semiotics is, in the final analysis, a matter of the angle from which we examine its relevance. The hypothesis we shall address is that the definition upon the ill-defined notion of the sign is the major reason why semiotics remains more a promise than an effective theory. The failure of semiotics is semiotic: the representation of its object of inquiry through the entity called *sign* is relatively deceptive. It is as though someone were to establish mathematics around the notion of the number, or the notion of an integral,

or the notion of sets. Indeed, there have been mathematicians who try to do just that; but in our days, those attempts are at best documented in the fact that there is number theory (with exceptional accomplishments), integral calculus, and set theory (actually more than one). But none defines mathematics and its goals. They illustrate various mathematical perspectives and document the multi-facetedness of human abstract thinking.

If we focus on the sign, we can at most define a subset of semiotics: sign theory, around classical definitions (as those of Saussure, Peirce, Hjelmslev, for example). But semiotics as such is more than these; and it is something else. Interaction being the definitory characteristic of the living, and semiotics its underlying condition, we could identify as subfields of interest the variety of forms of interaction, or even the variety of semiotic means through which interactions take place. Alternatively, to make interactions the subject of semiotics (as Sadowski, 2010, attempted) will also not do because interactions are means towards a goal. *Goals* define activities. Activities integrate actions. Actions are associated with representations.

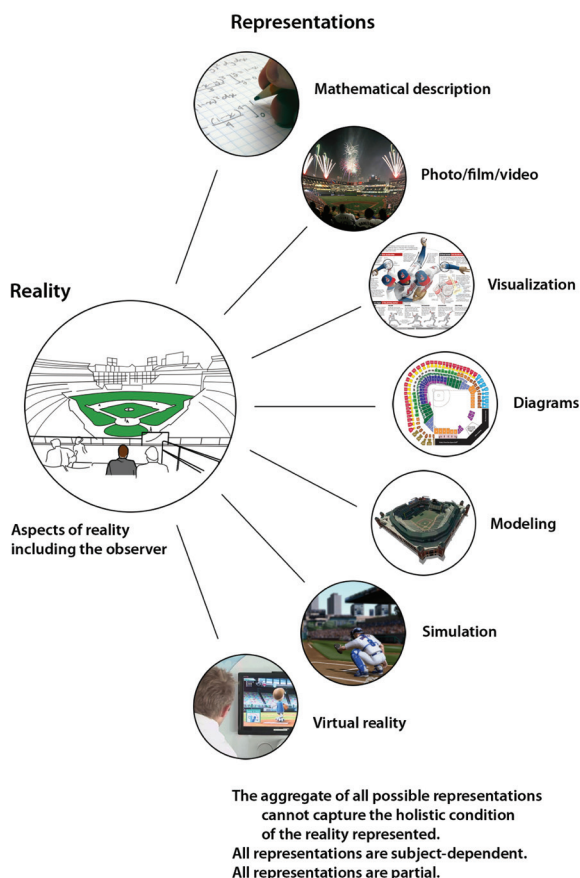
What is semiotics?" not unlike "What is mathematics?" or for that matter "What is chemistry, biology, or philosophy?" are abbreviated inquiries. In order to define something, we actually differentiate. Semiotics is not mathematics. It does not advance a view of the world, but it provides mathematics with some of what it needs to arrive at a view of the world—with a language. Mathematicians do not operate on pieces of land, or on stones (which mathematics might describe in terms of their characteristics), or on brains, on cells, etc. They produce and operate on *representations*, on semiotic entities conjured by the need to replace the real with a description. The *goal* of the mathematicians' activity, involving thinking, intuition, sensory and motoric characteristics, emotions, etc., is abstraction. Their *activity* focuses on very concrete semiotic entities that define a specific language: topology, algebra, category theory, etc.

Among many others, Nietzsche (cf. Colli & Montinari, 1975, p. 3) observed that "Our writing tools are also working, forming our thoughts." As we program the world, we reprogram ourselves: Taylor's assembly line "reprogrammed" the worker; so do word and image processing programs; so do political programs, and the programs assumed by organizations and publications.

### 2.3. Representation as a Goal

To represent is one of the fundamental forms of human activity. To express is another such form. The fact that there might be a connection between how something (e.g., pain) is expressed (through a scream) and what it expresses is a late realization in a domain eventually defined as cognition. The relation between what (surprise, for example, can also lead to a scream) is expressed and how expression (wide-open eyes) becomes representation is yet another cognitive step. And one more: There is a relation between what is represented (e.g., fear) and the means of representation, which can vary from moving away from the cause of the fear to descriptions in words, images, etc. Moreover, to represent is to present one's self—as a living entity interacting with other living entities (individuals, as well as whatever else a person or person interact with)—as an identity subject to generalizations and abstractions. There are signs (usually called *symbols*) (cf. Cassirer, 1923/1955) in mathematics, chemistry, and physics; more symbols are to be found in genetics, computer science, and artificial intelligence. But in these knowledge domains, they are not present as semiotic entities—i.e., as relevant to our understanding of interaction—but rather as convenient representations (of mathematical, chemical, or physical aspects), as formal entities, as means for purposes other than the acquisition and dissemination of semiotic knowledge. They are condensed representations. The integral sign  $\int$  stands for a limit of sums. It represents the operation (e.g., calculate an area, a volume). Let us recall Lewis Mumford's observations:

Figure 2. The subset of possible partial representations (text description, mathematical description, video or film, visualization, etc.)



No computer can make a new symbol out of its own resources,” (1967, p. 29).

The abbreviated inquiries invoked earlier—What is semiotics? What is mathematics? What is chemistry?—are relevant because behind them are explicit questions: What, i.e., which specific form of human activity, do they stand for? What do they mediate? What semiotics, or mathematics, or chemistry stands for means: What are their specific pragmatic justifications?

What can you do with them?

If we could aggregate all representations we would still not capture the reality in its infinite level of detail; nor could we capture dynamics. The living unfolds beyond our epistemologi-

cal boundaries. We are part of it and therefore every representation will contain the observed and the observer.

The representation of different parts of the human body in the primary somatosensory cortex is a very clear example of the role of semiotic processes. Those representations change as the individual’s activity changes. They facilitate preparation for future activities; they predate decisions and activities. They are in anticipation of change. The semiotics of the process is pragmatically driven. Think about the new fascination with text messaging and how the fingers involved are represented in the cortex. Semiotics understood in this vein returns

knowledge regarding how technology empowers us, as it reshapes our cognitive condition at the same time.

### 3. SEMIOTIC KNOWLEDGE

The reference is always the human being animated by the practical need to know in order to succeed, or at least to improve efficiency of effort under specific circumstances (context). Thus, “What is semiotics?” translates as “What defines and distinguishes human interactions from all other known forms of interaction? Indeed, the interaction of chemical elements (i.e., chemical reaction) is different from that of two individuals. Obviously, some chemistry is involved; however, the interaction characteristic of the living is not reducible to chemistry. “Mind reading” is not *abracadabra*; it is not picking up some mysterious or real waves (electro or whatever); it is not second-guessing the biochemistry of neuronal processes. It is modeling in one’s own mind what others are planning, what goals they set for themselves. In some way, this involves adaptive perception processes.

Physical interaction at the atomic level is quite different from that at the molecular and macroscopic levels, and even more different at the scale of the universe. As exciting as it is in its variety and precision, the physical interaction of masses (as in Newton’s laws of mechanics) does not explain aggregation, e.g., the behavior of crowds, or the “wisdom of crowds.” In the end, “What is semiotics?” means not so much to define its concepts (sign, sign processes, meaning, expression, etc.) as it means to address the question of whether whatever semiotics is, does it correspond to all there is, or only to a well-defined aspect of reality. Neither mathematics, nor chemistry, nor any other knowledge domain encompass all there is. Their specific knowledge domain is not reducible to others. If the same holds true for semiotics, the specific knowledge domain would have to correspond to a well-defined aspect of reality. It is obvious, but worth repeating, that semiotics (not unlike

mathematics, chemistry, physics, etc.) is a human product, a large construct subject to our own evaluation of its significance.

Before there was mathematics, or chemistry, or physics, there was an activity through which individuals did something (e.g., kept records using knots, mixed substances with the aim of making new ones, used a lever). In this activity, they constituted themselves as mathematicians, chemists, or physicists; and were recognized as such by others (even before there was a label for activities qualifying, in retrospect, as mathematics, chemistry, physics, etc.).

Returning to mathematics: Is the integrating view of the world it facilitates exclusively a human-generated representation of gnoseological intent and finality? Or can we identify a mathematics of plants or animals, of physical processes (such as lightning, earthquakes, the formation of snowflakes)? Does nature “make” mathematics? The fact that mathematics describes the “geometry” of plants, the movement of fish in water, and volcanic activity cannot be automatically translated as “plants are geometers,” or “fish are analysis experts,” or “volcanoes are topologists.” Rather, watching reality through the lenses of mathematics, we identify characteristics that can be described in a language (or several) that applies not to one specific flower or leaf, not to one specific fish or swarm, not to one volcano, but to all activity, regardless where it takes place. The generality of mathematical descriptions, moreover mathematical abstraction, is what defines the outcome of the activity through which some individuals identify themselves as mathematicians (professional or amateur).

For the sake of clarity: Nature does not make mathematics, as it does not make semiotics. Anthropomorphism is convenient—“the language of plants,” the “symbols of nature”—but confusing. Only with awareness of the activity is it epistemologically legitimized. There are no signs of nature, or semiotic processes of nature; there are human constructed models for understanding nature. The same applies to machines: There is no semiotics in the functioning

of a machine. It is made of parts assembled in such a way that it turns an input into a desired (or not) output. The human being projects semiotics into interaction with machines. Of course, there are signals, best expressed through values defining the physical process (e.g., electrons traveling along circuits). But to confuse signal—physical level—and sign—semiotic level—means to make semiotics irrelevant. Too many well-intended researchers operate in the space of ill-defined entities.

### 3.1. Awareness

Is there some generality, or level of abstraction, that can define the identity of a semiotician? Or are we all, regardless of what we do, semioticians, given that interaction, characteristic of all the living, cannot be avoided. Moreover, given that we all indulge in representations and act upon representations, does this not qualify us as semioticians? Given that we all interpret everything—regardless of the adequacy of our interpretations—does this make us all semioticians? The entire domain of the living is one of expression and interaction that seems to embody semiotics in action. Mental states are associated with neuronal activity. The physics and biochemistry, and the thermodynamics for this activity form one aspect. The other aspect is the understanding of each instance of the process, of the aggregate state to which it leads. However, there is a distinction between the activity and awareness of its taking place, of its consequences. Based on knowledge from different disciplines (biology, genetics, neuroscience, etc.), the following statement can be made: Semiotics at the genetic level, semiotics at the molecular level, and semiotics at the cell level, in association with information processes, are prerequisites for the viability of the living as such. Furthermore, it can be ascertained that bottom-up and top-down semiotic processes define life as semiosis, in parallel to its definition as information, i.e., energetic process (going back to the laws of thermodynamics). Awareness of semiotic process is not characteristic of genes or molecules; neither is information awareness

located where information processes take place. Awareness (of semiotics, or of information processes) corresponds to the meta-level, not to the object level.

What can we learn about semiotics—assuming that semiotics is a legitimate form of knowledge—by examining the world? First and foremost, that interaction, as a characteristic of the living, is extremely rich, and ubiquitous. Second, and not least important, life being change, interactions not only trigger change, but they themselves are subject to change. Observation yields evidence that some interactions seem more patterned than others (and accordingly predictable). Take the interaction between a newborn (human, animal) and parent. There is a definite pattern of nurturing and protection—although there are also cases of filial cannibalism (eating one's young, as do some fish, bank voles, house finches, polar bears). These patterns correspond to representations of the present and future, i.e., they are connected to anticipatory processes (underlying evolution). Or take sexual interactions (a long gamut, extended well beyond evolutionary advantage in the life of human beings); or interactions between the living and the dying. The epistemological condition of semiotics derives from the fact that life would continue even if there were no semioticians to ever observe it and report on what they “see” as they focus on interactions, or on the constructs we call sign processes. The existence of life, or the making of life, does not depend on adding semiotic ingredients to the combination of whatever might be necessary to make it. For that matter, it does not depend on adding mathematics or physics or chemistry to the formula. The awareness resulting from a semiotic perspective leads to the acknowledgment of such phenomena as living expression. Indeed, in the absence of representations, life would cease.

### 3.2. Encoding and Decoding

But things are not so simple as a cookbook for life. The mathematics for the cookbook is important in defining quantities and sequences in



time (first bring water to a boil, add ingredients in a certain order, simmer). The semiotics is relevant not so much for cooking for oneself, but in supporting preparation of the meal for others. This is what representations do as they are passed along in the organism. Cells “work” for each other; a cell’s state depends on the states of the adjacent or remote cells. The organism is the expression of all that is needed in terms of means of interaction—semiotic and informational—to make possible an aggregated whole of a nature different from that of its components. It is on account of complexity that this aggregation takes place and lasts as long as what we call *life*.

Expressed differently, semiotics is relevant for “engineering” interactions: recipes are the “shorthand” of cooking. They carry explicit instructions and implicit rules, that is, assumptions of shared experiences. Semiotics embodies the sharing, but does not substitute for the experience. The informational level corresponds to “fueling” the process, providing the energy. Taken literally, even the simplest recipe is disappointing. There is always something expected from those who will try it out. No recipe is or can be complete. The possibility to discover on your own what cannot be encapsulated in words, numbers, procedures, or images opens up the process of self-discovery. In this sense, semiotics is relevant for dealing with the question of what the future will bring: you mixed egg yolk and oil, and instead of getting mayonnaise, the ingredients start to separate. What now? At the level of the living, life, not mayonnaise, is continuously made. At the end of the life cycle, the ingredients separate, the semiotics disappears, information degrades. Semiotics encodes in generating representations, and decodes in interpreting representations. These are distinct practical functions otherwise inconceivable. *Encode* means as much as semiotic operations performed on representations. *Decode* means the reverse, but without the guarantee that the encoded will be retrieved. Quite often, we find a different “encoded” reality: Semiotic processes are non-deterministic.

### 3.3. *Nomothé* and the Idiographic

It comes as no surprise to anyone that interactions can be mathematically (or genetically) described. But mathematical descriptions (or genetic, as well) can only incompletely characterize them. More precisely: the mathematics of interactions is, after all, the description of assumed or proven laws of interaction. In this respect, law is a repetitive pattern. Physical phenomena are acceptably described in mathematical descriptions called *laws*. This is what Windelband (1894) defined as the *nomothetic* (derived from *nomothé* in Plato’s *Cratylus*, 360 BCE). The same cannot be said of living interactions, even if we acknowledge repetitive patterns. No living entity is identical with another. The living is infinitely diverse. Therefore, semiotics could qualify as the attempt to acknowledge diversity unfolding over time as the background for meaning, not for scientific truth. This is what Windelband defined as the *idiographic*. Remember the primitive man watching the sky and not knowing the “truth” he was seeing (Earth’s rotation). Organisms, while not devoid of truth (corresponding to their materiality) are rather expressions of meaning. Representations can be meaningful or meaningless. They are perceived as one or the other in a given context.

With meaning as its focus, semiotics will not be in the position to say what is needed to make something—as chemistry and physics do, with the help of mathematics—but rather to identify what meaning it might have in the infinite sequence of interactions in which representations will be involved. This applies to making rudimentary tools, simple machines, computer programs, or artificial or synthetic entities. Semiotic knowledge is about meaning as process. And this implies that changing a machine is very different from changing the brain. Inadequate semiotics led to the metaphor of “hardwired” functions in the brain. There is no such thing. The brain adapts. Activities change our mind: We become what we think, what we do. We are our semiotics.

## 4. WHAT NEW INTERACTIONS BECOME POSSIBLE

The fact that signs—better yet, representations—are involved in interactions is an observation that needs no further argument. Being entities that stand for other entities, signs might be considered as agents of interaction. Evidently, with the notion of agency we introduce the expectation of signs as no longer “containers” of representation, but rather as intelligent entities interacting with each other, self-reproducing as the context requires. Consequently, one might be inclined to see interaction processes mirrored into sign processes—or what Peirce called *semiosis*. But interactions are more than sign processes. Better yet: sign processes describe only the meaning of interactions, but not the energy processes undergirding them. This needs elaboration, since the question arises: What does “ONLY the meaning of interactions” mean? Is something missing?

### 4.1. The Physical and the Living

To describe interactions pertinent to non-living matter (the physical) is way easier than to describe interactions in the living, or among living entities. For such descriptions we rely on the physics of phenomena—different at the nano-level in comparison to the scale of reality or to the cosmic scale. Quantum mechanics contributed decisive details to our understanding of physical interactions (for instance, in evincing the entanglements of phenomena at the quantum level of matter). Focusing on signs caused semiotics to miss its broader claim to legitimacy: to provide not only descriptions of the meaning of interactions, but also knowledge regarding the meaning of the outcome of interactions, the future. When the outcome can be derived from scientific laws, we infer from the past to the future. Statistical distribution and associated probabilities describe the level of our understanding of all that is needed for physical entities to change. When the outcome is as unique as the living interaction itself, we first need to acknowledge that the living is

driven by goals—which is not the case with the physical, where, at best, we recognize attractors: the “teleology” of dynamic systems. Therefore, we infer not only from the past, but also from the future, as projection of the goals, or understandings of goals pursued by others. Possibilities describe the level of our understanding of what is necessary for living entities to change, i.e., to adapt to change. This is the domain of anticipation, from which semiotics ultimately originates. (In addition to my arguments, Nadin, 1991, on this subject, see Hoffmeyer, 2008). Therefore, semiotics should be more than the repository of meaning associated with interaction components.

As information theory—based on the encompassing view that all there is, is subject to energy change—emerged (Shannon & Weaver, 1949), it took away from semiotics even the appearance of legitimacy. Why bother with semiotics, with sign processes, in particular (and all that terminology pertinent to sign typology), when you can focus on energy? Energy is observable, measurable, easy to use in describing information processes understood as the prerequisite for communication. Information is more adequate than semiotics for conceiving new communication processes, which, incidentally, were also iterative processes. But there is also a plus side to what Shannon suggested: Information theory made it so much more clear than any speculative approach that semiotics should focus on meaning and significance rather than on truth.

Over time, semiotics attracted not only praise, but also heavy criticism (our own will be formulated in a later section). In general, lack of empirical evidence for some interpretations remains an issue. The obscurity of the jargon turned semiotics into an elitist endeavor. Structuralist semiotics (still dominant) fully evades questions of semiotic synthesis and the interpretant process. Too often, semiotics settled on synchronic aspects, a-historic at best (only Marxist semioticians take historicity seriously, but at times to the detriment of understanding semiotic structures). Closer to our time, semiotics has been criticized for turning everything into a sign, such semioticians forgetting that if

everything is a sign, nothing is a sign. In one of his famous letters to Lady Welby, Peirce writes:

*“It has never been in my power to study anything—mathematics, chemistry, comparative anatomy, psychology, phonetics, economics, the history of science, whist, men and women, wine, metrology—except as a study of semiotics.”* (Peirce, 1953, p. 32)

The message here is that semiotics is inclusive, and that it should not be arbitrarily fragmented. He does not bring up a semiotics of mathematics, chemistry, comparative anatomy, etc., because it is nonsensical to dilute the “study of semiotics” into partial semiotics. Those who do so deny semiotics its comprehensive perspective.

Parallel to this recognition is the need to assess meaning in such a manner that it becomes relevant to human activity. So far, methods have been developed for the experimental sciences: those based on proof, i.e., the expectation of confirmation and generalization. But there is nothing similar in respect to meaning, not even the realization that generalization is not possible; or that semiotic knowledge is not subject to proof, rather to an inquiry of its singularity. The *nomothetic* comprises positivism; the *idiographic* is the foundation of the constructivist understanding of the world (cf. Piaget, 1955; von Foerster, 1981).

## 4.2. Proof and Inference

Mathematicians would claim that their proofs are absolute. Indeed, they make the criterion of falsifiability (Popper, 1934) one of their methods: Let’s assume, *ad absurdum*, that parallels meet. If they do, then what? No scientific ascertainment can be proven to the same level of certainty as the mathematical, because it is a projection of the mind. By extension, this applies to computer science and its many related developments, in the sense that automated mathematics is still mathematics. (Mathematicians themselves realize that in the future, mathematical proofs will be based on

computation.) Science lives from observation; it involves experiment and justifies itself through the outcome. If the experiment fails, the science subject to testing fails. That particular observation is not absolute in every respect. Let us name some conditions that affect the outcome of experiments: selection (what is observed, what is ignored); evaluation (degrees of error); expression (how we turn the observation, i.e., data, into knowledge). Experiments are always reductions. To reproduce an experiment is to confirm the reduction, not exactly the claim of broader knowledge. The outcome might be disappointing in respect to the goal pursued: for example, the various drugs that have failed after being tested and approved. But the outcome might, as well, prove significant in respect to other goals: drugs that are dangerous in some cases prove useful in treating different ailments: thalidomide for arthritic inflammations, mouth and throat sores in HIV patients; botox for treating constricted muscles.

Failed scientific proofs prompt many fundamental reassessments. Compare the scientific theory of action at distance before Newton and after Newton’s foundations of physics; compare Newton’s view to Einstein’s; and compare Einstein’s science to quantum entanglement. Compare the views of biology prior to the theory of evolution, or to the discovery of the genetic code. Given the epistemological condition of mathematics, new evidence is not in the jargon of mathematics. A new mathematical concept or theorem is evidence. Probably more than science, mathematics is art. It is idiographic, not nomothetic knowledge. As we know from Turing and Gödel, it cannot be derived through machine operations (Hilbert’s challenge). If there is a cause for mathematics, it is the never-ending questioning of the world appropriated by the mind at the most concrete level: its representation. The outcome is abstraction. This is what informed Hausdorff (alias Paul Mongré) as he described human nature. There is, of course, right and wrong in mathematics, as there is right and wrong in art. But neither a Beethoven symphony nor Fermat’s conjecture (proven or not) is meant as a hypothesis to be



experimentally confirmed. Each has an identity, i.e., a semiotic condition. Each establishes its own reality, and allows for further elaborations. Not to have heard Beethoven's symphonies or not to have understood Fermat's law does not cause bridges to collapse, or airplanes to miss their destinations.

### 4.3. A Semiosis Between Art and Science

By its nature, semiotics is not a discipline of proofs. Not even Peirce, obsessed with establishing semiotics as a logic of vagueness (Nadin, 1980, 1983) produced proofs. In physics, the same cause is associated with the same effect (in a given context). Take the example of thalidomide first used as a sedative, which led to birth defects ("thalidomide babies") when pregnant women took it. Now consider the reverse: the medicine is used for alleviating painful skin conditions and several types of cancer. The semiotics behind symptomatology concerns the ambiguous nature of disease in the living. The ambiguity of disease is reflected in the ambiguity of representations associated with disease. Better doctors are still "artists," which is not the case with software programs that analyze test results. Diagnosis is semiotics, i.e., representation and interpretation of symptoms that is both art and science. Machine diagnosis is information processing at work. Human diagnosis is the unity of information and meaning.

When mathematicians, or logicians, translate semiotic considerations into mathematical descriptions, they do not prove the semiotics, but the mathematics used. For example, Marty (1990) provided the proof that, based on Peirce's definition of the sign and his categories, there can indeed be only ten classes of complete signs. But this brilliant proof was a contribution to the mathematics of category theory. Goguen's brilliant algebraic semiotics (1999) is in the same situation. "In this setting [i.e., user interface considered as representation, our note], representations appear as mappings, or

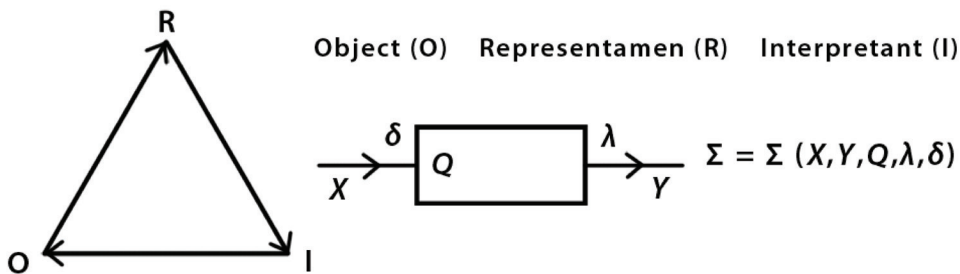
morphisms . . . which should preserve as much structure as possible."

My own attempts at proving that signs are relationally defined as fuzzy automata (Nadin, 1977) are more a contribution to automata theory than to semiotics. No semiotician ever cared about these attempts; none took such proofs to mean anything in examining signs in action or in understanding semiotics. For their art, which is the art of semiotic interpretation, the mathematical proof is of no relevance. The same holds true for the classes of signs. There are no such signs as *iconic*, *symbolic*, or *indexical*. These are types of representation. But to deal with the ten classes that Peirce advanced is cumbersome, to say the least.

### 4.4. Yearning for Legitimacy

This preliminary discussion deals with how we might define a foundation of semiotics that is not around a formal concept—the sign. Since the concept is subject to so many different interpretations, none more justifiable than another, we need to avoid it. The goal is to make the reader aware of why even the most enthusiastic semioticians end up questioning the legitimacy of their pursuit. Before further elaborating on my own foundational statement for semiotics—this text is only an introduction to it—I shall proceed with a survey of the semiotic scene. This should produce arguments pertinent to the entire endeavor. I derive no pleasure from reporting on the brilliant failure of a discipline to which I remain faithful. Let's be clear: it is not because semioticians (of all stripe) come from different perspectives, and use different definitions, that semiotics does not emerge as a coherent approach. Rather, because it does not yet have a well-defined correlate in reality, in respect to which one could infer from its statements to their legitimacy and significance. Only because we can practice semiotics, or put on the hat that qualifies someone as semiotician (professor or not), does not justify semiotics as something more than quackery. Can semiotics have a defined correlate in reality? Can it transcend the speculative condition that made

Figure 3. Sign and fuzzy automata



it into a discourse of convenience spiked with technical terminology? (Jack Solomon, 1988, argued that its own principles disqualify it from having universal validity.)

Everyone in the more affluent part of the world knows that society can afford supporting the unemployed, or helping people without insurance, or providing for self-proclaimed artists. But this by-product of prosperity, and the general trend to support everything and anything, cannot justify semiotics more than the obsession with gold once justified alchemy, or the obsession with cheap oil justifies wars in our time. In order to earn its legitimacy, semiotics (i.e., semioticians) has to define itself in relation to a compelling aspect of the living, something in whose absence life itself—at least in the form we experience it—would not be possible. If this sounds like a very high-order test of validity, those readers not willing to take it are free to remain insignificant, whether they call themselves semioticians or something else. With the demotion of Aristotelian inspired *vitalism*, life was declared to be like everything else. As our science evolved, the “knowledge chickens” came home to roost: We pay an epistemologically unbearable price for having adopted the machine as the general prototype of reality. The semiotic animal is not reducible to a machine (even though signs, in Peirce’s definition, are reducible to fuzzy automata; cf. Figure 3).

## 5. THE PERVERSE PLEASURE OF INSIGNIFICANCE

The reader who still opens any of today’s publications on semiotics—journals, proceedings, even books—often has cause to wonder: Is semiotics an exercise in futility? Authors of articles, conference papers, books, and other publications will probably present arguments like:

- There is a peer-review process in place that legitimizes their efforts;
- The situation in semiotics is not different from that in any other knowledge domain;
- There are no evaluation criteria to help distinguish the “wheat” from the “chaff.” In the democratic model of science (semiotics and other fields), “Anything goes.”

Each argument deserves attention. But first an observation (which might not seem related to the subject): The quality of education and research in general seems to diminish as more money is spent for them. Stated differently: The gap between excellence—yes, excellence still exists—and mediocrity is widening. Mediocrity is a contamination that threatens to set a *very* low common denominator. Pretty soon, a Ph.D. will be as common (and insignificant) as membership in those clubs that Groucho Marx refused to join because they would have him. However, this is not the place to address the way in which

expectations of higher efficiency (Nadin, 1997), characteristic of our current state of civilization, translate into the politics and economics and education of mediocrity. A different aspect is worthy of discussion here: Some disciplines are focused on relevant aspects of science, humanities, and current technology. They define vectors of societal interest. It does not take too much effort to identify the life sciences as a field in the forefront of research and education; or, for better or worse, computer science, in its variety of directions. Nanotechnology is yet another such field. It originated in physics, (which, in its classic form, became less relevant) only in order to ascertain its own reason for being well beyond anyone's expectations. Some readers might recall the time when scientists (Richard Smalley, 2001) claimed that nanotechnology would not work, despite the scientific enthusiasm of the majority of scientists in the field. In the meanwhile, nanotechnology has prompted spectacular developments that effected change in medicine and led to the conception of new materials and processes. Computer science met nanotechnology at the moment Moore's law, promising the doubling of computer performance every eighteen months, reached its physical limits.

Besides semiotics, many other disciplines (including traditional philosophy) live merely in the cultural discourse of the day, or in the past. More precisely, they live in a parasitic state, justifying themselves through arcane requirements, such as the famous American declaration: "We need to give students a liberal arts education" (a domain in which semiotics is often based). They do not even understand what *liberal arts* or *humanities* means today: using Twitter and the iPhone, or reading the Constitution? Being on social media or reading the "Great Books"? These are questions of a semiotic nature.

### 5.1. Organizations Confirm the Past

Semiotics as it is practiced, even by dedicated scholars, certainly does not qualify as groundbreaking, no matter how generous we want to

be. Rather, it illustrates what happens to a discipline in which its practitioners, most of them in search of an academic identity—a placeholder of sorts—regurgitate good and bad from a past of promise and hopes never realized. Ignore the fact that the quality of writing is sometimes questionable. (Less editorial assistance is available to compensate for the decreasing writing skills of many authors: articles published in *Semiotica*, or books on semiotics appearing under the imprint of Cambridge University are vivid testimony to this assertion.) What strikes the possible reader is the feeling that semiotics deals more with its own questions than with questions relevant to today's world. Even when some subjects of current interest come up—such as the self-defined niche of bio-semiotics (cf. Uexküll, 1934, 2010; Barbieri, 2007)—they are more a pretext for revisiting obscure terminology or for resuscitating theories dead on arrival. Congresses, the major public event of a society formed around a discipline, are the occasion for defining the state of the art in a particular knowledge domain. The ten international congresses on semiotics held so far make up a revealing story of how the enthusiastic beginnings of modern semiotics slowly but surely morphed into a never-ending funeral. There is a dead body carried in that casket—semiotics—and there are endless speeches about its greatness. Like all institutions, the International Association is more concerned with its own perpetuation than with the growth and quality of the discipline it is supposed to represent. The 10<sup>th</sup> Congress (Coruña, 2009), not unlike the previous Congress (Lyon, 2004) had a broad program in which, more often than not, the right words were used: *Culture of Communication. Communication of Culture*. Occasionally, scientists from other disciplines (e.g., Grzegorz Rozenberg, 1998) delivered tutorials on the hot subjects *du jour* (DNA computing). Salman Rushdie's lecture (quite good, although irrelevant for semiotics) became a frequently watched video on the Web. Such presentations (by the "rich and famous" of semiotics) were probably the most relevant part of such events. International gatherings, not only in semiotics,

are part of the academic tourism industry. (Next stop: China.) At the same time, they are a good opportunity to help desperate faculty members participate in a Congress, and eventually publish something that will count in the tenure process.

The founding members of the IASS (Greimas, Jakobson, Kristeva, Beneviste, Sebeok) had in mind the promotion of semiotic research in a scientific “esprit”: ...”promouvoir les recherches sémiotiques dans un esprit scientifique”. (French dominated at that time.) This important function is specifically mentioned on the IASS website. Even in its so-called new form, the website, seen from the perspective of semiotics, is a rather telling example of how limited the contribution of semiotics is in providing new means and methods of communication and interaction. An inadequate website is not yet proof of the inadequacy of the current contributions to semiotics. It is a symptom, though. In the spirit of the dedication to a scientific agenda, Eco, Solomon Marcus, Pelc, Segré—to name a few—contributed to a better reputation of semiotic research. They, and a few others (e.g., Deledalle 1997, 2001; Marty 1990; Bouissac 1977; Nöth 1985, 1995), and the followers of the Stuttgart School) succeeded in producing works worthy of respect.

The hope of ascertaining semiotics as a vital component of thinking, communication, and scientific foundation of our age remained high from congress to congress, from one meeting to another, from one publication to the many available today. But a closer look at what continues to be produced under the guise of semiotics leads to the realization that the initial optimism was either groundless, or did not reflect the potential of the many self-proclaimed semioticians. On behalf of the first congress (Milan, 1974), Umberto Eco (1975) wrote (in the Preface to the *Proceedings*) about a “fundamental” and an “archeological” task. The first would be the justification for the existence of semiotics; the second, to derive from its past a unified methodology and, if possible, a unified objective. Over the next 40 years (almost), many questions were subsequently raised: Can semiotics be unified? How does it relate to other subjects? What is

the impact of technology, globalization? The exercise, self-styled as a “tremendous chain of conferences,” continued (Vienna, 1979; Palermo, 1981; Perpignan & Barcelona, 1989; Berkeley, 1994; Guadalajara, 1997; Dresden, 1997; Lyon, 2004; Helsinki, 2007; La Coruña, 2009). Very little has been clarified regarding the initial existential questions: What justifies the existence of semiotics? What are its objectives? What is its methodology? The only significant aspect is that, despite their irrelevance, events such as congresses (and publication of the associated *Proceedings*) continue to take place! In keeping with the mercantile spirit of the time, the International Association for Semiotic Studies even came up with a scheme for a congress franchise.

Obviously, the statements made above require substantiation. Some of those persons alluded to might suspect the settling of some score (there is nothing to set since there is no score to keep). Others might suspect a generational conflict, or even an attempt to idealize the past (the romantic notion of “heroic beginnings”). Obviously, such possible interpretations cannot be avoided. Nevertheless, the issue brought up—lack of significance—and the motivation—the reason for addressing it as a subject worthy of attention—are quite distinct. Therefore, I shall proceed in three directions:

- (1) A short presentation of today’s major themes in the humanities, the sciences, and technology;
- (2) A short historic account of developments in semiotics;
- (3) A methodological perspective.

The intention is not to cast aspersions upon work produced in the field in recent, and less than recent, years, but rather, to show that this is probably the time of the most interesting (i.e., rewarding) subjects for semiotics. This is the time of new opportunity for semiotics to make its case as a viable discipline and to confirm its necessity. I do not write here delayed reviews of the many articles I indirectly refer to; neither do I write letters of evaluation for one or another

author. The intention is to stimulate a discussion on the fact that the sad state of semiotics today is, to a great extent, the result of defining semiotics in a manner counter-productive to its development. Please take note that the subject is not one or another “actor” performing on the “semiotic scene” (the “activists” in search of “offices,” the researchers, the students). The subject is semiotics itself, the implicit and explicit understanding shared by people active in the field.

Why is semiotics, with very few exceptions, in such a lamentable condition today? This is a scientific question. Concerning the “Why?” of the position I take: The attempt to redefine its foundation is intended as an invitation to everyone dedicated to semiotics, not to its occasional visitors. I do not promise miraculous solutions. This text is an expression of the love and passion I have for semiotics. The fact that it comes from an “outsider” (i.e., a semiotician who remains unaffiliated) should not be seen as an attack against the semiotic establishment. I’ve no ax to grind (and no time to do so), and aspire to no glory and to no office (national or international). My respect extends to everyone dedicated to such work—committee work and organizational tasks are neither easy nor pleasant, and rarely rewarding. As a matter of principle, I am sure that what semiotics needs most is neither an association nor congresses, and the like, but rather a different perspective. Now to the subject.

## 5.2. A *coup d’oeil* at the Humanities, Sciences, and Technology

The most captivating mathematics (a subject I place in the humanities), the most brilliant attempts to understand language, the most dedicated effort to understand the human condition—these are themes impossible to even conceive of without acknowledging their semiotic condition. Take only the most recent attempt to prove Fermat’s Theorem. Fundamentally, the approach extends deep into the notion of representation. The very elaborate mathematical apparatus, at a level of abstraction that mathematics never reached before, makes the whole enterprise semiotically very relevant. The entire discussion that accompanied the presentation of the proof, expressions of doubt, commentaries, and attempts to explain the proof are *par excellence* all subjects for semiotics. The subject is interpretation, the “bread and butter” of semiotics, its *raison d’être*. A question that begs the attention of semioticians is, “How far from the initial mathematical statement (Fermat’s Theorem) can the proof take place?” That is, how far can the representation of representation of representation, and so on extend the semiotic process before it becomes incoherent or incomprehensible?

Fermat’s short message in Latin (“*Cubem autem in duos cubos, etc.*”) (Figure 4) on his copy of a translation of Diophantus’ *Arithmetica* (3<sup>rd</sup> century CE) is a theorem represented in words, i.e., in a “natural” language. It is relatively easy to interpret. Later (1637), this theorem was “translated” into mathematical formulae.

Figure 4. Fermat’s Theorem in Latin

### OBSERVATIO DOMINI PETRI DE FERMAT.

*Cubum autem in duos cubos, aut quadratoquadratum in duos quadratoquadratos  
& generaliter nullam in infinitum ultra quadratum potestatem in duos eiusdem nominis fas est diuidere cuius rei demonstrationem mirabilem sane detexi.  
Hanc marginis exiguitas non caperet.*



Fermat's Last Theorem states that no nontrivial integer solutions exist for the equation:

$$a^n + b^n = c^n$$

if  $n$  is an integer greater than 2.

One did not need to know Latin, but had to be familiar with mathematical symbols in order to understand. And now, over 370 years later, after computation changed the way we think, mathematicians say that in order to prove Fermat's Theorem, we would have to prove a conjecture (Taniyama-Shimura Conjecture) that deals with elliptic curves. Understanding in this case implies specialized knowledge. Mathematicians are still not united in fully accepting the proof produced by Wiles (1995)—a brilliant piece of mathematics, regardless of its relation to Fermat. Chances are that no other discipline besides semiotics can assist in giving meaning to the effort.

As suggested, semiotics is a knowledge domain different from mathematics. Within this knowledge domain, the mathematical question concerns what in Peirce's semiotics is defined as the *interpretant process*. Fermat's description in Latin was unequivocal; the translation into mathematical symbolism is also unambiguous. The mathematical proof is so far removed from the simplicity of the Theorem that one can question the semiosis: from simple to exceedingly complicated. Under which circumstances is such a semiosis (i.e., epistemology) justified? This goes well beyond Fermat; it transcends mathematics. It becomes an issue of relevance because many semiotically based activities (such as genetics, visualizations, virtual reality, ALife, synthetic life) pertinent to the acquisition of knowledge in our age tend to evolve into complicated operations not always directly connected to what is represented. This is an issue of meta-knowledge. If knowledge acquisition, expression, and communication are indeed semiotically based, then this would be the moment to produce a semiotic foundation for meta-knowledge.

Would Charles Sanders Peirce, given his very broad horizon, have missed the opportu-

nity to approach the subject? I doubt it. By the way: as Einstein produced his ground-breaking theory, Cassirer found it appropriate to offer an interpretation informed by his semiotics (1923-1929). In other words, there is proof that semiotics can do better than indulge in useless speculative language games, as it does in our time.

What I suggest is that specialization—such as in the mathematics required to produce the proof, or the mathematics that Einstein mastered—is a necessary condition for the progress of science. But not sufficient! Specialists—and there are more and more of them—ought to relate their discoveries to other fields, to build bridges. For this they need semiotics as an integral part of their way of thinking, as a technique of expression, and as a communication guide.

We are experiencing various attempts to integrate computation, genetics, anthropology, philosophy, and more into understanding how language emerged and diversified. Never before has language—in its general sense, not only as the language we speak—been as central to research as it is today. Hausdorff, the mathematician who understood the semiotic nature of the human being, anticipated this. And since semiotics has, more often than not, been understood as the semiotics of language, it would be only natural to expect semioticians of all stripes to get involved in it. Genetics is, in fact, the study of DNA “expression,” of a particular kind of language defining the narrative and the associated stories that make up the “texts” and “books” of life. Or, as I shall argue, the narrative and the associated stories defining the unfolding of life over time. “Sentences” of a genetic nature identify not only criminals in a court of law, but also genetic mechanisms related to our health. Would Ferdinand de Saussure have missed the chance to collaborate with researchers who uncover the first “language genes”? Would Hjelmslev? No one expects semioticians to clarify the relation between brain activity and language. Brain imaging opened access to cerebral activity. But language is not necessarily housed in the brain, or only in the brain. Natural language is the most

ubiquitous medium of interaction. It is involved in knowledge acquisition, in its expression, communication, and validation. Semiotics, if founded not around the sign concept—quite counter-intuitive when it comes to language (Where is the sign: the alphabet, the word, the sentence?)—but with the understanding of the interactions languages make possible, would contribute more than descriptions, usually of no consequence to anyone, and *post facto* explanations.

### 5.2.1. Human Condition Means Semiotic Condition

The monkey that Nicoletis (2001) used in order to “download” the thinking that goes on when we play games does not qualify as an example for using language. The monkey initially acted upon the joystick in order to score. But once it noticed that it was sufficient to think about what it wanted to do, it chose the economy and speed of thinking. Are downloaded streams of data describing brain processes made up of signs? Obviously not. This is information in pure form. The semiotics is implicit in the observation that thinking and acting upon representations can be connected. The monkey condition is not equivalent to what we call human condition. But we play entire games of chess in our mind, not by necessarily moving pieces on a chessboard.

As speculative as the notion of the human condition is, we have finally arrived at the juncture where very good models of the human condition, understood in its dynamics, can be conceived, constructed, and tested. The underlying element here is actually what Hausdorff defined as the *zoon semiotikon*, and what Cassirer defined as *animal symbolicum*. Hausdorff, a distinguished mathematician, could have defined the human being as “mathematical animal,” but to him the qualifier *semiotic* meant a more general, more encompassing level. Cassirer was a philosopher; to him, generating symbols seemed more relevant than generating new philosophies. Before Hausdorff, and before Cassirer, many other scholars in the humanities considered the qualifier “semiotic” as co-

extensive of being human. (Some extended it to animals, as well.) Leibniz, with his *mirrors vivants de l’univers*, inspired Cassirer’s definition of the symbol and his attempt to define the human condition in semiotic terms. The active role of the Russian and Czech semioticians in explaining the role of language in the making of humankind, and Roland Barthes’ subtle analysis of language and culture, are convincing arguments that would not have failed to be in the forefront of the semiotic research associated with the current attempts to define the human condition (for more on the subject, see Nadin, 1986, p. 163).

The subject ought to be understood as broadly as possible. This means that within the realm of the living, there is a whole gamut—from the mono-cell to *homo faber*—of representations to consider. Is there anything that qualifies as semiotically relevant across the various forms of the living? Interaction is probably the most obvious aspect. At a closer look, the making of the living consists of integrated interactions—from the level of the cell to that of organisms. At all these levels, representations are exchanged. Therefore, semiotic processes appear as a characteristic of the whole (organism), but also as one among organisms (same or different). Semioticians are not invited to become biologists, rather to engage biological knowledge (acquired in specific experiments) in order to generalize the notion of semiotic process. That which lives is defined not only by the physics, chemistry, or energy of the process, but also by the various representations exchanged and the ability to interpret them. There was interactivity in every previous stage of evolution, as well as in cultural definition. Interactivity implied interpretation—the outcome depended on it—but never at the scale at which society makes semiotic-based interactions its major form of activity. Society also hopes to have the guidance of science, in particular semiotics, in giving such semiotic processes meaning. The availability of such guidance will help avoid costly consequences—such as those experienced in recent years: terrorism, technological errors, speculation, etc. Success and

failure depend upon interpretation. Machines are better in processing data, but not really better than humans in interpreting it. They can handle way more than the people who build them; but quantity does not automatically lead to improved comprehension in a changing context.

The major themes in the sciences beg no less for the contribution of semiotics. Computation is, for all practical purposes, semiotics at work in communication with information processing. Artificial intelligence, in its many flavors, cannot be conceived without integrating semiotic concepts in its concrete implementations. The new forms of computation—genetic, quantum, DNA, etc.—are all forms of semiotic processes. More specifically: No information process (e.g., computer, sensor-based information harvesting, intelligent agents-based activities) is possible without representation. Representation is the definitory subject of semiotics (in awareness of it, or in total disregard of it). While electrons move through circuits, and while logic is emulated in hardware (circuits performing logical operations), operations on representations are the prerequisite for any information processing. The variety of representations (for which Peirce delivered the types, i.e., indexical, iconic, symbolic) and their specific dynamics are superficially understood, if at all. The entire focus on the living, which affects the academic landscape, and human activity in general, is ultimately a focus on the semiotic processes implicit in mechanisms of life. It suffices to check out the major research directions in order to discover that we are getting better at understanding the object level—cells or membrane biochemistry, for example—and in describing the associated representational level. To realize the unity between the informational and the semiotic is a major scientific challenge.

Let us be clear: Representation is not reducible to the entity we call *sign*, regardless of how it is defined. Signs are media for representation, like letters in the alphabet are media for words, sentences, texts. The process we call *representation* cannot be reduced to one or several signs (cf. Figure 2). Just for the sake of the parallel mentioned earlier, we can say that the defini-

tion of semiotics based on the sign is at least as unsatisfactory as a definition of mathematics would be if it were based on numbers alone, or of chemistry based on elements, or of biology based on cells, or of linguistics-based on the alphabet. Representation would have to be further defined as a process, uniting information (measurable) and meaning (result of interpretation). It is in this condition that representation proves to be significant for the understanding of the living, of mathematics (a specific form of human activity), of science, of the arts, of communication, and of interaction. Despite this peculiarity, semioticians are so removed from the major scientific and humanistic themes of the day that they don't even know that this is their greatest chance—ever! The entire stem cell debate could have taken a different path had competent semioticians contributed to an understanding of stem cell “semiosis” and the relation to the broader issues of creativity.

### 5.2.2. *The New Languages of Interaction*

I will finish this compressed exposition by stating that technology is shaped by questions that, at first glance, impress as being semiotic in nature. Technological artifacts of all kind—from games to virtual reality labs in which new materials are conceived—rely on various types of semiotic entities, on representations in the first places, and their interpretation. They make sense, and can become a relevant subject of inquiry, only as new “languages of interaction.” The global scale of life makes an integrative approach necessary, but not in the sense discussed at the last congress, or in previous meetings (*Signs of the World*, Lyon, 2004, where “interculturality and globalization” were the convenient slogans of the semiotics community). In our time, we need a semiotic theory based on acknowledging diversity, while simultaneously providing means of expression, communication, and signification that pertain to the new scale of human activity. The GPS facility, accessible worldwide, is the first global embodiment of semiotics in action. I do not,



of course, expect semioticians to start writing articles on what kind of a sign a GPS indicator is, but rather to contribute semiotic concepts that will make the language of the system so much easier to understand and use. When GPS data will seamlessly integrate in what we do—drive, visit new places, connect to others, for example—that is, when it becomes part of our language, semiotics could support a concrete accomplishment. Hopefully, semioticians will be able to understand this opportunity.

On this note, a simple observation: Brain imaging revealed that taxi drivers in some of the big cities (London was the first address researched), difficult to navigate, developed in the process measurable new faculties. Of course, these are semiotic in nature: Understanding of representations and the ability to match goals and means (a request such as “Get me to Piccadilly in the shortest time,” involves quite a number of parameters). The emergence of GPS-based navigation might lead to the loss of those faculties. Semioticians should be aware of the fact that the world before maps and the world after maps became available are very different realities.

As technology evolves, more and more automated systems guide our navigation—in libraries, on the worldwide web, in air travel, on high-speed trains, on highways and toll roads, etc. Aaron Koblin (2008) documented this process in visualizations of extreme semiotic significance. So did Albert-László Barabási (see 2 examples from their work in Figure 5).

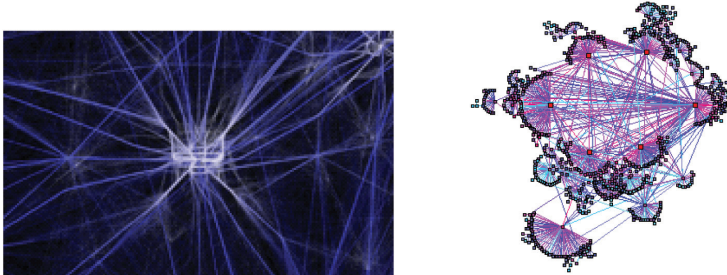
If Google, where Koblin currently works, had been the invention of semioticians, I could not find today’s state of semiotics deplorable. But it was not. Neither was Barabási’s work inspired by semiotics, but by networks. And if the Worldwide Web, through which many publications (including a few of semiotic interest) are presented, had involved the least participation of semiotics, we would have had a Web that is not syntactically driven. The inventor of the Web (Tim Berners-Lee, 1998, awarded with knighthood for his work) is still dreaming of a semantic stage. (For me, personally, only a pragmatically driven web makes

real sense. But this is a different subject.) While the GPS actually changes the nature of our relation to space, and indirectly to time, its semiotics is a legitimate question waiting to be addressed because it involves a new semiotic condition for the human being. The military purpose of the orientation system is spectacularly transcended by rich semioses that, strangely enough, emerged without any input from semioticians. Koblin’s work is only one example among many. If today semiotics were to contribute to a semantic Web, we would avoid the many errors that have affected the growth of the Web into the monster it is now. We find data on the Web, to the extent of overwhelming the user, but we do not really find information, and almost never meaning. If this is not a challenging semiotic project, then I don’t know of any.

Yes, there is semiotics at work in the activity of Luc Steels, Stevan Harnad, and Juyan Weng. João Queiroz, and Angelo Loula (the latter two initiated a new journal in semiotics) pursue a promising agenda. And yes, in the AI domain, there is a definite awareness of the semiotic component of intelligence. Tony Belpaeme and Angelo Cangelosi come to mind in this vein. But the work of such researchers is not presented at semiotics meetings and congresses or in the regular semiotics publications.

Obviously, this short account is not exhaustive, and it is less systematic than it would be in a different context. The intention is only to suggest that semiotics has a very fertile ground to cultivate, if semioticians care to work at it, or if professionals from other disciplines pay more attention to semiotics. It is not too late! In a different context (Nadin, personal communication, 2005), I brought up *The Semiotic Engineering of Human-Computer Interaction*, a book written by a computer science professor (trained as a linguist), Clarisse Sieckenius de Souza (2005), who “spread” the semiotic word in the HCI community. We have here an example of an applied understanding of semiotics informed by the desire to advance issues of interaction—to make it into a foundation for new forms of engineering. It is modest proof,

Figure 5. Air traffic paths Atlanta and social networks in Canberra



if anyone needed more proof that so much can be done, provided that semiotics competence guides the effort. Aware of this characterization of her book (which semioticians managed to ignore), she recently wrote to me by e-mail: “Having studied semiotics does make a difference [...] I have the impression...that HCI professionals and students educated in North America tend to have a ‘What is in it for me?’ approach. [...] As you know, the answer is, ‘a whole new world, but it will take a lot of critical thinking to get it.’”

### 5.3. A Short Historic Account of Developments in Semiotics

As already mentioned, at the first Congress of the International Association of Semiotic Studies, the point was made that a historic account could help in defining the methodology, at least in respect to how semiotics had been practiced over time. The second point I want to bring up is that semiotics has had more than one chance in history to make its case, and to make useful and sensible contributions. Semiotic “seeds” were planted early in all known cultures. But as is always the case with history, you find in the past what you are looking for. And attention was focused on spoken language and the sign more than on representation. Before the Greek word *simeiotika* was acknowledged, there was the Hebrew *oth* for sign: the Hebrew Torah makes reference to the lights in the firmament, Shabbat, the mark of Cain, the rainbow, the token of the

covenant, all covering a broad understanding of the sign (“And this shall be a sign to you . . .”). The intention underlying these signs is pragmatic, guiding human activities that aided in establishing a stable body of knowledge: the sign as a mark of genuineness, of authenticity, of promise. The same pragmatic propensity is obvious in the Chinese, the Indian, and the Arabic infatuation with the sign. In Western Europe, the sign emerged also in a context of an applied understanding: means of orientation, symptoms as a prerequisite for diagnosis. It was only very late—probably after Locke (1690)—that questions related to the way in which the mind operates prompted a focus on the sign as a means for understanding and sharing. With Lambert (1764), questions concerning the connection between thinking and things were articulated. But these were questions of representation pertinent to cognition, not sign-based considerations.

#### 5.3.1. Pragmatic Relevance

We cannot avoid the general observation that semiotic awareness led to more than one attempt to define its knowledge domain and its specific methods. Still, so it seems, each start was relatively short-lived. The generically defined “ancient times” had such a start, with works such as Plato’s *Sophistes* (*The Sophist*, 360 BCE), Aristotle’s *Poetica* (350 BCE), and the Stoics, mentioned in almost every account of history. It is worth mentioning that Sextus

Empiricus (in *Adversus Mathematicos*, VIII) took note of the fact that the distinction between what is signified, what signifies, and the object informs early attempts to understand semiotics as focused on the verb *to introduce* something. The object and the signifier are material; the signified (*lekton*) is not, but it can only be right (adequate) or not (inadequate). Indian Buddhism and Brahmanism, the Christian infatuation with signs (St. Augustine's *De Doctrina Christiana*, 397 CE, and St. Anselm's *Monologion*, 1075-1076; Hopkins, 1986), and Avicenna's explorations in medicine and theology remain documentary repositories of the many questions posed by two very simple questions: How can something in the world be "duplicated" in the mind? Take note: the question is not about signs, but about re-presentation. Moreover, once we think about it (the reality duplicated in the mind), can we know it (or assume that what we know corresponds to reality)? Or does knowing actually involve a practical activity with a desired outcome?

Wilson (1984) came up with a provocative statement of significance to semiotics: "Scientists do not discover in order to know, they know in order to discover." The inversion of purpose (the causality) points to opportunity. Reading classical texts (such as those mentioned above)—and very few semioticians care to do that—reveals that the sign was only the trigger of the interactions it made possible, not associated with their meaning, and even less with their significance. From the beginning, the fascination was with semiotic knowledge, that is, what we learn from observing interactions, and how these are subject to betterment. It is not the history that is important here, but rather the attempt to understand the need for semiotics—if a need indeed exists. The premise guiding this effort is *pragmatic relevance*: If semiotics does not make a difference, as mathematics, chemistry, and physics do, why bother with it? After the rather modest beginning of semiotic inquiry, the interest in formulating semiotic questions diminished. However, the still controversial "Middle Ages" were yet another start. The works of Roscelin (who introduced extreme

nominalism); Guillaume de Champeaux (who maintained that universals exist independent of names), and Abélard (on logic) stand as examples for the enthusiasm of those seeking in semiotics answers to the many challenges of those times. Let's be clear: The fundamental opposition between nominalism and realism is a test case. If things are only names, semiotics would be in charge of the world. If, alternatively, the world, in its manifold materiality, were to look at names and call them a poor attempt at describing it, semiotics would be useless. Jean de Salisbury (*Metalogicon*) suggested that abstractions are not related to signs and take the role of names and naming. It is a fascinating journey to read Occam, William of Shyreswood, Lambert d'Auxerre, and Roger Bacon, first and foremost because their questions, extended to the domain of rationality, will inspire the third attempt at restarting semiotics in the classical age. To put it succinctly, it was not much more successful than the previous beginning. Hobbes (*Leviathan*, 1651) the *Logique de Port Royal*, (or *The Art of Thinking*, 1662) John Locke (the forms of reasoning and *The Division of Sciences*, 1690), and foremost, Leibniz (symbolic and mathematical thought, 1672-1696) are precursors of the modern rebirth associated with de Saussure and Peirce.

Important, even for those disinclined to seek guidance in works of the past, is the distinction between language associated with convention or law (*nomoi*)—such as programming languages—or with nature (*phusei*)—such as the genetic code. Nobody expects today's semioticians to become historians. But in the absence of a broader understanding of our concepts, we will continue to explore, blindfolded, new continents (of thought and action). I do not doubt that Saussure and Peirce are valid references, but I suggest that Hermann Paul's (1880) *diachrony* is far more conducive to understanding the specific dynamics of languages. This is only one example. Nikolai Sergeyevitch Troubetzkoy might be another, as is Louis Hjelmslev.

### 5.3.2. *Old Wine in New Skins?*

The modern rebirth of semiotics eventually legitimized what others were doing within their respective disciplines: philologists, structuralists, scholars in literary theory, morphology. Many fascinating ideas have been advanced, and it seemed that a promising new age began. But the effort had one major weakness: it remained focused on the sign. Once a new territory was defined, many moved into it, while actually continuing to do what they had always done. This is not unusual. The most recent example is the morphing of mathematicians and physicists into computer scientists. It took a while until the “new science” (if “new” can be justified in having Leibniz as the final reference) settled into its “language” and “methods.” But in the case of semiotics, those who have run over the border and sought “political asylum” in the “free country” of semiotics actually remain faithful (*captive* would be a more accurate descriptor) to their old questions and methods.

Therefore, semiotics became the stage for literary critics, art historians, confused structuralists, and even for some linguists, mathematicians, and sociologists—even some philosophers ventured on the stage. Before too late, we had the semiotics of feminism, multiculturalism, human rights, sexuality, food, and even the semiotics of wine; we had gay and lesbian semiotics, environmental semiotics, and even global warming or sustainability semiotics. *But no semiotics!* Semiotics in this form became a critical discourse of convenience for everything opportunistic. Philosophy, in its classical form, could have performed the same without the heavy terminology that alienated even those who were convinced that semiotics is a legitimate endeavor. While all the subjects—and there are way more than what is listed—are, of course, relevant within the broader context of culture and civilization, the qualifier *semiotic* at most justified the opportunistic take around the sign as identifier, but did not essentially contribute anything constructive.

### 5.3.3. *Logocratic Ideology*

Preoccupation with what is called *natural language* affected the focus on the sign. It informed the reading of past attempts in semiotics in such a manner that what actually lies behind the sign is cast aside, never really recognized. All this rendered the notion of sign captive to an ideology that dominated semiotics from its beginnings. Simply stated, this ideology is *logocratic*. That is, it ascertains that every sign can be reduced to a language sign; moreover, that any interaction is language dependent. Since language is the dominant medium of formalization and abstraction, one can understand why this ideology went unchallenged until Charles Sanders Peirce, and later, Cassirer. Roland Barthes thematized the totalitarian nature of this language. Totalitarian regimes rely upon the authority of language in order to consolidate their power. Even the sciences (physics, mathematics, chemistry, etc.) can at times consolidate their “power” through the “languages” they cultivate, to the detriment of alternative understandings in their object domain. Computer science and genetics fully illustrate this thought.

Attempts were made within semiotics to challenge the logocratic model. For instance, some scholars tried to advance semiotic notions connected to human activity; others (inspired by Jakob von Uexküll, 1884-1944, as author of theoretical biology; cf. 1934, 2010) reached beyond the human being into the larger domain of nature. But within semiotics itself, dominated by scholars who fled language studies, such attempts were at best tolerated, but never taken as a scientific challenge. If, finally, semiotics could in our days free itself from the obsession with sign-based language as object of its inquiry, it could help debunk quite a number of dogmatic positions. Or at least it could become a guide for maintaining meaningful dialog, among those who acknowledge images, sounds, smell, and tactility as relevant to interactions.

Even though I have made some historical references, I’m not trying to rewrite the history of semiotics (in which very convincing work was already done). I am not even trying to as-

sociate moments in history with the currency of a particular subject. We are not so short of histories as we are short of better semiotics. What I attempt here is to point to a development that explains the linguistic bent of even some of the best works produced at the end of the last century. The brilliant literary accomplishments of the French School, as well as the powerful arguments of the Russian-Prague formalists and the Soviet school, and even the German and American elaborations of the 1980s and 1990s are pretty much driven by the same implicit understanding that natural language is paradigmatic, and that a sign-focused semiotics could further consolidate this position. We will not be able to escape the deadly embrace of this limited understanding unless and until semioticians establish a fresh perspective.

They should at least acknowledge that language is not always language. This is important because even though languages are structurally different, we have generalized from the Indo-European languages to the new languages of programming. In doing so, we miss the opportunity to take advantage of the characteristics of other cultures. Moreover, we have generalized from Indo-European language to images, sounds, and other expressive means, although their semiotic conditions are different. If the logocratic model is problematic in the first place, it becomes even more so when it generalizes on account of a particular language experience instead of integrating as many as possible (corresponding to the richness of human activities unfolding in various contexts). However, at the periphery—i.e., exactly that part of the world that was ignored by Western semiotics—semiotic awareness “outside the box” developed quite convincingly and semiotics gained in significance. Of course, the periphery was “colonized;” English is the *lingua franca*, and semiotics was imported like so many West-based intellectual endeavors. But recently, awareness of language and logic characteristics of practical experiences not reducible to those of western civilization started to inform alternative understandings.

Let me explain: French (as an example of western language and logic) and Japanese (as an example of a very different language and logic) are difficult to reconcile (to elaborate extends beyond the scope of this text, see Nadin, 1997, pp. 168-169, 214, 325). And so is the phonetic writing of many western languages different from the synthetic Korean alphabet. Let’s face it: the most interesting semiotics today seems to evolve in China (which will host the next international congress on semiotics), Korea, Japan, and India. The latter is the recipient of most of Western outsourcing, which is often semiotic work by the way: translations, word processing, scanning, record keeping, programming, etc. While the sign is not discarded, the focus of such a work is rather on broader semiotic entities (text, narrative, game, etc.). This suggests, indirectly, an interest in issues of representation, which are not affected by differences in languages and the associated differences in logic (from the 2-valued Aristotelian logic to the Oriental multi-valued logical systems). If only Baumgarten’s sketchy semiotics, which is part of his attempt to provide a foundation for aesthetics (*Aesthetica*, 1750), were to be considered, semioticians would at least, instead of generalizing from the language-defined sign, seek a broader understanding of the sign as such, as Peirce attempted. Such an understanding will in the end have to translate into the most important dimension of the sciences: predictive power. We are pretty advanced in the predictive aspects of the physical world; we are still at a loss in regard to predictive aspects of living processes. Let it be noticed that the logographically driven semiotics focused on the sign could at best deliver explanations for semiotic processes concluded (characteristic of the physical reality). Analytical performance characterizes this attempt. But it could not serve, even in the best of cases, as knowledge on whose basis future semiotic processes could be envisaged or, for that matter, designed, tested, and validated as means to support human activity. A semiotics running after, instead of leading to desired semiotic processes cannot serve as



a bridge among sciences, and even less as an innovative field of human activity.

These lines are only an indirect argument in favor of more semiotics of the visual or of multimedia, of learning from the differences in various languages, and of discovering the underlying shared elements of such languages. Whether we like it or not, language ceased being the dominant means of knowledge acquisition, just as it ceased being the exclusive means of knowledge dissemination. Representations in expressions other than in language are the rule, not the exception. Moreover, representation, in its broad sense, shapes human interaction to the extent that it renders the semiotics of natural language an exercise in speculative rhetoric.

The fact that means of representation are simultaneously constitutive of our own thinking and acting is not yet reflected in the semiotic elaborations of our time. Some researchers, unfortunately ignoring each other, rushed to establish a computational semiotics, and even cognitive semiotics, not realizing that the fashionable qualifiers “computational” and “cognitive” mean, after all, a semiotics of semiotics. What semiotics does not need is a new way of packaging the worn-out speculations resulting from the ceremonial of an old-fashioned dance around the sign—the elusive princess at a ball where everyone seems blessed with eternal oblivion.

Since computational semiotics was mentioned (cf. Stephan, 1996; Rieger, 1997, 2003; Gudwin & Queiroz, 2005) it is appropriate to ask whether such a discipline is possible. The broad agreement that knowledge is expressed more and more in computational form could translate into a well-defined goal: express semiotic knowledge computationally. As such, the goal deserves attention because even though deterministic machines are inadequate for capturing nondeterministic processes, we can work towards conceiving new forms of processing that either mimic the living or even integrate the living (hybrid computation). Computational semiotics (making reference to Dmitri Pospelov and Eugene Pendergraft, to James Albus, to “language games” behind

which Wittgenstein is suspected, to Luis Rocha and Cliff Joslyn, and even to Leonid Perlovsky and his intelligent target tracker) is more than looking for justification for AI research, or for some computer-based terminology associated with signs. It would be encouraging to engage those interested in foundational aspects of semiotics in a computational effort. One possible result could be a semiotic engine conceived as a procedure for generating representations and for supporting interpretation processes. But this is already a methodological direction, probably more significant within the broader context of human activity in our days.

#### 5.4. A Methodological Perspective

The possibility of a semiotic engine brings up the third and last aspect I listed above: What defines the semiotic method? Our concepts, whether semiotic or not, are a projection of our own reality. Our environment embodies matter in an infinite variety of expression. Its dynamics results from energy-related processes, themselves of infinite variety. There is change, including our own; there is the rate of change, testifying to an acceleration related to improved performance, but not necessarily to better understanding of what and why we do what we do. There is also failure. The broader the scale of human endeavors, the bigger the scale at which we experience failure. For all practical purposes, a powerful earthquake and a massive tsunami are of a scale comparable to a nuclear power plant breakdown (and its many consequences). And there is the human being: *We are what we do* defines the living, including the human being. We are currently experiencing the computational condition of research and activity.

Among other things, humans observe nature (while being part of it) more through the deployment of computational means. And they attempt to change the world according to needs they have, desires they form, goals they express, capabilities they acquire. In this encompassing process of the human-being’s continuous self-making, humans are semiotic animals, able to

operate not only on what is available (from stones, tree branches, edible vegetation, to swiftly running rivers and combustible matter), but also on representations of what the world actually is. Computation is representation driven. This ability is acquired, tested, and continuously changing. To operate on representations is to transcend the immediate, the present. Only the *zoon semiotikon* (and similarly the *animal symbolicum*) has an awareness of the future in the sense that they can affect the dynamics of existence. Only through the intermediary of semiotic processes of representation do human beings free themselves from the immediate.

#### 5.4.1. Information and Meaning

Representations are a prerequisite for natural or artificial reproduction. The sperm and the egg to be fertilized are embodied representations of the particular male and female; so is the stem cell, unfolding under complex anticipatory dynamics. Computer programs “translate” algorithms—describing a course of action for reaching a well-defined goal—into operations on representations. Computer viruses, probably more than other successful programs, illustrate artificial reproduction as it results from a dynamics associated with pre-defined operations (the reverse engineered Stuxnet is a good introduction to the subject). Adaptive characteristics of the living and adaptive mechanisms in the world of machines, as different as they are, correspond to two different modalities for generating representations appropriate to changing contexts of existence or functioning. In adapting, the living experiences information processes (corresponding to energy- and matter-related phenomena) and semiotic processes (corresponding to meaning, and embodied in the narrative of life and its many associated stories).

Space and time are constitutive representations. Furthermore, it is epistemologically suicidal not to realize that concepts, which are representations, help to both describe and constitute the world. We perceive the world empowered (when not blinded) by our thinking and supported (when not handicapped) by arti-

ficially extended perceptions. We “see” today much, much more than what we see; we “hear” today much more than what our ears bring to us. But in the end, we never escape the epistemological circularity of our perspectives. This applies to mathematics as it does to semiotics. For people focused on a sign-centered semiotics, a sign definition is as adequate as we can make it adequate. But it is a construct, always subject to questioning, as Sadowski (2010) recently questioned Peirce’s definition, or as I (Nadin, 1983) questioned Saussure’s definition (notwithstanding the relevance of his linguistic contributions, cf. Bouissac, 2010). Something else is at stake: not the adequacy of sign-based semiotic concepts, but the ability to support, to guide practical experiences. The first integrated VLSI (i.e., integrated circuits), celebrated as one of the major accomplishments in the technology of the last 50 years, was a project in applied physics. Today, we integrate millions of transistors in a chip, or achieve technological performance in myriad ways; physics and awareness of the characteristics of the living fuse into a new perspective. But after all is said and done, the entire effort is focused on *representations*—of arithmetic, calculus, geometry, physics, etc. No doubt, the chip remains a magnificent outcome of mathematics, physics, chemistry, and technology, i.e., engineering. But what is “condensed” on the chip is knowledge—representations, not signs, expressed in digital form. Ultimately, this knowledge is representation of all we know about arithmetic, calculus, geometry, etc., of what we know about graphics, color, form, shape, etc. The most recent (and probably soon-to be improved upon) 3DS game player from Nintendo makes 3D representation on a 2D monitor (no goggles needed) possible. The victory of information processing (implementation of the binocular parallax) is associated with a semiotic accomplishment: the meaning of 3D in situations of search, hiding, exploring realistic representations of landscapes, etc. Playing hide-and-go-seek involves our individual characteristics, our *ad hoc* knowledge pertinent to hiding and seeking. Playing an MMOG (massively multi-player online game) involves

embodied knowledge. If this knowledge reflects the reductionist-deterministic view of the world, the game will be a good simulation of this perspective—but not a new perspective of our own being, of our condition as semiotic animals. This is a world of action-reaction. Playing with others, located around the world, via the medium of the game recovers anticipation. This is a victory for semiotics, even if semioticians have to date missed the meaning of such innovative applications.

#### 5.4.2. *Monsieur Jourdain Did Not Know He Was Speaking Prose*

The most fascinating semiotic applications of recent years came not from semioticians, but from the people who practice semiotics without knowing they do so. To talk about military applications would require an expertise I do not have. (Plus: I prefer not to endorse them.) The entire genome project is such an example. So is virtual reality, that is, computing representations that recreate aspects of the real world. In a virtual reality application for someone who wants to learn how to juggle more than three or four balls at a time, the action pertains to the representation, not to real balls. The glove senses “representation” of balls; speed can be adjusted, and gravity itself is re-presented, made subject to the individual’s control. Not only *Nike* and *MacDonald’s*, but also the whole branding craze is semiotic in nature. Politics—the practice of gaining access to power—involves itself in semiotics, and elections are won (or lost) on account of the appropriate (or inappropriate) semiotics. It is an example of *gamification*—make everything a game, stimulate new forms of interactions, use reward mechanisms to stimulate performance.

But what are semioticians doing? The old soup of psychoanalytic extraction is warmed up again and again; literary criticism is disguised as semiotic analysis; structuralist considerations are rewritten in semiotic jargon; linguistic terminology is made to appear semiotic. To forever analyze popular culture (after Barthes and Eco exhausted the theme), film, music, new media,

and video games might lead to texts published by editors as clueless as the writers, but not to the knowledge that society has the legitimate right to expect from semiotics. Books on the semiotics of games will never replace the experience of the game itself, or of conceiving the game. Let us open a “Story Lab” where semiotics can be practiced in generating new stories, corresponding to the fast dynamics of the present, instead of continuing the impotent discourse on narrativity (without understanding the difference between narration and story). And let us provide semiotic methods for the human interactions of the future, not attempts to explain what these interactions were.

Have I given the impression that conditions were ideal in the “good old days” of the semiotic revival of the early 1970s (or earlier)? I hope not. Have I incited a conflict between succeeding generations of semioticians? Probably, in the sense that I still hold to the notion (Peircean, by the way) that without an ethics of terminology, each of us will be talking about something (the sign, let’s say) and understanding something else. The best example is the use of the word *sign*, and the tendency to substitute *symbol* for *sign* (or *vice versa*). For this ethics to emerge, we also need an encompassing semiotic culture: more people who read primary sources, not approximate derivations, and more people with *original* ideas who actually read what has already been written on the topic—and give credit where credit is due. Yes, there was more scholarship before, despite the absence of Google or Wikipedia—sources of generalized mediocrity—which some believe substitute for true research effort. Without the realization of the need for scholarship, well-intended newcomers will rediscover “continents” that were already explored, and consequently miss their chance to contribute fresh thoughts. A recent example: The 1<sup>st</sup> International Conference of Semiotics and Visual Communication was held on March 31, 2011. Where were these semioticians in 1983, when semiotics of visual communication was first introduced (cf. Nadin, 1985)?



Mediocrity corresponds to a new semiotic condition of the human being: Within shorter cycles of change, and under the inescapable pressure of faster dynamics, there is no room left for depth. Humankind is shaping itself as a species of shallow enterprise, a breadth-focused existence, contributing spectacularly to its own end (within a perspective of time that makes the end still far away).

In various attempts at making up “specialized” semiotics—of music, law, sex, and so on and so on—mostly left in some state of indeterminacy, well-intentioned authors decided to use the concept of the sign in order to deal with particular objects of their interest. Obviously, someone can take a ruler to measure how long a carrot is, or how short a mouse’s nose. Appropriateness of perspective, and thus of qualifiers for a certain action or tool, is a methodological prerequisite for any scientific endeavor. Philosophy is not measured in gallons; a work of art is not reducible to the number of knots in the canvas; music is not the map of sound frequencies. The sign, well- or ill-defined, can be the identifier of choice for pragmatic reasons: How well does the STOP sign perform its function? (But when the car is fully automated, the sign as such becomes obsolete.) How appropriate are the various components of a sign such as a logo in a corporate identity “language”? (But when the life of a corporation is no longer than the life of its only product, identity is consumed.) Why is a certain selection made (color, shape, rhythm) in the attempt to establish conventions for communication purposes, or within a culture? (Such choices will change as fast as anything does in our time.)

It is evident that semiotics integrates the concept of the representation through something called a sign (or, previously, a symbol). It is less evident that semiotics is not reducible to signs, or to the formal relation among signs (what is called *syntax*). Those who do not realize this irreducibility might at times generalize in a manner not beneficial to semiotics. The best example is that of semioticians forcing their contrived terminology on hot domains of knowledge. *Biosemiotics* (cf. Barbieri, 2007)

is such a domain; and many self-delusional attempts have been made to find semiotics in biology, instead of first asking the question of how semiotics might be relevant to advancing biology. The grounding of semiotics in biology will not justify it more than its grounding in sign theory. What counts is that biological processes are defined by representation, consisting of both informational and semiotic processes. This could be important to semioticians, but only after they find out what this means. However, more important than the syntax of life is life itself, a narration that encompasses semiotics and pragmatics. Its deviations in stories (disease, accident, birth and death, etc.) are far more conducive to knowledge than inventories of signs.

## 6. CONCLUSION

The day when scholars and students of semiotics become the hottest commodity in the labor market and are traded like neurosurgeons, high-performance programmers, football players, movie stars, or animators, we will all know that semiotics finally made it. Currently, semiotics is of marginal interest, at most, in academia. Nobody hires semioticians. I am convinced that this can change. But for this change to come about, everyone involved in semiotics will have to think in a different way, to redefine their goals. Semioticians need the patience and dedication necessary for working on foundational aspects, starting with defining the specific domain knowledge and the appropriate methodology. And they need to define a research agenda for semiotics above and beyond the speculative.

## ACKNOWLEDGMENT

I would like to express my gratitude to the antÉ—Institute for Research in Anticipatory Systems, The University of Texas at Dallas, and to the Hanse Wissenschaftskolleg (Hanse Institute for Advanced Studies), Delmenhorst, Germany, for supporting the research that made this article possible.

## REFERENCES

- Aristotle. (350 B.C.E.). *Poetics* (S. H. Butcher, Trans.). Retrieved March 31, 2011, from <http://classics.mit.edu/Aristotle/poetics.html>
- Augustine. (397). *De doctrina christiana, I-III*.
- Barbieri, M. (Ed.). (2007). *Introduction to biosemiotics. The new biological synthesis*. Heidelberg, Germany: Springer Verlag. doi:10.1007/1-4020-4814-9
- Baumgarten, A. G. (1750). *Aesthetica*. Frankfurt-ander-Oder, Germany [Kley.]. *Impens., I, C*.
- Berners-Lee, T. (1998). *Semantic Web Roadmap*. Retrieved March 31, 2011, from <http://www.w3.org/DesignIssues/Semantic.html>
- Bouissac, P. (1977). *Circus and culture: A semiotic approach (Advances in Semiotics)*. Bloomington, IN: Indiana University Press.
- Bouissac, P. (2010). *Saussure. A guide for the perplexed*. New York, NY: Continuum International.
- Cassirer, E. (1921). *Substance and function and Einstein's theory of relativity* (pp. 351–445). (Swabey, W. C., & Swabey, M. C., Trans.). Chicago, IL: Open Court.
- Cassirer, E. (1955). *Philosophy of symbolic forms* (Manheim, R., Trans.). New Haven, CT: Yale University Press. (Original work published 1923)
- Deledalle, G. (1979). *Théorie et pratique du signe: Introduction à la sémiotique de Charles S. Peirce*. Paris, France: Payot.
- Deledalle, G. (2001). *Charles S. Peirce's philosophy of signs: Essays in comparative semiotics (Advances in Semiotics)*. Bloomington, IN: Indiana University Press.
- Eco, U. (1975). Preface. In Chapman, S., Eco, U., & Klinkenberg, J.-M. (Eds.), *A semiotic landscape/Panorama Sémiotique* (pp. v–vii). The Hague, The Netherlands: Mouton.
- Eco, U. (1976). *A theory of semiotics (Advances in Semiotics)*. Bloomington, IN: Indiana University Press.
- Gallese, V. (2001). The “shared manifold” hypothesis. From mirror neurons to empathy. *Journal of Consciousness Studies*, 8(5-7), 33.
- Goguen, J. (1999). An introduction to algebraic semiotics, with application to user interface design. In C. L. Nehaniv (Ed.), *Computation for Metaphors, Analogy, and Agents* (LNCS 1562, pp. 242-291).
- Gudwin, R., & Queiroz, J. (2005, April 18-21). Towards an introduction to computational semiotics. In *Proceedings of the IEEE International Conference on Integration of Knowledge Intensive Multi-Agent Systems*, Waltham, MA (pp. 393-398).
- Hobbes, T. (1651). *Leviathan*. London, UK: Andrew Cooke.
- Hoffmeyer, J. (Ed.). (2008). *A legacy for living systems. Gregory Bateson as precursor to biosemiotics*. Berlin, Germany: Springer Verlag.
- Hopkins, J. (1986). *A new, interpretive translation of St. Anselm's Monologion and Proslogion*. Minneapolis, MN: A.J. Banning Press.
- Koblin, A. (2008). *Aaron Koblin website: Information*. Retrieved April 1, 2011, from <http://www.aaronkoblin.com/info.html>
- Lambert, J. H. (1764). *Neues Organon oder Gedanken über die Erforschung und Bezeichnung des Wahren und dessen Unterscheidung vom Irrtum und Schein*. Leipzig, Germany: Johann Wendler.
- Locke, J. (1690). Of the division of the sciences. In Locke, J. (Ed.), *An essay concerning human understanding*. London, UK: The Baffet.
- Lotman, J. M. (1990). *Universe of the mind: A semiotic theory of culture* (Shukman, A., Trans.). Bloomington, IN: Indiana University Press.
- Marty, R. (1990). *L'Algèbre des Signes: Essai de Sémiotique Scientifique d'après Charles Sanders Peirce (Foundations of Semiotics, 24)*. Amsterdam, The Netherlands: J. Benjamins.
- Mongré, P. (1897). *Sant' Ilario. Thoughts from Zarathustra's Landscape*. Leipzig, Germany: C. G. Nauman.
- Morris, C. W. (1938). *Foundation of the theory of signs* (1st ed.). Chicago, IL: University of Chicago Press.
- Mumford, L. (1967). *The myth of the machine: Technics and human development*. New York, NY: Harcourt, Brace, Jovanovich.
- Nadin, M. (1977). Sign and fuzzy automata. *Semiosis*, 1(5).
- Nadin, M. (1980). The logic of vagueness and the category of synechism. *The Monist*, 63(3).
- Nadin, M. (1982). *Semiology: Is it nonsense?* Providence, RI: Brown University.

- Nadin, M. (1983). The logic of vagueness and the category of synechism. In Freeman, E. (Ed.), *The relevance of Charles Peirce* (pp. 154–166). La Salle, IL: The Monist.
- Nadin, M. (1985). On the meaning of the visual: 12 theses regarding the visual and its interpretation; and the discipline of interdisciplinarity (introduction). In Nadin, M. (Ed.), *Semiotics of the visual: On defining the field*. Amsterdam, The Netherlands: Mouton.
- Nadin, M. (1986). Pragmatics in the semiotic framework. In Stachowiak, H. (Ed.), *Pragmatik, II: The rise of pragmatic thought in the 19th and 20th centuries* (pp. 148–170). Hamburg, Germany: Felix Meiner Verlag.
- Nadin, M. (1991). *Mind—Anticipation and chaos (Milestones in Research and Discovery)*. Stuttgart, Germany: Belser.
- Nadin, M. (1997). *The civilization of illiteracy*. Dresden, Germany: Dresden University Press.
- Nicolelis, M. A. L., & Shuler, M. (2001). Thalamocortical and corticocortical interactions in the somatosensory system. *Progress in Brain Research*, 130, 90–110. doi:10.1016/S0079-6123(01)30008-0
- Nietzsche, F. (1975). *Kritische Gesamtausgabe Briefwechsel* (Colli, G., & Montinari, M., Eds.). Berlin, Germany: Walter de Gruyter.
- Nöth, W. (1985). *Handbuch der Semiotik*. Stuttgart, Germany: Metzler.
- Nöth, W. (1995). *Handbook of semiotics (Advances in Semiotics)*. Bloomington, IN: University of Indiana Press.
- Paul, H. (1880). *Prinzipien der Sprachgeschichte* (1st ed.). Halle, Germany: Max Niemeyer.
- Paul, H. (1970). *Principles of the history of language* (Strong, H. A., Trans.). College Park, MD: McGroth.
- Peirce, C. S. (1953). *Letters to Lady Welby* (Lieb, I. C., Ed.). New Haven, CT: Whitlock.
- Piaget, J. (1955). *The child's construction of reality*. London, UK: Routledge/Kegan Paul.
- Plato. (360 B.C.E.). *Cratylus* (B. Jowett, Trans.). Retrieved April 10, 2011, from <http://classics.mit.edu/Plato/cratylus.html>
- Plato. (360 B.C.E.). *Sophist* (B. Jowett, Trans.). Retrieved April 10, 2011, from <http://classics.mit.edu/Plato/sophist.html>
- Popper, K. R. (1934). *Logik der Forschung*. Vienna, Austria: Mohr Siebeck.
- Popper, K. R. (1959). *The logic of scientific discovery*. London, UK: Routledge.
- Rieger, B. B. (1997). Computational semiotics and fuzzy linguistics. On meaning constitution and soft categories. In A. Meystel (Ed.), *A learning perspective. International conference on intelligent systems and semiotics* (pp. 541–551). Washington, DC: Government Printing Office.
- Rieger, B. B. (2003). Semiotic cognitive information processing: Learning to understand discourse. A systemic model of meaning constitution. In Kühn, R., Menzel, R., & Menzel, W. (Eds.), *Adaptivity and learning. An interdisciplinary debate* (pp. 347–403). New York, NY: Springer.
- Rosen, R. (1985). Organisms as causality systems which are not machines: An essay on the nature of complexity. In Rosen, R. (Ed.), *Rosen: Theoretical biology and complexity* (pp. 165–203). Orlando, FL: Academic Press.
- Rozenberg, G., Paun, G., & Salomaa, A. (1998). *DNA computing. New computing paradigms*. New York, NY: Springer.
- Sadowski, P. (2010). *Towards systems semiotics: Some remarks and (hopefully useful) definitions*. Retrieved March 16, 2011, from <http://www.semioticon.com/semiotix/2010/03/towards-systems-semiotics-some-remarks-and-hopefully-useful-definitions/>
- Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication*. Urbana, IL: University of Illinois Press.
- Sieckenius de Souza, C. (2005). *The semiotic engineering of human-computer interaction*. Cambridge, MA: MIT Press.
- Smalley, R. E. (2001). Of chemistry, love and nanobots (nanofallacies). *Scientific American*, 76–77. doi:10.1038/scientificamerican0901-76
- Solomon, J. (1988). *The signs of our time. Semiotics: the hidden messages of environments, objects, and cultural images*. Los Angeles, CA: Jeremy C. Tarcher.
- Stephan, P. (1996). Auf dem Weg zu computational semiotics. In Dotzler, D. (Ed.), *Computer als Faszination* (p. 209). Frankfurt, Germany: CAF Verlag.
- von Foerster, H. (1981). *Observing systems*. Seaside, CA: Intersystems.

- von Uxeküll. (2010). *A foray into the worlds of animals and humans* (O'Niell, J. D., Trans.). Minneapolis, MN: University of Minneapolis Press.
- von Uxeküll, J. (1934). *Streifzüge durch die Umwelt von Tieren und Menschen*. Berlin, Germany: Julius Springer Verlag.
- Wiles, A. (1995). Modular elliptic curves and Fermat's Last Theorem. *The Annals of Mathematics*, 141(3), 443–551. doi:10.2307/2118559
- Wilson, E. O. (1984). *Biophilia: The human bond with other species*. Cambridge, MA: Harvard University Press.
- Windelband, W. (1894). Geschichte und Naturwissenschaft. In *Präludien. Aufsätze und Reden zur Philosophie und ihrer Geschichte* (pp. 136–160). Tübingen, Germany: J. C. B. Mohr

*Mihai Nadin has been preoccupied with semiotics, underlying interaction, since 1971. His interest in the foundational aspects of semiotics goes back to 1978 (Sign and Value). In 1982, he taught the first course in semiotics and user interface (RIT); in 1985 (Eugene, OR), he gave the first tutorial on the topic of Interface Design—A semiotic paradigm, which was further developed as part of the Computational Design Program (begun at the University of Wuppertal). He conceived applications during his consulting work for Apple Computer (later for IBM, DEC, Wang, NeXT). In tenuous dialog with Max Bense and his group (especially Frieder Nake), Nadin advanced the semiotic machine metaphor (1983) suggesting that computations are a specific form of semiotic activity. Nadin set the foundations for the semiotics of the visual (The Meaning of the Visual: On Defining the Field, 1985). The study of semiotics triggered Nadin's interest in anticipatory systems (Mind—Anticipation and Chaos, Ohio State University, 1987). Since 2004, Nadin is Ashbel Smith University Professor at the University of Texas at Dallas, and Director of antÉ—Institute for Research in Anticipatory Systems. He was awarded a Fellowship at the Hansa Institute for Advanced Study. Most recently (prompted by Andres Kurismaa), Nadin has focused on works in semiotics by Rothschild, Buytendijk, Palágyi—which have been ignored or misunderstood; and on Nikolai Bernstein's texts concerning anticipation expressed in human movement.*