Knowledge Discovery, Transfer, and Management in the Information Age

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Chapter 5
Semiotics is Fundamental Science

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ABSTRACT

There is no way to acquire, store, and disseminate knowledge other than semiotically. Yet semiotics is hardly acknowledged in science, and not at all as science. Were it not for the fame of a few writers (Barthes, Derrida, and especially Eco), associated more with the semiotics of culture, few would even know that such a knowledge domain exists. In the age of computers, genetics, and networks—all of underlying semiotic condition—semiotics would at best qualify as pertinent to an obscure past, but insignificant for current endeavors. Gnoseologically, there is little to gain from acknowledging the shortcomings of semiotics. Epistemologically, quite a bit is at stake in grounding semiotics among the fundamental sciences. For this to come about, new interrogations become necessary: Why knowledge? What is knowledge? What kind of knowledge? How is knowledge acquired? One way or another, the answer will acknowledge semiotic processes as a necessary factor. The perspective advanced in this chapter relies on an understanding of the living, and, in particular, of the human being, that ascertains anticipation as definitory. The future is made part of the present via semiotic processes. This is significant because in the age of neurons, suggestive of brain activity and of attempts to emulate it, to distinguish between knowledge supporting human activity, embodied in new technologies, and knowledge essential to the unfolding of the living becomes very difficult.

1. PRELIMINARIES

The largely accepted foundation of semiotics as a "sign" discipline explains its accomplishments. But it explains even more the inadequacy of semiotics in affirming itself as a fundamental science. Indeed, being captive to a recursive model, embodied in the sign definition, affects its own credibility as a specific knowledge domain. Those active in physics, and even chemistry, economics, and cognitive science, know that they cannot practice these

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disciplines without mathematics. Of course, language descriptions, such as those utilized for science in its philosophic phase (Aristotle, Plato, Galen, Ptolomy, Bacon, Occam) are an alternative, but only to a certain extent.

The semiotics of the beginnings of science were pretty much disguised as philosophy (Copernicus, Galileo, Leibniz, Descartes, even Kant). The separation of the sciences from philosophy is marked by the constitution of scientific languages: subsets of so-called natural language. Semiotics followed suit, and attempts were made, especially by Peirce, to define a semiotic language. Within this attempt, the sign consolidated its center-stage position. The necessity of scientific languages corresponds to the desire to transform descriptions of reality (such as geography, astronomy, geology, hydrology, etc.) into conceptual tools for operating on models. Moreover, these tools would have to inform activities for making tools that can be used to change reality.

Semiotics has a different knowledge domain. It does not actually deal in changing reality, but in supporting the acquisition of knowledge based upon which human action takes place. It is in this role that semiotics is fundamental. There is a degree of necessity that explains the body of knowledge of particular disciplines. Geography requires specific tools and methods for describing the world in its permanent change. Astronomy and, for that matter, geology and hydrology are by necessity a cognitive reflection of the reality they capture or try to affect. For semiotics to reach the same level of necessity, it would have to reflect the characteristics of the knowing subject, not, as with the sciences, of the known object. Only when semiotics acquires the same degree of necessity as the sciences, but in respect to the process of knowledge acquisition, 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. This will further consolidate its condition as fundamental science.

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 (in particular, Eco, 1976; as well as 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, what it takes to be successful.

Since our aim is the grounding of semiotics in the human activity of knowledge acquisition, we shall 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 organizations dedicated to its further development and in the teaching of semiotics) deserves more attention, given the significance of "organized labor" to the success of the endeavor. We will affirm the grounding of semiotics in the dynamics of phenomena characteristic of the threshold of complexity associated with the living. A more specific grounding, in *anticipation* as a

characteristic of the living, will be suggested, as well.

It does not suffice to ascertain that the living, by its nature, is complex. Therefore, in order to make a clear distinction, we define complexity in connection to the criterion of decidability that Gödel (1931) introduced. Accordingly, a complex system cannot be fully and consistently described. All other systems (those that can be unequivocally specified) qualify either as simple or, at most, complicated.

Within this view, complexity is not a matter of scale. Moreover, it does not accept degrees (the empty formula of "higher complexity" and the like). Since the living is characterized by complexity, it follows that any formal representation, including the modeling of the natural system, can be only a reduction. However, in line with Gödel's original subject of inquiry (consistency and completeness, the description of natural numbers), it also follows that formal means, which the human being constructs in the process of acquiring knowledge, can themselves reach complexity. Such formal means, which Gödel defined in the strictest known manner, are as undecidable as the living itself. It is quite reasonable to assume that semiotics, understood in its broadest sense, is itself undecidable. This probably applies to all fundamental sciences. Short of providing the formal proof here, it suffices to say that semiotic entities, such as new sciences, continue to multiply as the semiotic activity itself expands.

Complex systems being undecidable, their dynamics is only partially subject to predictive, probability-based descriptions: expectation, forecast, prediction, etc. Indeed, representations of the living are not the outcome of deterministic processes, but rather of interactions that involve randomness, as well as non-deterministic processes. Nobody can predict the next scientific breakthrough, the next creative work of art, the next breakdown of markets, or the next revolution. Predictions are nothing but an extension from a description of a past or current state to a future state conceived within a law-based understanding of phenomena. But not everything in reality is subject to law. (We shall return to these observations.)

The non-living is subject to prediction. Indeed, the knowledge acquired over time and expressed in scientific laws supports a broad spectrum of successful predictive activities: the entire exploration of outer space is based on such activities; so are the most common uses of machines (cars, TV sets, computers, refrigerators, etc.). The laws of physics and chemistry underlie such practical endeavors. Prediction applied to the living, in the form of medical assessments, for example, corresponds to the misguided notion that since the laws of physics apply to everything material, they apply just as well to life. Some are successful, some are not.

To affirm that the decidability threshold, in Gödel's sense, is embodied in semiotic descriptions means that the living is fundamentally not the domain of quantified physical and chemical processes, but the domain of meaning. Meanings do not have to be consistent.

2. TO REMEMBER IS TO EMBODY THE MEMORY OF EXPERIENCE

Regardless of which semiotic perspective (language-based, logic-based, informational, etc.) the various groups of semioticians have 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 the dynamics

of the physical world, has led to the affirmation of humanity's dominant role in nature. This is a technology-dominated nature within which the human being exercises a controlling power. 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. We seek meaning in natural and other phenomena. Awareness of the semiotic nature of human activity is implicit in science and in the humanities. Nevertheless, semiotics empowered the human being to the detriment of the rest of reality, in the sense that human interpretation of the various representations of the world guides human action.

We might not like such a pronouncement, just as many would not like to see how semiotics contributes to dictatorships (Hitler's, Stalin's, the North Korean and Saudi dynasties, etc.). It will cost a lot, in terms of knowledge and awareness, to ignore the victims of the "friendly fire" that caused so much "collateral damage" (in either "hot" or "cold" wars). Indeed, the dominating position of reductionist-deterministic theories prompted not only successes (the Industrial Revolution, for instance), but also serious damage to the environment and to human nature.

Be this as it may, 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. Interactions take place through an intermediary. Signs or not, semiotics is about the *in-between*, about *mediation*, about guessing what others do, how nature will behave. It is about dealing with the re-presented, the image, the word, the smell, the tactility. They are re-presentations. Of course, they can be re-presented in turn (the name of an odor is quite different from what it smells like). Two human beings touching each other transcend 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, 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 (Mitchell et al., 2008)—reading someone else's mind (identifying patterns of brain activation associated with different things). This in itself suggests semiotic activity related to anticipation, in the sense of a pre-understanding of the other via representations. 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 about mind-reading and associated this faculty with mirror neurons. From this perspective, the semiotics of intentions, desires, and beliefs no longer relies on representations embodied in cognitive states, i.e., successive phenomena eventually expressed in choices, decisions, or actions. There is no sign to be identified in this context.

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), 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 (mainly representations), 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 above, there is no sign to identify, rather a process of understanding, of reciprocal "reading" and "interpreting," of "coordination." 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.

3. TO DESCRIBE IS TO MAKE LANGUAGE

Every instance of acknowledging change is at the same time an instance of making up the language to describe what change brings about. 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, in shared language (speech, writing, images, etc.), for persons seeking an understanding of semiotics in connection to practical activities. Mathematics is in the same situation. 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., re-presentation of what is measured. Of course, no measurement replicates the measured in its entirety! 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." We make our language as we make and remake ourselves. 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 expressed as a description of the changing world. Descriptions, such as points, lines, and intersections, and formal entities, such as circle, square, volume, etc. are part of mathematical language. 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.). The language of mathematics, of logic, of chemistry, of physiology, of genetics, of physics, for example, are constructs. In the attempt to describe something, we make the language necessary for the task. The language consists of an alphabet and of rules for operating on the "words," "sentences," and "texts" we generate. The most intuitive example is that of the digital computer: an alphabet of two letters, and Boolean logic. "Utterances" in this language are precise, but not necessarily expressive.

4. FORMING THE THOUGHT

Informed by mathematics, or by any other science, 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. The fact that we see and hear "before" we actually see or hear corresponds to the "predictive" component of visual or sound perception. The fact that each action is based on pre-actions corresponds to the anticipatory nature of human dynamics. 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: Semiotics is consubstantial with living and self-awareness.

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—regardless how defined—is relatively deceptive. It is as though someone were to establish mathematics around the notion of the number (we would need at least operations in order to reach from numbers to arithmetic); or the notion of an integral, or the notion of sets. Indeed, there have been mathematicians who have tried to do just that. 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. Mathematics transcends numbers and seeks higher levels of generality and abstraction.

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. It is the awareness of change captured in representations. In terms of its meaning, it is the actions it informs. A noise in the woods can mean danger, or nothing at all consequential. 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—subject of psychology and sociology—are means towards a goal. Goals and activities are dynamically connected. Activities integrate actions. Actions are associated with representations. What is left out is the meaning, because the reference of representations is itself changing and eludes capture within the sign.

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, and to infer from it to the meaning of the process they describe. 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. Mathemeticians are after the truth of phenomena. A mathematical proof is nothing other than the confirmations of a precise description of reality.

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. Computation-based mathematics reshapes mathematics. It gives mathematics a new condition: outcome of a deterministic machine. The predictive component in visual and aural perception reflects the fact that we acquire data from the world, but also produce our own data (Nadin, 2003). Associated with meaning, data becomes information.

5. ALL REPRESENTATIONS ARE INCOMPLETE

To represent is a fundamental human activity. To express is to represent within the context of interaction. The fact that there is a connection between how some state (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 (i.e., presentation of whatever prompts the expression) is yet another cognitive step. And one more: There is a relation between what is represented (e.g., fear) and the means of representation; they can vary from moving

away from the cause of the fear to descriptions in words, images, etc. As already suggested above, to represent is to present one's self as a living entity interacting with other living entities (human or non-human). Representation is the path towards what cognitive science describes as generalizations and abstractions. In the representation in Figure 1, a stadium was chosen as an example: It can be described in words, it can be photographed or videotaped; memorabilia connected to the experience of being at the stadium can evoke the experience.

Among the most common representations are those used in mathematics (the so-called symbols, such as the numbers, the variables, operations among numbers, the equal sign, the integral sign, etc.). Similar, and often the same, are the representations used in physics. Partially, the language of mathematics undergirds descriptions of physical phenomena. Chemistry, genetics, computer science, artificial intelligence, and artificial life also utilize representations. Sometimes they extend into the culture: the table of elements (where, for instance, Au stands for gold, H for hydrogen, C for Carbon) is an example. So are the representations of astronomy, meteorology, and geography. To understand a map (city, country, trail, etc.) for the purpose of navigation is to be aware of a language that includes scale and other conventions (e.g., a red cross stands for a hospital), and even codes e.g., (highways are represented differently than are country roads).

These examples focus more on visual notations. But there are sounds or sequences of

Figure 1. The subset of possible partial representations (text description, mathematical description, video or film, visualization, etc.). The aggregate of all possible representations cannot capture dynamic reality. All representations are subject-dependent.

sounds that perform the same function: they re-present. Actually, sound representations precede visual representations. Imitating the sound of a dangerous animal is an example that comes easily to mind; likewise for imitating sounds with the aim of enticing (such as bringing a bird or animal within reach).

It is within natural interactions where the awareness of re-presentation, as a means for knowing, finds its origins. Indeed, in nature, smell, sound, and marks left are indicative not only of presence (immediacy), but also of what was (some animal just passed through) or what is coming. In this respect, re-presentations embody awareness of past, present, and future, as well as proximity or remoteness (the distant howl of an animal, the flapping of wings, the buzz of an insect, the distant thunder). Nature continuously "makes" new representations: changes in behavior of plants and animals, changes in the genetic code, for instance. The awareness of what representations stand for is acquired through interactions. Without doubt, sexuality (i.e., reproductive drive) is probably dominant for the longest stretch in the history leading to current representations. As a matter of record: The vector of change over time (along the path of evolution) is from direct interactions to representation-based interactions, and currently to interactions limited to representations, or representations of representations. This is what defines the human being's cognitive path: from being an outcome of natural dynamics and part of nature, to becoming an engineer of a dynamics subordinated to human goals. Semiotic awareness, which instantiates metacognition (knowing what we know) is nothing other than the realization that acting upon representations enhances the outcome of human activity. The rest of the living realm does not reach metacognition.

Between the marks left by living entities in the environment of their existence and the notations of mathematicians, chemistry, physics, genetics, etc., the difference is between awareness of the immediate (in time and space) and predictive capabilities. No other form of the living has acquired such capabilities, notwithstanding anticipatory characteristics of the living. The subject will come up again.

Representations, usually called "symbols" (Cassirer, 1923-1929), are present in the respective knowledge domains where they are generated, not as semiotic entities, but as notations. The integral sign $\int$ stands for a limit of sums. It represents the operation (e.g., calculate an area, a volume). The human being "reads" nature as a "language" expression, and, in the process of knowing, generates new representations. Let us recall Lewis Mumford's observations: No computer can make a new symbol out of its own resources," (1967, p. 29), in order to, once again, point to semiotics as consubstantial with human activity.

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 has the following meaning: What are their specific pragmatic justifications? What can you do with them? We have just seen that awareness of re-presentation is augmented over time, through learning. We have also seen that this awareness is not the specific domain knowledge of the sciences.

From the perspective of knowledge, the following needs to be stated: If we could aggregate all representations we would still not capture the reality in its infinite level of detail; nor could we capture dynamics in its open-endedness (not to say without affecting it). The living unfolds beyond our epistemological boundaries. We are part of it. Our change is part

of a broader change, which, again, influences our own. The sequence is infinite. Therefore every representation contains the observed and the observer. If the representation is only a sign, dynamics is left out.

Without exception, in every form of the living, the body is represented in the "brain," i.e., in the cortex (no matter how simple such a cortex for more rudimentary entities). For something to take place, muscles are engaged, otherwise, there is just no expression anywhere. This is even more so the case with the human being. The representation of different parts of the human body in the primary somatosensory cortex is a very clear example of the role of representation processes. Representations in the somatosensory cortex change as the individual's activity, translated in muscle engagement, changes. They facilitate preparation for future activities; they predate decisions and activities. They are in anticipation of change. In this particular expression, we can identify the process of representation of the body in the cortex as a semiotic process: the change in reality becomes a change in the representation of reality. The semiotics of the process is pragmatically driven (that is, it depends on what we do). 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 as it reshapes our cognitive condition at the same time. While in the last 60 years the brain has not changed in any significant way, the human being's cognitive condition has undergone deep changes, expressed in the higher sensory threshold, decreasing attention span, and multi-tasking abilities, for example. "The human brain has not changed at the anatomical level, but now it works differently," (Togo & Cantelmi, 2012).

6. THE GNOSEOLOGICAL CONDITION OF SEMIOTICS

Knowledge is pursued in many ways (including some more than doubtful). The hope is that knowledge will assist the human being in performing better in a fast-changing world. The reference to knowledge is always in respect to 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 percept-action 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 (the level of metacognition). The significance of physics or mathematics can be quantified. The significance of semiotics is subject to meaning awareness (or lack thereof).

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 geometricians," 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. The marks left, the odors, and the sounds are natural expressions consubstantial with what they express (an animal in heat smells differently, behaves differently, even sounds different). There are no semiotic processes of nature: Interrelations are not of semiotic intent, but of existential significance. There are, however, human constructed models for understanding nature. Some of them belong to biology, zoology, botany, etc.; others to cognitive science. The same observation 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. An artificial muscle can do the same. 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.

In the more recent infatuation with predictions (of political, economic, sports, meteorological events, for example), the word "signal" describes meaningful data, i.e., relevant information as opposed to noise. This shift in semantics cannot be ignored, especially since the complex networks discipline (Newman,

2003), almost synonymous with large data sets processing, has become very fashionable. Facing the difficulties of handling huge amounts of data afforded by large set of sensors of all kinds (e.g., for weather prediction, economic cycles, elections) integrated in networks, scientists also distinguish between signal—data that is significant to what they are looking for—and noise, which Shannon defined in connection to data transmission over communication channels. Obviously, signal in this sense is different from what is discussed from the semiotic perspective: signals in machines, signals in nature. Since pragmatics is decisive, it is too late to reach a consensus with the new complex networks scientists for the proper terminology. In fact, what they call "signal" is nothing other than information, i.e., meaningful data (Nadin, 2011). Interestingly enough, the scientists of complex networks realize that there is a deterministic component to their effort (establishing the inventory of the network), and a non-deterministic component: to understand the meaning of connections.

7. WHO IS A SEMIOTICIAN?

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 even more as semioticians? Given that we all interpret everything—regardless of the adequacy of our interpretations—does this make everyone (including their dogs and cats; Sheldrake, 2011) 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 the particular forms of information processes, are human constructs that serve as prerequisites for explaining the viability of the living as such. Along this understanding, which rejects the realism of biosemiotics (where symbols are as real as chemical elements or as electrons), it can be ascertained that bottom-up and top-down semiotic processes define life as semiosis. This definition is as legitimate as that of life as information process, or as a thermodynamic process. Awareness of semiotic process is not characteristic of genes or molecules; neither is information awareness located where our knowledge states that information processes take place. Awareness (of semiotics, or of information processes) corresponds to the meta-level, not to the object level. This distinction seems to escape the biosemioticians' understanding of semiotics, or that of various information theory practitioners (e.g., neural networks scientists, AI researchers).

What can we learn about semiotics 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 signs or 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 physical has past and present imprinted on it; the living, the future, in anticipation of which it unfolds. The awareness resulting from a semiotic perspective leads to the distinction made above. Indeed, in the absence of representations, the future could not be expressed, and life would cease. The hypothesis that representation is a necessary, but probably not sufficient, condition for life can be experimentally verified.

8. COHERENCE

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 (for example: 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 when 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 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*. However: Complexity is not the outcome of aggregation.

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, the simplest, as well as the most elaborate, 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 beat egg yolk and oil together, 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. Let's say: Make a Morse Code-based equivalent. *Decode* means the reverse. Machines encode in such a manner that decoding always retrieves the original. In the living, there is no guarantee that the encoded will be retrieved. Quite often, we find a different "encoded" reality: Semiotic processes are non-deterministic.

9. LAW AND HISTORY; GESTALT

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. This is why the cognitive condition of information-age individuals changed as much as it has.

10. ON THE POSSIBILITY OF INTERACTIONS

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 a new expectation for the understanding of signs. They are not to be conceived as "containers" of representation, but rather as intelligent entities. Signs are "alive," 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?

11. VITALISM IS DEAD. BUT THE PHYSICAL AND THE LIVING ARE STILL DIFFERENT

When vitalism, as the doctrine of the *élan vital* (which some equate with the soul) was debunked, the questions of causality associated with the realization that the biosphere is not reducible to the physical were simply brushed aside. Over time, every scientist claiming that the living and non-living have a different dynamics was eliminated from the list of potential Nobel Prize nominees (and avoided). In recent years, this has started to change. For whatever it is worth, Stewart Kauffman (2012, and Giuseppe Longo, quite in agreement with him) managed a breakthrough. You can ascertain that the evolution of the biosphere has no entailment laws, and this will not expel you from science. Moreover, a large number of scientists from many different fields—the chemist Gunter von Kiedrowski, mathematician Giuseppe Longo, quantum physicist Gabor Vattori, and others in computer science, molecular biology, among other fields—enlisted their expertise in dealing with issues pertinent to what life is, how life is expressed, how life emerges. The major meeting at CERN (May 2011), not necessarily a vitalist address, defined a research agenda not yet matched by similar efforts in the USA (although he NASA Astrobiology Institute is looking for signs of life in the universe at a price of 40 million dollars in grants).

The pressing question is, of course, the beginning of life (pretty much in the spirit of the beginning of the universe, an acceptable inquiry even for those fanatically opposed to a distinction between the living and the non-living). While this is not the place to enter the dialog on the beginning of life, let it be noted that semiotic considerations are an expression of awareness. To the extent that there is no life on Mars (still a subject of inquiry), there is no Martian semiotics. But there are semiotic questions, rooted in the living on Earth, that can be formulated in respect to Mars (or any other planet).

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, and 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. 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).

Of course, the question of whether one can identify semiotic processes within the living cannot be ignored. Biosemioticians are given to the model of "semiotics" at work at all levels of the living. Their position (called "realism in philosophy") deserves closer scrutiny. Let's be clear: If their assumption is correct, the beginning of life is the beginning of semiotics (in implicit form). I have reasons to argue (and shall return to this) that this is not the case, and that semiotics, like other means of knowledge acquisition, expression, and dissemination is a human construct.

12. PROOF AND INFERENCE

Mathematicians would claim that their proofs are absolute. Indeed, they make the criterion of falsifiability (Popper, 1934/1959) 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.

13. 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 symp-

toms. They are 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.

14. ONE REDUCTION TOO MUCH

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 a new foundation for semiotics, let us survey the semiotic scene. 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. They surrendered their inquiries to a discipline that cannot succeed in its current form. Semiotics as a sign-focused endeavor promises more than it can deliver. The subject of semiotics 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. It is circular by its own definition: Signs report on signs. 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 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. The model of life emerging from a "lucky" combination of chemical elements belongs to the same family. (The obsession with this model does not fade away (Longo *et al.*, 2013) 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, moreover, nothing except like a machine (Descartes, *Discourse de la méthode,* 1637; de la Mettrie, *L'homme machine*, 1748). 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 2). And sign processes, i.e., semioses, are not machine-like, but rather life-like: difficult to fathom (not to say, predict). Science in the echo-chamber of determinism can only confirm a poor form of causality, instead of uncovering the richness of causal processes.

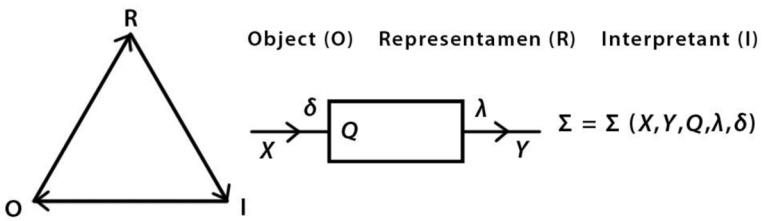
15. INSIGNIFICANCE IS THE RESULT OF FAILED PRAGMATICS

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? A speculative discourse? 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. 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 (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

Figure 2. Sign and fuzzy automata



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.

16. EMBODIED IN DEAD STRUCTURES

Semiotics as it is practiced, even by dedicated scholars, certainly does not qualify as fundamental science or 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. What strikes the possible reader is the feeling that semiotics deals more with its own questions than with questions relevant to science, philosophy, or 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.

Very little has been clarified regarding the questions articulated in the context of a new beginning for semiotics. On behalf of the first congress in semiotics (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. In short: What justifies the existence of semiotics? What are its objectives? What is its methodology? These questions are still open (and avoided).The only significant aspect is that, despite their irrelevance, events such as conferences, symposia, and congresses continue to take place. However, this is the time of new opportunity for semiotics to make its case as a viable discipline and to confirm its necessity. But for this to come about, the never challenged understanding that semiotics is a theory of the sign deserves to be discussed—and debunked, if possible.

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. In the absence of fundamental research, for which nobody seems to have patience and dedication, semiotics has been monetized in applications that promised public success. The broader questions of the significance of semiotics to the acquisition, expression, and dissemination of knowledge are not fundable—and not really welcome by publishers. The semiotics of fashion is apparently more lucrative than the semiotic processes involved in the modeling of the world, or the semioisis of cognitive processes. Fundamental research might be shunned, but without it, not only semiotics will face further degradation into journalistic or essayistic discourse.

17. LOST OPPORTUNITIES

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 still not concluded attempts to prove Fermat's Theorem (most recently Colin McClarty, 2013). 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.") on his copy of a translation of Diophantus' *Arithmetica* (3rd century CE) is a theorem represented in words, i.e., in a "natural" language (Figure 3). It is relatively easy to interpret. Later (1637), this theorem was "translated" into mathematical formulae. Fermat's Last Theorem states that no nontrivial integer solutions exist for the equation:

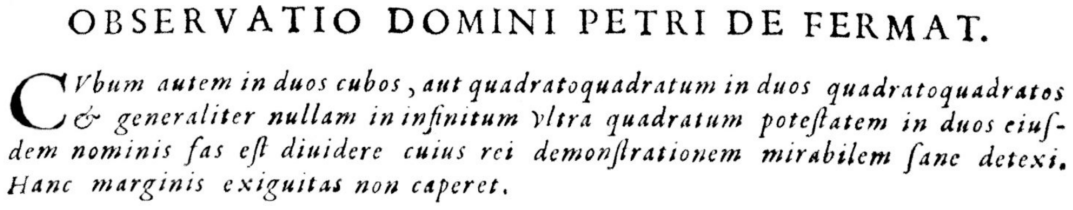
$$a^n + b^n = c^n$$

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 Andrew 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

Figure 3. Fermat's Theorem in Latin


OBSERVATIO DOMINI PETRI DE FERMAT.

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

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? McClarty argues that since Fermat's Theorem is about numbers, we should probably be able to prove it just by limiting ourselves to numbers. But this goes well beyond Fermat; it transcends mathematics. It becomes an issue of relevance because many semiotically based activities (such as genetics, visualizations, sonification, 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 scientific horizon, have missed the opportunity to approach the subject? Probably not. By the way: as Einstein produced his ground-breaking theory, Cassirer (1923) found it appropriate to offer an interpretation informed by his semiotics. In other words, there is proof that semiotics can do better than indulge in useless speculative language games, as it does in our time.

This all suggests 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 the interface of semiotics as an integral part of their way of thinking, as a technique of expression, and as a communication guide, but also as an integrative procedure. Within the cell, as a significant biological entity, there is chemistry, physics, genetics, and there are exchanges of data, and even of information (interpreted data). To examine only one aspect is to miss the fact that the cell *integrates* all these levels. Reductionism, so fruitful in examining physical reality, is deadly when applied to the living. Of course, the reduction to signs is no less damaging, especially in view of the fact that life is identified as an open-ended dynamic process within and open system.

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, predicted this development. 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 we 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. There are motoric aspects to it, as there is a powerful sensorial component. Natural language is the most ubiq-

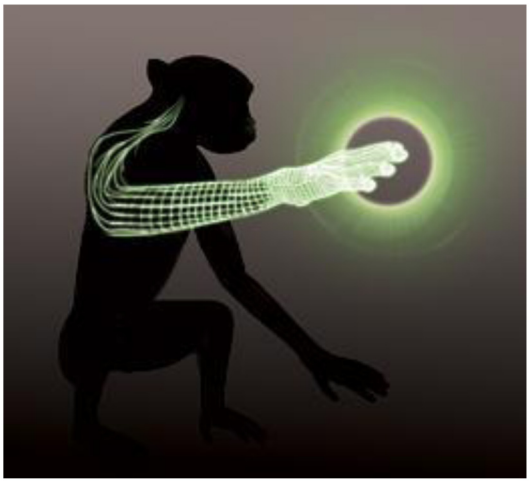
uitous medium of interaction. It is involved in knowledge acquisition, in its expression, communication, and validation. Semiotics, if founded not around the sign concept—quite counter-intuitive when it comes to language (Where is the sign: the alphabet, the word, the sentence?)—but with the understanding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

18. DOWNLOADING THINKING

The monkey that Miguel Nicolelis (2001) used in order to "download" the thinking that goes on while 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 (such as those involved in the monkey's thinking) made up of signs? Do the components of such strings stand for some represented entity? Obviously not. This is data to be validated in action, that is, to obtain its meaning in the action performed. The semiotics is implicit in the observation that thinking and acting upon representations can be connected. The monkey condition in the experiment is not equivalent to what we call the human condition. There is no metacognition to speak of. But humans play entire games of chess in their mind, not by necessarily moving pieces on a chessboard. The monkey would qualify for semiotic awareness if it could play in its mind. With the same technology, Nicolelis used, we could get access to it (Figure 4).

As speculative as the notion of the human condition is, we have finally arrived at the juncture at which very good dynamic models

Figure 4. Experiments with primates conditioned to behave like human beings are actually demonstrations



can be conceived, constructed, and tested. Mental causation (richer than determinism), free will, and the neural substratum of consciousness are no longer only subjects of speculation (Tse, 2013). We obtain access to data specific to each, even if in the process of doing so we affect them (given the extreme sensitivity of the cortex).

The underlying element of our interrogations 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 *miroirs vivants de l'universe*, 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.) They would have, I suspect, joined the scientists who are trying to obtain access to thinking.

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? As already stated in the preliminaries, 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 hopes to have the guidance of science, in particular semiotics, in giving meaning to data processing. This guidance could help avoid costly consequences—such as those experienced in recent years: terrorism, technological errors, speculation, various forms of addiction, etc. Success and failure depend decisively more upon interpretation than upon the amount of data. An infinite amount of data cannot compensate for an error in interpretation. Machines are, by many orders of magnitude, better in processing information, but not really better than humans in interpreting it. They can handle way more data than the people who build them; but quantity does not automatically lead to improved comprehension. In a changing context, interpretation becomes consubstantial with dynamics. Machines do not change; humans (the living) change.

The major themes in the sciences beg no less for the contribution of semiotics. Computation is, for all practical purposes, semiotics at work in 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. So are neural networks, modeled on the brain. 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. 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 definition 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 data (measurable) and meaning (result of interpretation), that is, allowing access to information. 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. The new focus on the brain (the brain-mapping initiative) is yet another opportunity.

19. INTERACTION IS (ALMOST) ALWAYS SEMIOTIC

I will conclude 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." In the virtual reality cave (a notion inspired by Plato's understanding of knowledge), the interaction is semiotic. The global scale of life (reflected in the global economy) makes an integrative approach necessary. 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.

It does not suffice to sing hymns of praise to the global economy of higher profits, or to deplore its consequences for those who rarely enjoy its advantages. Semiotics could facilitate a better understanding of the choices we have in the global economy. 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. In the absence of such a development, technology will continue to

deliver solutions to problems that are none, but that become part of our life. In absence of semiotic awareness, hacking, cyberterrorism, and identity theft are nothing but the result of greedy technological advances.

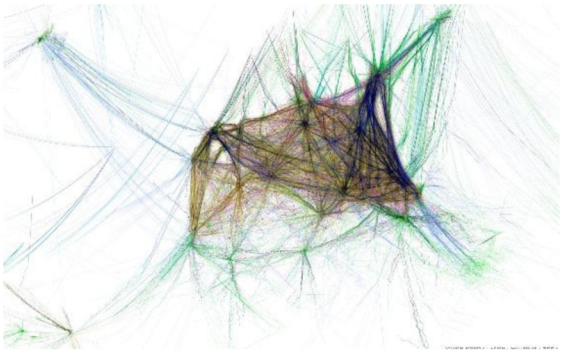
On this note, a simple observation: Brain imaging revealed that taxi drivers in some of the big cities (London was the first address researched), difficult to navigate, developed in the process measurable new faculties Indeed, the plasticity of the brains of those who navigate under the influence of GPS data changes (not always for the better). Of course, these changes 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) are semiotic processes. The emergence of GPS-based navigation might lead to the loss of some faculties. (The same have a tougher time working with maps or following verbal instructions.) 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, for example. Aaron Koblin (2008-present) documented this process in visualizations of extreme semiotic significance. So did Albert-László Barabási (see examples from their work in Figures 5 a, b, c). 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 mathematical 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 (Berners-Lee, 1998) is still dreaming of a semantic stage.

On this note, a statement of principle: For me, personally, only a pragmatically driven Web makes real sense. Indeed, as a medium of interaction, the worldwide Web will become significant when new forms of activity will become possible. There are some modest beginnings: designers working on the same project in a cooperative manner; the new possibilities offered by the so-called 3D printing. Spectacular innovations are almost regular occurrences. Moreover, medicine practiced over networks is a new experience promising not only remote diagnosis and surgery, but also the interaction of experts involved in understanding the uniqueness of the patients. The new 3D printing technology could deliver artificial skin for grafts performed after an accident.

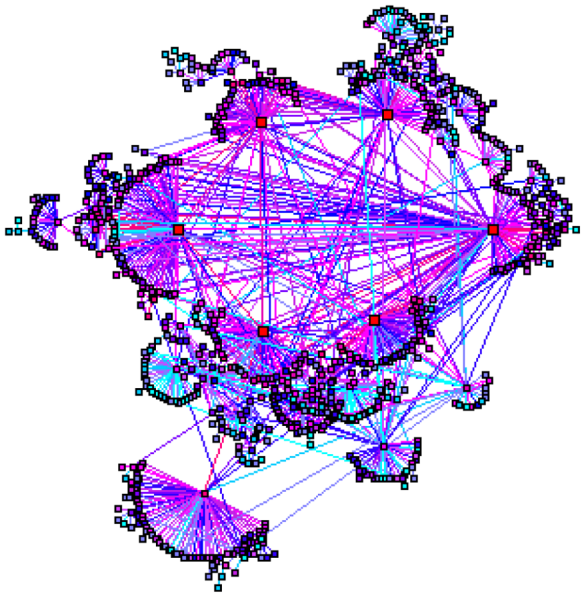
While the GPS actually changes the nature of our relation to space, and indirectly to time, its semiotics is a legitimate question waiting to be addressed because it involves a new semiotic condition for the human being. The military purpose of the orientation system is spectacularly transcended by rich 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. The Google Glass project is an attempt to integrate semiotics (of seeing and hearing, in particular) in the new "embodiment" (i.e., glasses) of computation that the company makes possible.

Figure 5. a, b) Aaron Koblin: flight pattern and air traffic paths Atlanta, c) Albert Laslo Barabasi: social networks in Canberra



(a)

(b)



(c)

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, 2005, 2011), 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, 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.' "

20. SEMIOTICS HAS MORE HISTORY THAN CURRENCY

The first Congress of the International Association of Semiotic Studies justified the need for a historic account as a step in defining its methodology. 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 . . ."). Avicenna's work on prophethood can be mentioned in the same vein (cf. Al-Akiti, 2004).

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.

21. SYNCHRONY – DIACHRONY: A DISTINCTION OF 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), Aristotles' *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 Brahman-

ism, the Christian infatuation with signs (St. Augustine's *De Doctrina Cristiana*, 397 CE, and St. Anselm's *Monologion*, 1075-1076; see 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?

Edward O. 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 (1880/1970) *diachrony* is far more conducive to understanding the specific dynamics of languages. This is only one example. Nikolai Sergeyevitch Trubetzkoy (1939/1969) might be another, as is Louis Hjelmslev (1943).

22. TAROT CARD READING IS NOT (YET) AN ACADEMIC DISCIPLINE

But it might become one. Universities are teaching square dancing, how to have an orgasm, mixed marriage (and techniques for politically correct divorce), for example. And since education is by its nature one of the most involved semiotics activities, it is fair to state that semiotics can take credit (or blame) for the MOOCs, but also for the degradation of teaching and learning into entertainment. The context is the modern rebirth of semiotics. It actually legitimized what others were doing within their respective disciplines: philologists, structuralists, scholars in literary theory, morphology. Many fascinating ideas were advanced, and it seemed that a promising new age began. But the effort remained focused on the sign, since everything—sex, food, art, elections, and nanoscience, for instance—could be interpreted as signs. Once a new territory was defined, many moved into it, while actually continuing to do what they had done before. 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.

More precisely, semiotics enrolled itself in the service of a perspective of reality that ignores fundamental distinctions—such as those between the living and the non-living (*physis*)—within reality. It adopted determinism and became an instrument for its further consolidation, against the evidence that dynamics, i.e., change, is non-deterministic

Semiotics became the stage for literary critics, art historians, confused structuralists, and even for some linguists, mathematicians, and sociologists. Some philosophers also 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!* Anticipation, on account of which semiotics was legitimized as a new perspective of change, was discarded. 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.

Most relevant is the estrangement of semiotics from medicine, where at least some of its necessity, in the form of diagnostics, was established. Aligned with all disciplines looking at humans (and animals and plants) as having the sameness that physical entities have (all electrons are the same, after all), it ended up as a useless exercise. In reality, there are no identical patients; labels define a spectrum, not a precise condition. What's good for one patient can be lethal for another. If semiotics had accounted for this uniqueness, and for an understanding of health or disease as process, medicine would have continued to practice it. Since it did not, physics ("Let's weigh the patient, measure blood pressure, height, etc.") and chemistry ("Let's check the composition of blood, urine, stool, etc.") took

its place. Human beings become machines to be repaired. The consequence of this failure of semiotics cannot be deplored enough.

23. THERE IS MORE TO INTERACTION THAN LANGUAGE

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. The echo-chamber effect is based on pressure exercised through language.

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 some historical references have been provided, this is not the place to rewrite the history of semiotics (in which very convincing work was already done). We are not so short of histories as we are short of better semiotics. Here an attempt has been made 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. Language is only one among the many semiotic entities involved in representation, expression, and communication.

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. Thinking in German is quite different from thinking in Chinese. 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, 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, the aural, 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. To visualize or to sonify is to acquire a cognitive identity

different from that of individuals talking about or writing about the same subject. 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.

We do not want to eliminate the possibility of computer-based generation of representations. Even if such representations would facilitate limited forms of knowledge acquisition and expression, there is no need to downplay their use. However, if machine-generated representations were to trigger the claim of replacing the living processes leading to comprehensive dynamic representations of a changing world, we would face a real danger. In representing something, the living simultaneously re-presents itself. This contributes to the knowledge the outlook and the sense of future derived through human representations. Each representation, after all, embodies anticipation. Machines, regardless of their level of sophistication, do not anticipate.

24. IS THERE A SEMIOTIC METHOD?

What defines the semiotic method? Concepts, whether semiotic or not, are a projection of our own reality. The environment (the world in which the living is identified) embodies matter in an infinite variety of expression. The dynamics of the world 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. This, of course, does not necessarily lead 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. Failure as much as success testifies to the adequacy of knowledge. 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).

Knowledge of natural phenomena as much as awareness of the limits of our knowledge as it applies to what we conceive are related.

Nature is becoming more and more what human beings are doing to it (sometimes responsibly, many times not). For the living, regardless of its scale and kind, the following holds true: we are what we do! The human being acquired awareness of this condition; as we moved farther away from the rest of nature this awareness informed new forms of expressing human identity. We are currently experiencing the computational condition of research and activity. The role of representations within this condition has changed considerably.

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.

25. SEMIOTICS IS ABOUT MEANING

The living takes in the world as *representation*. 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 predefined 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 adaptive processes, the living experiences information processes and semiotic processes. Information processes correspond to energy- and matter-related aspects of the living. Semiotic processes correspond to meaning. They are embodied in the narrative of life, unfolding along a timeline, and expressed in its many associated stories.

This is an opportunity, as good as any, to spell out the alternative to the semiotics focused on the sign. I suggest that, instead of the atomistic view of a sign obsessed with semiotics, we adopt a dynamic view, of events succeeding in time. The notion that each event—such as perceiving an image, hearing a sound, experiencing a texture, etc.—is "made up" of signs is less important than the determination to integrate successive experiences. Narration is a historic record:

event1, event2, event3. . . .

Influenced by information processing, some would call it a time series:

$S_1\ S_2\ S_3. \ldots$

In this view, the series is made up of succeeding signs. While each event is relevant, the focus is on the integrated series, more

precisely, on its meaning. But more on a narration-based semiotics in the concluding part of this study.

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 artificially 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.

26. IN THE AGE OF GAMIFICATION

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 (supported by public money, of course) would require an expertise I do not have. To repeat: *Semiotics is fundamental science*. The entire genome project is an example of semiotics in the forefront (even if not carried out by semioticians). Virtual reality, that is, computing representations that recreate aspects of the real world, is applied

semiotics. 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. (Figure 6) Not only *Nike* and *MacDonald's*, but also the whole branding craze is semiotic in nature. Lawyers engage semiotics in defining the nature of patents (Jones, 2013). 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. This is an example of *gamification*—make everything a game, stimulate new forms of interactions, use reward mechanisms to stimulate performance (Figure 6). Indeed, if still images are acceptable representations of a world changing slowly, film images are a next step: keep a record of change as it takes place. However, if interactions are of interest, games are a good medium for representing them. All of the above, and much more, is semiotics at work without the involvement of semiotics.

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. Semiotics became part of the jargon of intellectual property lawyers because, of course, a bit of exotic vocabulary could make an impression in the courts. Since patents became a source of profit to be adjudicated by judges who can barely understand the science (or the speculation) behind them. Semiotics is brought up as a "social science" arbiter. 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. On a constructive note, here is a suggestion in the spirit of the time: Let us open a "Story Lab" where semiotics can be practiced in generating new stories, corresponding to the fast

Figure 6. Learning how to drive (or fly, or navigate, etc.) by using games (embodied in simulators). Reality is represented, realistic control elements serve for training and evaluation.

dynamics of the present. Instead of continuing the impotent discourse on narrativity (without understanding the difference between narration and story), we could build upon the knowledge pertinent to how brains react to stories (Pollack, 2013; Stephens *et al*., 2011). And let us provide semiotic methods for the human interactions of the future, not attempts to explain what these interactions were.

Conditions were not ideal in the "good old days" of the semiotic revival of the early 1970s (or earlier). But the questions asked were inciting. 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 used to be more quality scholarship, despite the absence of Google or Wikipedia—sources of generalized mediocrity—which some believe substitute for true research effort. Society could not afford, as it does in our days, to fund mediocrity. 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.

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? Of course, when the car is fully automated (that is, when it navigates autonomously, as in the self-driving car almost at the implementations stage), the sign as such becomes obsolete. How appropriate are the various components of a sign such as a logo in a corporate identity "language"? Of course (again) 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. Sonification promises to make representations more powerful by addressing hearing, the most "natural of human senses. The fact that meaning, not sound, is the purpose of representation often escapes the understanding of the newly minted sonificators.

It is undisputed 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. We are all our narration. Its aggregate defines the species in a certain span of time Its deviations in stories (disease, accident, birth and death, etc.) are far more conducive to knowledge than inventories of signs.

27. NARRATION AND STORY

The most intuitive description of the *narrative* is the following: the record of a sequence of events as they succeed in time. The word (from the Latin *narrare*) means to recount. It suggests that a record of succeeding events in time, a time series, describes what individuals or groups accomplish and how. Therefore, each narrative adds up to knowledge, at least in the sense of documenting successful and less successful activities.

The simplest way to organize our own experiences is to take note of how they succeed, one after the other, along the timeline of our own existence. This inspired Gelernter (1991) to generate the *flowing stream*: the sequence of every electronic document—mail, photo, draft, URL, notes, etc.—in the order of their reception (or in the order of their generation). It seems a simple idea, but in fact it was the innovation that changed the nature of data management in the broadest sense possible.

A record of succeeding experiences allows us to see what these experiences have in common, and what distinguishes them. It is a conduit towards understanding them. The most telling narratives are those we experience naturally: the succession of day and night, of seasons; the succession of plant life, of animal behavior in the environment, of celestial bodies (sun, moon, stars, etc.). The succession of our activities is relevant: some we choose, others are imposed upon us by the nature of our activity.

With the exception of Windelband (1915), almost no one has tried to define the distinction between narrative knowledge, corresponding to a historic record of change (*idiographic*), and scientific knowledge (*nomothetic*), corresponding to our attempts to describe how reality works. (Psychoanalysis tried to hijack the concepts, but the attempt remained unsuccessful.) The idiographic captures patterns of events; the nomothetic focuses on scientific law. Of course, those who accept the religion of determinism would like to transform the uniqueness of experience captured in the narration into laws, thus opening the avenue towards automating whatever we do. To a certain extent, such attempts have succeeded: all tools are an expression of this preoccupation. In our age of digital descriptions and digital machines (which actually are programs), more progress in this direction is made. A concise formulation of the attempt described above is: to transform the art of doing things into the science and technology of performing.

Thesis 1: Narration is a record of change.

Let's take a closer look at narration. For the sake of illustration shown in Box 1: On September 11, 2001, two airplanes flew into the Twin Towers in lower Manhattan and destroyed them. One airplane hit and damaged the Pentagon; a fourth plane crashed southeast of Pittsburgh. Of course, you can consider any other record of successive events. Temporality defines the condition of the narration: something happened after something else.

7:59: American Airlines Flight 11, departs 14 minutes late from Logan International Airport in Boston for Los Angeles International Airport

8:14: Aircraft is hijacked

8:14: United Airlines Flight 175, departs from Logan International Airport in Boston for Los Angeles International Airport.

8:20: American Airlines Flight 77 departs from Washington Dulles International Airport for Los Angeles International Airport.

8:42: United Airlines Flight 93 takes off from Newark International Airport bound for San Francisco International Airport, following a 40-minute delay due to congested runways. 8:42 to 8:46 (approx.): Flight 175 is hijacked.

8:46:30: Flight 11 crashes at roughly 466 mph (790 km/h or 219m/s or 425 knots) into the north face of the North Tower (1 WTC) of the World Trade Center, between floors 93 and 99.

8:50 to 8:54 (approx.): Hijacking begins on Flight 77.

9:03:02: Flight 175 crashes at about 590 mph (950 km/h, 264 m/s or 513 knots) into the south face of the South Tower (2 WTC) of the World Trade Center, between floors 77 and 85.

9:28: Hijackers storm the cockpit on Flight 93 and take over the flight. The entry of the hijackers is overheard by flight controllers at Cleveland.

9:37:46: Flight 77 crashes into the western side of the Pentagon at 530 mph (853 km/h, 237 m/s, or 460 knots) and starts a violent fire.

9:58:59: The South Tower of the World Trade Center collapses 56 minutes after the impact of Flight 175.

10:03:11: United Airlines Flight 93 is crashed by its hijackers and passengers at 583 mph (926 km/h, 272 m/s, or 509 knots), due to fighting in the cockpit 80 miles (129 km) southeast of Pittsburgh in Somerset County, Pennsylvania

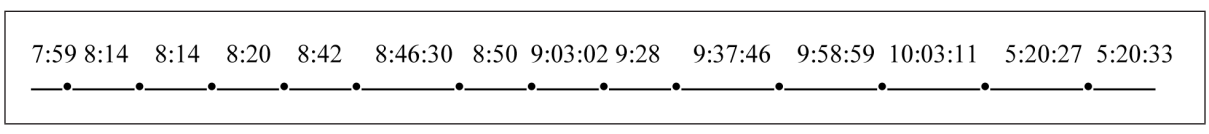
5:20:27: The penthouse on top of 7 World Trade Center crumbles apart, only about 6 seconds before the entire building would begin to collapse.

5:20:33: 7 World Trade Center, a 47-story building, collapses.

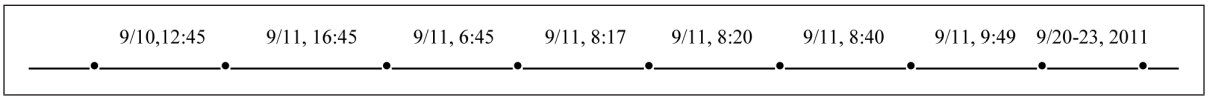
Consider everything that the events of 9/11 changed. The world after the 9/11 narration is different from the world before September 11, 2001.

The following are interpretations of the narration (Box 2), i.e., stories, and I would refrain from validating or discarding any of them.

Box 1.



Box 2.



On September 10, at 12:45: Willie Brown, mayor of San Francisco, gets a call from his airport security advising him to be cautious about air travel on September 11.

September 11: Two hours before the first airplane takes off, 2 workers at the instant messaging company ODIGO receive warning messages about the attack to take place.

September 11, 8:17: Passenger Daniel Lewin, from a top secret Israeli anit-terrorist unit is either stabbed or shot to death.

September 11, 8:20: Transponder signal stops transmitting identification for AA flight 14

September 11, 8:40: Nasty and Duff, code names for 2 F-15 pilots from the 102nd Fighter Wing of the Otis Air Force Base National Guard in Falmouth, scramble after UA flight 175.

September 11, 9:49: F16 from Langley AFB reaches Washington to perform Combat Air Patrol. It took them 19 minutes for a flight that should have lasted 7 minutes.

September 20-23, 2001: "Five of the alleged hijackers have emerged, alive, innocent and astonished to see their names and photographs appearing on satellite television. ... The hijackers were using stolen identities, and investigators are studying the possibility that the entire suicide squad consisted of impostors." [quote from *London Times*, 9/20/01, see also BBC]. Yet these same individuals are later officially established as the 9/11 hijackers in the 2004 9/11 Commission Report.

The second timeline is an excerpt. Actually, a great amount of variations is available, in full detail, on the world-wide Web. The reader should take note of the following:

1. The timeframe is extended in order to suggest prior knowledge of the attacks.
2. Unrelated information is added.
3. Data is provided on events (such as the assassination of a passenger) to which nobody had access.
4. It is intimated that actions to avoid or mitigate the situation are delayed.

Of course, all kinds of hypotheses ("The government did it." "The buildings were blown up intentionally." "The secret services engineered the attacks," and much more along this line) made it into the public arena (and continue to engender more stories). In short: The narration (historic record) is interpreted and becomes an open-ended story-generating machine.

Thesis 2: Story is an open-ended process of interpreting narration.

Change characteristic of the living (from conception to birth, maturity, and death), and change of the physical world (mountains change, stones are "polished" by wind and water, oceans undergo cycles of ebb and flow, etc.) can be recorded. Depending upon the resolution (how fine the grain of our distinctions) of our observations, the various narratives of change constitute a body of knowledge on whose basis science advances and technol-

ogy is produced. In this sense, narrations are data sequences about change over intervals. Given the open-ended nature of reality, the data is always incomplete. Moreover, the data is not associated with meaning. It only reports on changes (at minute 8:46 on 9/11, the Towers were still intact; seconds later, the South Tower is hit), not on the context (terrorism in the contemporary world). The interpretation confers meaning, and puts the events in context.

As interpretations, stories are contextual. In storytelling (memories, memoirs, fictional works, among many kinds of interpretations), data is associated with meaning. Quite often, intentionality takes over: moralizing, alerting to danger, making false statements, debunking false statements, etc. Narrations are intention-free. Stories are driven by goals, that is, by intentions.

Thesis 3: Narrations are representations of change.

Without entering into details, let us take note of the fact that objects $\{o_1, o_2, \ldots\}$, natural or man-made, processes $\{p_1, p_2 \ldots\}$, natural or artificial, attributes $\{a_1, a_2, \ldots\}$ of objects or processes, can be described in many ways. They can be named (labeled, as the terminology of cognitive science suggests), measured, depicted in drawings, photographed, videotaped, filmed, turned into sounds, animations, games, etc. Words can be used (and made up if necessary) to explain what they are. These are all substitutes for something else, i.e., *representations* of the real in its materiality.

The structure of language corresponds to the same perception. It is sequential in the way in which existence itself is sequential. The sequentiality of narration corresponds to an understanding of time as durations between successive states of the narrated change.

Thesis 4: Stories are interpretations of the narration of change.

To interpret a narration means no more or less than the attempt to reconstitute the represented from the representation. Succeeding events and their representation are, of course, not the same. Therefore, the "reconstitution" of reality from the representation is not so simple as remaking an image in a puzzle. A person's picture is a representation; the "remaking" of the person is always partial: memories of how the person behaved, moved around, spoke, are part of the interpretation. Reconstitution of the represented from a time series (a scientific method currently in use) can acknowledge the time sequence, confirming it, or challenging it. Interpretation of a narration can take many paths. One, for instance, is the ever more intrusive data-mining. The sequence associated with patterns of behavior (the store one visits, time of visit, how long the shopping lasts, the number of items on the shopping list, payment modality, etc.) becomes a profile. Data is associated with meaning: to shop at Kmart indicates an economic status different from that of shoppers at high-end boutiques in Manhattan or Hollywood. All kinds of inferences are made from consumer patterns; and new information is dumped on the individual in order to affect changes in behavior. There are, of course, many other profiles that can be derived from the narration representing human behavior.

In contrast to data-mining, stories are interpretations of a different nature. Indeed, the sequence "Queen dies, then King dies" (a simple narration) can easily lead to a story: Queen dies because the King was unfaithful; King dies because Queen poisoned him (or had someone do it), or cursed him. In the story, data is associated with meaning corresponding to the context. Stories often challenge the se-

quence: first, second, third, etc. are sometimes reshuffled in the story (third becomes first, or second, etc.). Data-mining is data driven; stories are meaning processes.

Through stories, information is associated with meaning (Nadin, 2011) in view of the intentions of the storyteller (or the story-generating machine). The information regarding the falling apple (or the falling of anything: stones, meteorites, individuals, etc.) reveals the meaning of the physical laws, in particular the law of gravity. But it can, as well, associate the narrative to a story different in its condition from the one expressed in the theory of gravity: poetic, dramatic, religious, metaphysical. Kings fall from power, leaves float in the wind (slow falling), the fall of Rome marked the beginning of the "Dark Ages" (whose meaning is disputed by many); people who fall on account of faith lost need help to get up and get on with life; fallen angels come to earth to redeem themselves; and so on. Some are subject to confirmation through experiment; others, being unique, are not. Richard Feynman, recalling the passing away of his first wife, noticed the clock that stopped at the time recorded on his wife's death certificate. The narration prompted the physicist, a self-declared atheist, to produce a scientific story: elimination of mystery, poetry, religion, etc. He knew that he had fixed the clock, and that it might stop if moved. But similar narrations—the clock that stops exactly with the last breath of a dear person, or of some celebrity—populate culture and foster storytelling in many variations.

Thesis 5: The clock of narration and the clock of interpretation are different.

The clock of narration corresponds to the rhythm of events in the physical world (see the timeline of the 9/11 events, above). The clock of interpretation projects into the physical world rhythms characteristic of the change in the living, in particular, rhythms associated with interpretation (all the stories about the same event). When we react to something, the reaction time affects performance. When we imagine things in the future, we have the convenience of controlling the rhythm of time. Indeed, as events unfold in time, the gravity-based machine that measures the interval corresponding to the movement of celestial bodies—the clock—serves as a reference. This is the meaning of the data delivered by clocks. The living is affected by intervals in the environment of existence; but the living also introduces its own rhythms into reality. Saccadic movements, the foundation of sight, have a rhythm different from the heartbeat and neuronal connections. Birds in flight or the slow fall of leaves are other examples of particular time scales; the heartbeat of animals is extremely varied.

Time characteristic of life is not reducible to intervals. As a matter of fact, there is no proof that time scales uniformly. In other words, time at universe scale, where we refer to phenomena that happened way in the past (even millions of years ago), and time at the nanoscale, where we refer to very fast interactions, might be different in more ways than order of magnitude. The narration of phenomena from the remote past—let's say star explosions—and the narration of current phenomena of extreme dynamics (such as fermentative metabolism, and earthquakes) are different to the extent that they appear to us as associated with different realities (Lara *et al.*, 2009). Being a record of change, each narration is a representation of the dynamics of reality. Each interpretation of a narration is a story: the meaning we associate with the information on record. A faster clock, such as the clock of interpretations, is what it takes to evaluate the possible consequences of the phenomena on record in the narration. In

other words, the future itself is nothing but the outcome of a faster clock. As a virtual reality, this future depends on the rate of change expressed by the clock. We refer to possible futures—plural!—because we can build clocks with various speeds: from very slow to extremely fast. Each such clock allows us to investigate the future *not as a probability*, but *as possibilities* (often negating probabilities). This is where innovation takes place. If the information in the narration is continuously subjected to interpretations from the future, facilitated by the faster clock, its meaning becomes *anticipation*. Therefore, a foundation of semiotics that reflects the nature of the living can only be grounded in the anticipatory processes definitory of the living.

28. SEMIOTICS IS ABOUT THE MEANING OF CHANGE

In Section 25, meaning was identified as the outcome of semiotics. In the same section, a semiotics emancipated from the sign and focused on narration was suggested as an alternative. The following will specify the thought. Moreover, the suggestion that semiotics is consubstantial with anticipation, as the definitory characteristic of the living, will be pursued.

At each level of the living, from the monocell to the human being (so far the most elaborate form of the living) we distinguish the sensorial, the cognitive, and the motoric. Knowledge is accumulated with the help of the senses, with the contribution of the brain, or in association with the motoric. Metabolism, reproduction, and self-repair are expressions of the interaction between the individual and the world. The fact that science has focused all it takes to qualify something as "alive" has consequences for our understanding of ourselves and of the environment in which we live.

The descriptive, analytical approach of the past is transcended in the present of synthetic science. All kinds of sensors, mimicking the senses, are designed and fabricated with the aim of facilitating new forms of perception. Neurons are the next to go on line. Since Pitts and McCulloch (1943), they were mathematically described, and more recently embodied in silicon, carbon nanotubes, and other materials. As far as the motoric is concerned, even more daring projects are carried out by those seeking to emulate muscles, joints, and cartilage. There is so much to fix and so much to replace.

In this study, an argument was made along the line of questioning the tendency to boil down all phenomena to the Cartesian reductionist-deterministic understanding of reality (Nadin, 2010). More precisely, we need to make distinctions: synthetic neurons are representations of living neurons. As such, synthetic neurons facilitate knowledge acquisition based on the reduction

Living → Neurons → Deterministic Aspects → Dynamics of Synthetic Neurons

Thus, it is intrinsically ascertained that the dynamics of the living, i.e., the variety of processes through which the living is expressed, is identical, or at least significantly equivalent, to the dynamics of the synthetic; moreover, that this dynamics can be represented by deterministic processes (some non-linear in nature).

Empirical evidence strongly contradicts this viewpoint. A neuron extracted from the whole represented by a living entity is quite different from the neurons in action as the living entity interacts with the world. Within the wholeness of the living entity, neurons

are further integrated in the sensorial perception and the motoric. It is a never-ending back-and-forth through which each neuron is continuously "remade." Actually, what we call neurons, or sensors, or muscles are continuously evolving organic entities.

But let us not restrict the discussion to the neuron. Rather, let us examine the more encompassing modeling issue. Robert Rosen's model is adopted in what follows. Regardless of the position we adopt in respect to the synthetic (or artificial), it is not so much an expression of knowledge about what is synthesized as if is an attempt at modeling.

In what Louie (2007) entitled "A Rosen Etymology," a distinction is made between physical science pertaining to entities purely physical in nature (i.e., non-living), and biology, pertaining to organisms. In 2003, Louie presented Robert Rosen's a modelling relation between two systems, shown in Figure 7 (Louie, 2009).

A modeling relation between two systems, such as the natural system N and a formal system F, has F as a model of N if and only if the diagram commutes:

$$c = \delta \circ i \circ e$$

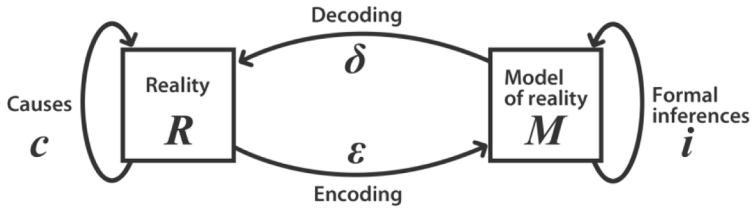
Without going into further details (involving the mathematics appropriate to describing the modeling process), let us take note of the fact that the dynamics of the natural system is represented in the final system. All our operations on the representation reflect our own condition. Change in N takes place along a series of intervals (what is called a "timeline"). Therefore, we need to assure that in the formal system the representations are coherent with the time series of the dynamics of the natural system. One more necessary condition: Changes in natural system ought to be reflected (encoded) in the formal system.

From this simple diagram, once can easily infer that a model is supposed to reflect the wholeness of the natural system represented. A synthetic neuron (sensor, muscle, etc.) does not fulfill the conditions of a modeling relation. In fact, when coupled to the natural, the synthetic changes the condition of the natural. Indeed, a knee replacement (a pretty standard surgical procedure) changes the organism. The hybrid new entity has different characteristics. From a semiotic perspective, the following are the consequences:

1. Modelling is part of the pragmatics of knowledge acquisition.
2. There is no effective procedure for distinguishing between the observed and the observer.

With all these in mind, it is easy to infer that a modeling relation implies semiotics in encoding and decoding between the system N and the formal system F. The nature of representations that make up the formal system depends upon the precise activity through which

Figure 7. Rosen's modelling relation



the final system is established. This activity is ultimately determined by the purpose of the representation. Aesthetic modeling (expressed in the formalism of art, literature, design, music, etc.) is definitely of a nature different from that of mathematical and computational modelling. Within each formal system, inferential entailments ars possible. Each results in a different form of knowledge. Indeed, there is knowledge about the world in art, as there is also in physics, chemistry, philosophy, etc. In the final analysis, representation implies interpretation, i.e., the purposeful attempt to derive new knowledge about the represented from operations on the representation.

These preliminaries could be conducive to a new understanding of semiotics only if they set a methodological framework for understanding the possibility of and necessity for the discipline. As with science and every other form of human activity, semiotics is grounded in the awareness of change.

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, footballs 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. If semiotics changes 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. A semiotics that has narration as its defining subject will be able to approach change much better than a sign-obsessed semiotics.

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