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Biological Organisms as Semiosic Systems: the importance of strong and weak anticipation

Abstract:
The biological realm is examined as a semiosic system that transforms basic matter into a complex and intimately networked diversity of morphological forms according to generic sets of self-generated rules of formation. Semiosis is understood to operate as a function *f(x)=y* where the mediative rules of formation*, f,* operate within predictive or anticipatory capacities. Strong and weak anticipation are examined and the paper concludes that strong anticipation, operating as a virtual or imaginary hypothesis construction is a basic property of the biological realm. Strong anticipation enables the biological species to develop multiple hypothetical 'network motifs' about its future activities within the environment. The species will 'choose' one of these probabilities – any of which would be functional – to articulate in actual time and space. This theory rejects random mutation as the source of innovative evolution and adaptation. Weak anticipation is defined as Natural Selection and is described as a *post hoc* model of strong anticipation's 'selected solution'.

KEYWORDS: Semiosis, Morphology, Function, Weak and strong anticipation

Introduction

The basic assumption of this paper is that biological organisms are semiosic systems. What does this mean? What is 'semiosis'?

Our world consists of energy organized as particulate *forms of matter*. These individual forms or morphologies survive both as individual units and as general types or species, such as hydrogen atoms or oxygen molecules or e. coli bacterium or homo sapiens.

The biological realm is extremely active in its processing and organization of matter. It can be more accurately described as a 'complex adaptive system'. Biological units are engaged, in themselves, in a constant transformative processing of matter, involving not only the assimilation and transformation of external matter taken within each unit, but as well, the eventual death of each individual unit as an active processing system. Such a temporal finiteness to the individual unit requires a separate system to produce more units of that typology or species to enable this transformative processing of matter to continue with some reliability. This relentless processing of matter requires an authoritative and stable organizational model(s) or referential abstract(s) that oversees and guides the continuity of morphological organization. The biological realm, therefore, operates as a complex architecture of a referential template entangled with multiple individual actualizations of that template. This interplay between stability and diversity, or model and actual, is a fundamental aspect of the biological realm (Ives and Carpenter 2007, Monod 1971, Rosen 1991).

An important result of the entanglement of these two contrary processes is that the biological system has the capacity for the self-organization or self-definition of its referential model. This means that a biological morphological type can develop its model of itself, by itself, without external agential intervention. It is able to do this because these two basic processes, the model and the actual, interact constantly with each other in a state of existence defined as 'far-from-equilibrium' where the fragile asymmetry between the two contrary zones (model and actuality) creates an openness to each other's informational data and therefore, enables the model to change and adapt (Bak 1996, Holland 1995, Kauffman 1993). We will be exploring the self-organization of the referential model within the theme of *strong and weak anticipation*.

Our universe and all its properties, physical, chemical, biological – and social, functions as a complex architecture (Taborsky 2002). The definition of complexity will be discussed further in this paper.. But the first basic requirement of matter – is that it must exist spatiotemporally or *morphologically.* This means that matter can only exist as a form that is finite in both time and space. Essentially, this means that matter exists only when it is *measured* within temporal and spatial perimeters. Morphology, as the process of generating these spatiotemporal forms, can be examined on several levels. There is a force of *potentiality* or an agenda of continuous morphological generation that counteracts the entropic dissipation of old forms. There are *actuals* which are understood as those particular spatiotemporally discrete or finite morphological units. And there is that compressed information, the type or *model* that provides a general reference template for developing the individual forms. We will return to these three processes.

In addition, if we consider interactions between singular units, we observe another attribute of the biological realm – an adaptive capacity. The interaction that the individual morphological unit has with other units, where input data is transformed by some means to output data, is not mechanical and random but capable of constructive adaptive change. For example, coexisting competitor species of finches on the Galapagos islands over the years develop divergent jaws and beaks to exploit a variety of seeds (Grant 2006). Another example explains that "when young blue mussels sense that the green crabs are near their particular path – no one knows the telltale signal, but it's likely a hormone or other chemical – they begin to thicken their shells. After several months, the shell is 5% to 10% thicker than it would otherwise have been…If crabs don't happen to be around, the mussels don't bother making thicker shells" (Freeman, A. and J. Byers 2006: 745).

If we further analyze these interactions between singular units, we must acknowledge that the internal actions of the unit are differentiated from the external. There is an ‘interface’, usually a membrane, between the two realms, the internal and the external. However, this interface zone can extend beyond the ‘hard membrane’ by means of other sensory apparatus such as temperature differentiation and chemical volatiles, and it can be difficult to make precise definitions of what is internal, what is external, and how each behaves. For example, volatile chemical cues guide host location and host selection by parasitic plants; that is, the parasitic plant ‘sniffs out’ a new host (Runyon et al 2006). As another example, the prokaryote unicellular bacterium is, in its singularity, external to another bacterium; the cytoplasm is the internal mass inside the cell membrane of that bacterium. However, when a bacterium reproduces by binary fission it splits in two; this singular cytoplasm sets up a situation where one part, the daughter cell, whose properties were once part of the internal cell matter, is now external to the original cell.

We can see from the above few points that informative interactions between individual units and between general types, is a basic part of the biological infrastructure. The infrastructure is actually a complex informational network, where particular and general information, functionally interact not only within the same species but within different species.

How does this complex biological activity function? Within a semiosic mode. As Jesper Hoffmeyer writes, ‘every life form exists both as itself, i.e., as an organism of “flesh and blood”, and as a coded description of itself, the latter being lodged within the remarkable DNA molecules of which the genetic material is composed” (1996:15). Furthermore, this ‘code’ or model seems to function within a different temporal mode than the individual organism, for “it is the coded version, the genetic material, that is passed on to the next generation by means of procreation, while the organism must die. So what survives is in fact a code for something else, an image of the subject – not the subject itself. Life is survival in coded form" (ibid:16). That is, semiosis concerns itself with the process by which morphological reality operates as a complex *informational* architecture comprised of both a stable model of information about its own organization and also many finite and diverse articulations of that model. It is also an adaptive architecture in that this model interacts with other morphologies and can, as required, constructively change itself – this means that it can not only change its individual units but it can change its general model; that is, biological systems have developed the capacity to control their own future.

This paper will be in two parts.

A. This section will attempt a brief comparison of Saussure and Peirce. It will contrast the Saussurian dyadic model of semiology with the Peircean triadic model of semiotics to explain how Peircean semiosis enables a complex adaptive network.
B. This section will examine how a biological organism functions as a sign. This will explain how a biological system operates as an 'informed' and informing knowledge system, i.e., as a *function* within a complex adaptive network that operates using both *strong and weak anticipative actions*.

SECTION A

An introduction to semiotics and a common error

What is semiotics and what is a sign?

A common definition of semiotics is "simply the analysis of signs or the study of the functioning of sign systems" (Cobley and Jansz 1999:4) This tautology is not very helpful. After all, what is a 'sign'?

Then, there is Umberto Eco's "Semiotics is concerned with everything that is *taken* as a sign. A sign is everything that can be taken as significantly substituting for something else…Thus *semiotics is in principle the discipline studying everything which can be used in order to lie*" (1976:7). Notice the requirement for an agential interpreter who observes something and 'takes it as a sign, as a substitution of something else'. Notice also that the 'something else' need not exist.

The Port Royal seventeenth century school states that "the sign comprises two ideas – one of the thing represented – and its nature consists in exciting the second by the first" (Nöth 1995:21). There is some kind of connection, almost innate, where Y is brought to mind by viewing X. Obviously, an observer is required.

Or "semiotics involves the study of signification, but signification cannot be isolated from the human subject who uses it and is defined by means of it, or from the cultural system which generates" (Silverman 1983:3). Notice the insistence that semiotics has something to do with 'signification' and that it operates solely within the human realm and is cultural rather than natural.

There is the definition of semiotics as a 'code system', for example, in Prieto's "the code which is used in a semiotic act is that semiotic structure on which the sender's and receiver's knowledge of the signals is based" (1975:129. In Nöth 1995: 210). In this case, the sender and receiver, two individual agents, share knowledge of a code.

Or " A *Sign, or Representamen*, is a First which stands in such a genuine triadic relation to a Second, called its *Object*, as to be capable of determining a Third, called its *Interpretant*, to assume the same triadic relation to its Object in which it stands itself to the same Object" (Peirce CP: 2.274).

Without going much further in such an encyclopedic outline, we can see some difficulties with these definitions. These can be reduced to a conflict between sign systems based around a logic of equivalence and a logic of composition. The first, and the focus of all but the last of the above examples, is Saussurian semiology; the second, provided by the last quotation, is Peircean semiotics.

A brief comparison of Saussure and Peirce

Semiology

It is vitally important, as many do not, to distinguish between the two ideologies. Saussure uses *semiology*, while Peirce uses *semiotics*. Despite the insistence by some authors of their identity, it is a serious error to equate them. Semiology refers to *words*; that is, to sign systems created and used by human beings. As a descriptive methodology, it is focused around the metaphoric or symbolic translations of cultural phenomena, where 'this' means 'that' according to some socially defined lexicon. Semiology has a straightforward agenda; it substitutes one word or image for another word or image; it is a 'nominalist' system, focused on '*nomen*' or names. It works with actual units, shuffling them around mechanically to connect them on a conceptual board. Semiotics, on the other hand, is not descriptive; it is analytic. It examines the formation of those actual units, or morphologies. Its analysis is focused on the transformative action that takes input data, and using normative rules, organizes this data as an output. The whole process of input/organization/output is, together, the development of a morphological unit, a sign. Semiosis, moreover, is not confined to the human conceptual process but produces forms or morphological realities within the physico-chemical, biological and cognitive realms.

As Deely points out, semiology is a subset of the whole science of semiotics, and is focused primarily in the literary realm (1990:2-3). Guiraud states that Saussure “emphasizes the social function of the sign”, i.e., the symbolic artifacts of a dyadic metaphor or code and referent (1975:5) where A stands for C . Barthes states that semiology finds “language (in the ordinary sense of the term) in its path, not only as a model, but also as a component” (1967:10-11). As Saussure notes, his analysis is confined to human processes, and in particular, to the symbolic, for “language is a system of signs that expresses ideas, and is therefore comparable to writing, to the deaf-mute alphabet, to symbolic rites, to codes of good manners, to military signals, etc. …A science that studies the life of signs in society is therefore conceivable; it would be a part of general psychology; we shall call it semiology” (1964: 33).

The Saussurian semiological act is dyadic and mechanical. This means that there are two nodal sites in the interaction, which are termed the *signifier* and the *signified*. Or more simply, the stimulus (the sound of the word, the image as a signal), and our interpretation of that stimulus. Furthermore, “both terms must exist” in their own right (Deely 1990:23). The two units are both existentially real and all that semiology is doing is connecting the two. This dyadic structure obviously requires an external authoritative ‘metanarrative’ or codebook and an agent using this codebook to bring these two nodes in contact.

The Saussurian analysis enables a cultural description of social systems; that is, it enables the researcher to explore how human beings have constructed their culture to imbue natural and artificial objects, and beliefs and behavior, with social meanings. As a dyadic descriptive framework, it focuses on that authoritative agent or the "systems of signification" (Barthes 1967:9) that connect the two 'real objects', the sound and the meaning, the object and the meaning. Peirce wrote this about the dyad, "Let me remind you of the distinction referred to above between dynamical, or dyadic, action; and intelligent, or triadic action. An event, A, may, by brute force, produce an event, B; and then the event, B, may in its turn produce a third event, C…. Each step of it concerns a pair of objects" (CP: 5.472).

In a dyadic semiological or nominalist frame, there are two actual units. An external agent then provides an intentional connection between the two. This means that a Saussurian analysis lends itself readily to theories of the authoritative domination of this agent, viewed as the metanarrative, whether it be parents, employers, corporations, government or social customs (Lyotard 1984). The Saussurian analytic frame enthusiastically lent itself to the postmodern attempt to deconstruct this 'metanarrative' and supposedly return human consciousness to direct connections with the object, a naïve notion of essentialist purity. Semiology is best understood within a nominalist perspective, where the focus is on the socially defined meanings of objects and people. It operates as a descriptive outline of assigned meanings, beliefs and behavior, and has no capacity to examine the generation of morphological units. To understand that, we require semiotics and the process of semiosis.

Semiosis

Semiosis is a triadic frame, and there are not three *units* but three *relations*. Semiosis is "an action, or influence, which is, or involves, a cooperation of *three* subjects, such as a sign, its object, and its interpretant, this tri-relative influence not being in any way resolvable into actions between pairs" (Peirce CP: 5.484). The Peircean semiotic frame consists of three relations: input, mediation and output.

"The fact is the subject, the resulting idea is the predicate and the mediative connection is thought" (CP:1.485). This triadic process is irreducible; all three relations are a requirement for the morphological unit, which is understood as a whole, the semiosic sign, which can be understood as a spatiotemporal form, a 'morpheme'. A further point to focus on, is that the mediative connection is not random but is an act of reason; it is an 'informed action'.

The triadic process is best understood as a function where $f(x)=y$. [1]This simply means that *x*, the object or input, is transformed by means of the mediative rules of *f* into *y* or output. Or, a bacterium absorbs nutrients (*x,* object) and transforms them by means of its internal rules (*f*) into its own 'interpretant' reality *(y)*. All bacteria of a set or type operate according to these common rules *f* and therefore, all will, more or less, interact with that particular *x* in the same way. As a triadic function, the sign exists as a complete 'morpheme' linked within a network to other signs.
Semiosis is the science of morphology, the generation of forms. It has nothing to do with 'names' or nominalism; its focus is on the generation of the existential form, made up of an interaction of three relations, that can last for a nanosecond or a millennium. The generation or the sign is a process of matter *becoming informed* or rationally organized within both a typological and a particular morphology.

The transformative mediative relation of '*f*' in the semiosic function is a major key to understanding semiosis and we will be analyzing this function within this paper under the theme of *anticipation*. This process of mediation is an act of generalizing , an *act of reason* that synthesizes or normalizes the disparate informational qualities of particulars to provide a 'general' or 'universal' that enables individual units to maintain cohesive membership in a community, a set, a species. The 'general' is a

1 Peirce discusses functions, as 'an operation performed on the arguments' and the concept of a transformation from x to y in CP: 4.250-255.

commonality that acts as a future-oriented law, for "every habit has, or is, a general law. Whatever is truly general refers to the indefinite future…. The past is actual fact. But a general…cannot be fully realized. It is a potentiality" (Peirce CP: 2.148). Mediation acts as a set of evolving normative habits that is, in addition, adaptive, for it is " capable of a definite increase in knowledge" (CP:5.311). As such a forward-looking law, the general functions as a referential template that anticipates the articulation of the individual unit and as such, guides and constrains its morphological emergence.

The Peircean Sign as a Biological Function

The genuine sign is a triadic process, an action made up of a logical process of three relations – an input stimuli, a mediative process that uses general *rules* to process and interpret this input data, resulting in an output or interpretation. The whole triad of *f(x)=y* acts as a single morphological reality, the Sign. This triad is an irreducible set of relations. It is not, as in the Saussurian frame, three separate existential 'things', i.e., separate input data, separate Rules, separate interpretation. Again, the Peircean Sign is a process of *f(x)=y* where input *x* is mediated and transformed by the rules *f*, to produce an interpretant *y*.

Importantly, the mediation is an act of reason. We must insist on this; mediation is not a mechanical act nor is it an act of communication. It is an analytic act. As Peirce noted, "Thought is not necessarily connected with a brain. It appears in the work of bees, of crystals, and throughout the purely physical world; and one can no more deny that it is really there, than that the colors, the shapes, etc., of objects are really there…. Not only is thought in the organic world, but it develops there" (CP:4.551). That is, the mediative rules that govern this 'informed organization of matter', in the biological world, are an act of reason – not random or kinetic mechanics. Furthermore, they are not fixed; they develop, they evolve. This triadic analytic process is the fundamental infrastructure of our world, for “so prolific is the triad in forms that one may easily conceive that all the variety and multiplicity of the universe springs from it” (CP:4.310).

Semiosis then becomes aligned with the algebraic study of both functions where *f(x)=y* and calculus – $\lim_{x \to p^+} f(x) = l$ which studies the nature of the rules *f* (or limits, constraints) put upon *x*, the input, as the rules transform it to an interpretation. Essentially, this means that the rules about the transformation of *x,* the input, have a limited capacity to carry out that transformation. If the input is more than the rules can handle, then *x,* the input, dissipates. The rules cannot process that input. The biological realm has developed strategies to prevent the threat of a constant entropic dissipation of energy and has enabled its systems to accept and process more and more diverse matter. Biological systems have acquired the capacity to evolve and adapt their morphological rules of transformation of input to output, so that they can continue producing material morphologies, even if these are different morphologies. As Peirce noted, the biological realm is non-linear, for “matter entirely foreign to the premises may appear in the conclusion” (CP:3.641). The realm with the least capacity to change its rules, and therefore, the realm with the least complex morphologies, as well as being more subject to individual entropic dissipation, is the physico-chemical realm.

The biological realm exploded in morphological diversity and complexity of form because it moved its mediative or transformative function into the internal control of subsets of the realm, i.e., into the control of species and even subsets and sub-subsets of species. Locating the definition and nature of its mediative rules within multiple levels of subsets whose behavior was defined by local pressures, meant that those subsets reorganized their rules only according to their local environmental requirements. This multi-faceted architecture provided a local accountability and flexibility that reduced a requirement for massive general rule reorganization and resulted, as well, in an increased complexity and diversity of rules. This produced an exponential explosion of diversity of forms and a resultant reduction of entropy as diverse morphologies developed with their own specific local rules to process matter to myriad forms. As an aside, it should be noted that the human realm has moved the mediative rules out of the physical and into the symbolic; its rules are therefore totally arbitrary and extremely flexible.

In conclusion, it can be seen that a semiosic analysis, using the Peircean triadic analysis of Relations, can be used to constructively explain the self-organizing and evolutionary and adaptive capacities within the biological realm.

SECTION B

How a biological organism functions as a sign

Matter is primal and universal but exists only when it takes on form (Thompson [1917]1966). Morphological production occurs within a topological structure, a network, which is made up of morphological forms (nodes) which are interactive with other forms/nodes. The system of nodes and interactions forms another level of reality, a network. Networks, in the physical, chemical, biological, neural, economic, informational and social systems, are increasingly being extensively studied (Albert and Barabási 2002, Barabási 2002, Barabási and Albert 1999, Castells 2000, Christensen and Albert 2007, Christensen et al 2007, Newman et al 2006, Watts 1999) and as noted, are found in all realms, the physico-chemical, biological and hominid. For example, “living systems form a huge genetic network, whose vertices are proteins and genes, the edges representing the chemical interactions between them” (Barabási and Albert, 1999: 2). The nervous system is a network "whose vertices are the nerve cells, connected by axons" (ibid). Societies are networks, "where vertices are individuals or organizations, and the edges characterize the social interactions between them" (ibid). Signs exist only in networks; however, the focus in this paper is on the formation only of the sign, rather than the formation of the networks.

The analytic model used to examine this morphological function, the sign, is a two-dimensional Cartesian coordinate quadrant (Fig. 1 and Taborsky 2006). I'll make a few preliminary comments about this graph. First, the two quadrants on the right hand side, quadrants I and IV are understood to operate in external space, local and non-local. This is the space of classical mechanics, the realm of our basic everyday experience and the foundation of most of our science. The two quadrants on the left side, Quadrants II and III operate in internal space, local and non-local. This is quantum space. It is a basic axiom of this theory that the two realms, the internal and external are not in an 'either-or' situation but are embedded within and necessary to each other.

In this paper, I will focus on *anticipation*, as operative within the relations of Quadrants III and IV, which are understood respectively as strong and weak anticipation. 'Strong anticipation refers to an anticipation of events generated by the system itself. Weak anticipation refers to an anticipation of events predicted or forecasted from a model of a system' (Dubois 2000a).

Following Dubois, anticipation is a property not merely of the biological realm, as Rosen (1985) affirmed, but of all systems, physical, biological and social. "As anticipatory properties exist in fundamental physical systems…anticipation must be a key property for any non-living and living systems which are more complex, like physical, chemical, biochemical, ecological, economical, social systems" (Dubois

2000a:28). Anticipation refers to the establishment and operation of symmetry inducing normative habits of morphological formation. "Anticipation is not only related to predictions but to decisions: hyperincursive systems create multiple choices and a decision process selects one choice. So, anticipation is not a final goal, like in cybernetics and system science, but is a fundamental property of physical and biological systems" (Dubois, Abstract, 2000a). What this means is that a semiosic system has the capacity to, itself, create multiple hypothetical or *imaginary 'virtual visions'* or simulations of its nature and behavior in its environment. These imaginary states, which we call 'strong anticipation' enable the system to anticipate the actualization of these states and on the basis of these simulations, make an *informed choice* about which organizational mode is 'the best solution' for that environment. After this decision is made and a mode of organization is actualized, the biological system then has the additional capacity to develop an *abstract model* of this organizational mode, which Dubois defines as 'weak anticipation', and retain that model as a governing referential guide that steers the morphologies of developing individuals within that system.

Questions within this area include the nature and relevance of these two types of anticipation, the ability of a system to develop and reject anticipative capacities, and the relation between strong anticipation and the growth of complexity. The development of a complex and evolving capacity for anticipation and the concomitant capacity of the system to itself make decisions about its future morphological state is a primary characteristic of the development of the biological realm from the physico-chemical realm. The reality of two types of anticipation suggests that the two step evolutionary framework of neodarwinism (Fisher 1930, Mayr 1942) – a framework that rejects anticipation and is instead based around a primary random or uninformed mutation of a single model supported by a *post hoc* 'natural selection' of that model – is an inadequate analysis. The semiosic biological system is not a random or mechanical process but an informed, reasoned and self-controlled process.

The Model of the Semiosic Process

The analytic model, a two-dimensional Cartesian coordinate quadrant, enables a morphological analysis that acknowledges differential spatial and temporal parameters of measurement. The ontological and epistemological 'cuts' (Atmanspacher 1994, 1999, Primas 1993), which are modeled respectively as the vertical Y and horizontal X axes, establish measurement parameters for six unique topological interactions termed relations.

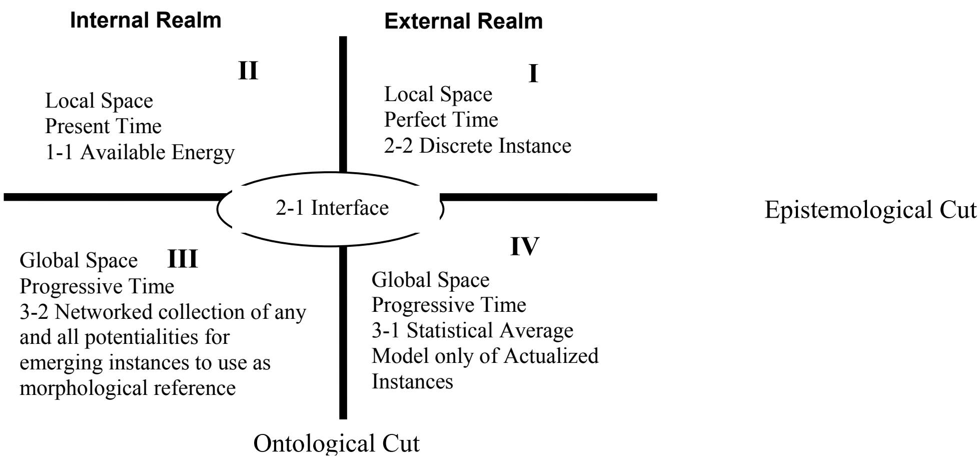

FIGURE 1. The Cartesian Quadrant.

The X and Y Axes and Relations

A relation is an existential string. It is a primitive morphology, where two nodes functioning as horizons of influence, which is to say, as horizons of measurement, establish a configuration, a morpheme of data functioning within a unique time and space – and mode. Again, a relation is a construct developed within a pair of 'functors' or mapping measurements which set up a structure-preserving primitive form, a linear string. I have found it difficult to offer a clear name for this string. I have frequently referred to it as a dyad because the string exists within those two nodes of measurement; however, this term is inappropriate because it suggests two existential realities when I am referring to only one. Perhaps a better choice might be to call it a *singlet*. 2 I only wish to assert that reality exists in such a primal form; however, I will further claim that such an existential string, although it exists 'as such', cannot do so in isolation. Reality requires that these strings function within an ordered triadic form.

The semiosic process selects three of these *singlets* from the six relations, which it then sets up as a triadic function *f(x)=y* of three relations. This entire function is one morphological reality, a sign, and operates as input/mediation/output, with '*f*' understood as the mediative act of transformation from input sensate data to output interpretation (Taborsky 2006).

The vertical ontological Y cut, a result, in the physical and biological realms, of temperature differentiation, demarcates spatial experience into internal and external spatial values. Internal space provides an irreducible mass of data and external space provides a reducible discreteness of data.

The horizontal epistemological X cut sets up a hierarchical level; it differentiates between local (individual) spatial values and non-local global (communal) spatial values. This cut ensures that morphological realities are capable of interaction with

2 Peirce refers to a 'singlet' in a different outline, to refer to an object 'as such' (CP:4.345).

other forms not simply in a random kinetic manner which would be all that would be possible within a local or individual definition, but, due to the hierarchical authority of general or common identities, these morphologies are capable of cohesive interaction with each other because their composition includes information organized within the collective laws of shared typologies rather than the peculiarities of individuals. With this cut, which acts as the introduction of the temporal parameters of present, perfect and progressive time (Matsuno 1998, 1999), we now have an analytic scheme of four quadrants, I, II, III and IV [Figure 1].

I add two further relations to the quadrant, namely, the aspatial and atemporal universal property of pure imagination, and the interface relation located at the coordinate origin, which brings the relational acts to six in total (Table 1).

Seven Measurements

The morphological architecture has seven basic measurements: internal and external space; local and global space; and present, perfect and progressive time.

Internal spatial measurements produce morphologies that act without horizons; internally organized matter is unable to recognize boundaries and cannot 'see' or react to otherness. This type of information is high energy and rapidly dissipative. When linked to other measurements that inhibit its dissipation by establishing boundaries, its expansive and undirected energy activities promote rapid and sometimes novel interactions with other data.

External spatial measurements establish horizons or limits and enable definitive values of the informational identity of a morpheme. The membrane of a cell acts as an information closure; its perimeters define the extent of the immediate control that the cell has over its internal information.

Local spatial measurements set up non-distributed actions; i.e., two different proteins can maintain their differences even when they work in contextual cooperation.

Global or non-local spatial measurements distribute a property as general information among a set. These distributed values permit symmetry-inducing properties within that collective, e.g., enabling interactions amongst particular units as well as enabling a continuity of morphological type of a species.

Time is not a universal abstract measurement (Newtonian/Galilean linear time) but is a restricted measurement functioning as a compositional property of the morphological reality. There are three different temporal measurements which produce three different morphological realities (Matsuno 1998, 1999).

Present time measures a reality that functions within *now* time without links or references, without past or future. The information provided by the morphological measurement of pure present time operates only in internal and local or isolate space. An example is a 'feeling of heat' without consciousness of that feeling.

Perfect time moulds experience within distinct asymmetrical parameters, i.e., as 'this' instantiation differentiated from 'that' instantiation. It enables individual kinetic interactions and comparisons and operates in external and local or closed space.

Progressive time establishes values within generalized continuity; it has no capacity to describe an individual state whether in present or perfect time but can deal only with commonalities operating as a general attributes. It operates within global or open space and both internally and externally.

These seven measurements operate within the dynamics of asymmetry and symmetry. Local space and present and perfect time contribute to asymmetry, i.e., to differentiation of form and relation; global space and progressive time contribute to symmetry, i.e., to communal cohesion and continuity.

Mode is a value that refers to the style of connection that relations have with each other. The connection can be either of potential, actual or necessary use. A potential use implies an optional use, an actual use defines a genuine use of that measurement; a necessary use implies a required use of the measurement.

The Real, the Imaginary, the Finite, the Infinite

The X and Y cuts set up negative and positive values that explain a morphological capacity for four different types of behavior – the imaginary, the real, the local and the non-local. The 'real' is shown on the right-hand side of the quadrant; its measurements, both local and non-local, are discrete and statistical. Whether measuring the particular unit or an abstract model, its actions are mechanical, as in Rosen's outline of the simple system (1991). Neodarwinism is focused exclusively on the mechanical or right side of the quadrant; that is, the local and the non-local in external space. Darwin "moved biology into a Newtonian framework" (Brooks and Wiley 1988:xii). The imaginary, on the left side, the internal realm, both local and non-local, provides hypothetical measurements – both of which are rejected in a neodarwinian analysis.

TABLE 1. The Six Relations: Code/Space/Time/Function

2-2 in Quad I	External Local	Perfect Time	Discrete Actual Information
1-1 in Quad II	Internal Local	Present Time	Possible Information
3-2 in Quad III	Internal Global	Progressive-perfect Time	Hypothetical morphemes
3-1 in Quad IV	External Global	Progressive-present Time	Statistical Average
2-1 at Origin	Borderline Interface	Perfect-Present Time	Attractor Phase
3-3	Aspatial	Atemporal	Universal Logic

Note: The relations are defined using Peircean terminology (Degenerate Cases 1.525-537)

THE RELATIONS

Again, a relation is a string, a primitive morphology, where two nodes functioning as horizons of influence establish a configuration, a morpheme of data functioning within a particular time and a particular space – and mode. Relations are real but they cannot exist on their own; they only exist within a triadic function, the Sign.

The Local Relations: Internal and External

Two of the relations define local realities, both internal and external. These two relations are modeled in the upper half of the Cartesian quadrant

Relation 1-1 Quadrant II

The most basic and primitive relation, is found in quadrant II. The relation is coded, using Peircean terminology, as 1-1 or Firstness as Firstness. This means that the two nodes are both operating within Firstness. Firstness is a relation of possibility, of freedom, where "the free is that which has not another behind it, determining its actions" (Peirce CP: 1.302) but is "a state, which is in its entirety in every moment of time as long as it endures" (1.307). Matter in this state is 'perfectly simple and without parts" (CP:1.531). This relation moulds reality without boundaries, as an *isolate* state, in internal and local space and present time. Given that this data exists without perimeters, it allows a wide number of degrees of freedom of interpretation (output) and the emergence of novelty of ultimate form by virtue of the relatively unformed and ambiguous nature of its content. The functionality of this relation, i.e., its nature and horizons of influence, is the expansion of freedom of morphological innovation or interpretation by means of the vagueness of its data content. An example would be a sensation of 'hotness' which can then be transformed into the specifics of either a malfunctioning furnace or a fever. It could be a provision of a number of chemical properties; the provision might promote the development of specific tactics in the cell to accept or reject those properties or even, form them into a specific morphology. This measurement acknowledges only that there is an input of unexamined data located internally in local space and present time. It can be transformed into discrete usable information by the semiosic act which must measure and stabilize its energy content by linking it to two other relations; otherwise, its data and energy content will rapidly dissipate.

It is an important relation, confirming the veracity of chance and freedom in the universe. The relation contributes highly unstable, possibly usable but indecisive data, enabling an information system to explore a variety of options – typical and atypical – as it selects a specific direction of interpretation. Because the matter is measured only within present time and local and internal space, its data content will be brief and will dissipate rapidly if the system does not link that content to a specific direction of interpretation. As such, this relation, despite its expansive capacity, cannot destabilize an entire system

Relation 2-2, Quadrant I

Measurements in the relation of 2-2 or Secondness-as-Secondness provide data operating in external and local space and perfect time; as such, the data is differentiated, it is *closed,* for "constraint is a Secondness" (Peirce CP: 1.325) and we view it as 'real' or actual. Any discrete entity, from a rock to a word, can be considered an example of this 'definitive definitiveness' of containment and contiguity and it is the basis of most of our daily experiences; for "the idea of second is predominant in the ideas of causation and of statical force" (CP:1.325); it is facticity, it is the quantitative basis of Newtonian kinetic or reactive mechanics. The information in this measurement, operating only within discrete perfect time, local space, external space, is capable only of random and kinetic connections. There is no collective law that unites the particular and permits a commonality of behavior and therefore, no continuity of data or possibility of collaboration. Information provided by this relation will dissipate rapidly, not due to its own inherent vagueness as within the 1-1 relation in quadrant II, but by means of the reactive damage of unregulated and random kinetic interactions.

How are the energy-dissipating problems of these two relations of local spatial values and immediate temporality dealt with? By the provision of relations that measure time and space within symmetrical or continuity-promoting values. We move to the lower level of the Cartesian quadrant.

Non-Local Measurements and the Function of Anticipation

The two quadrants produced by the epistemological cut, the X cut, introduce non-local or global space and temporal synergy; in particular, this cut permits *open* (as differentiated from isolate and closed) interactions and a progressive and continuous time measurement. What we now have is a bileveled architecture, enabling both metabolic individual reactive processes in quadrants I and II, and reproductive or synthesizing and continuous common processes in quadrants III and IV. The measurements in quadrants III and IV provide distributed values that ensure the typological continuity of particular forms and the development of common habits, of general laws, of regularities of morphological forms. These values, which Peirce understands as the capacity of *representation* (CP:1.532) act as symmetry-inducing constraints to guide and inhibit the emergent local, individual instantiations developing in the local level (quadrants I and II) in present or perfect time.

The measurements in quadrants III and IV provide two versions of compressed information. Information that is compressed or condensed has removed variations and provides information only about commonalities or common habits that operate as general rules of formative processes. These function to guide the emergence and development of individual morphologies and thus enable anticipatory predictions. Our world cannot function within only the two top level quadrants of undifferentiated matter and discrete closed particulars, for this would reduce behavior to kinetic randomness. There must be a function that provides morphological symmetry and reproductive continuity. The X-cut establishes this function and ensures an open system. However, as Brooks notes, "evolutionary theory has never fully come to grips with apparent lawlike behavior in biological systems" (1988:3).

It should be noted that a non-local relation, which provides those common rules to induce symmetry, can never operate as or by itself. It has no capacity to exist, as itself, in present and perfect 'now' time because it operates in progressive or continuous time. It has no capacity to exist in 'this' or local space, as a discrete entity, because it operates in non-local space. We must not "fall into the contradiction of making the Mediate immediable" (Peirce CP: 5.289). That, in common parlance, is Platonic Idealism, it is idolatry. The properties of the non-local relation are active only when the relation is connected to a local relation in present or perfect time.

With the use of either or both of these two relations of generality, the morphological system can *anticipate*. Anticipation refers to the capacity to envisage future states, either as hypothetical graphic networks or as abstract models; these simulations allow the system to analyze its possible future properties and behavior without taking the risks of experiencing that actuality in real time and space. This derived information guides its choices and actions to enable its future states to be productive rather than destructive (Dubois 2000a, 2000b, 2002).

Relation 3-2 Quadrant III

Relation 3-2, or Thirdness-as-Secondness, functions in internal and global or non-local space and progressive time. One node operates within Thirdness, the other node operates within Secondness. This relation operates as a 'virtual information processor'. Ontologically and epistemologically, its measurements are completely negative rather than positive. It is best described, mathematically, as a 'purely imaginary number', i.e., a compressed or squared imaginary number (*i squared).* However, it can only become operational when operating as a complex number, i.e., when linked to real number measurements that occur within local spatial perimeters. It functions as a heuristic process to come up with a number of hypothetical or *imaginary* solutions to environmental stimuli, an 'irrational plurality' of correlates or connections (Peirce CP: 5.70) This is not a model; a model abstracts from actual existences and then generalizes the nature of this reality. This is a *strong anticipatory process* (Dubois 2000a), which does not model actual sensory data but instead graphically outlines multiple probable future interactions in the environment, based on a cumulative series of informational searches within that environment (Dubois 2000a,b, 2002). The process can be described as providing "network *motifs* – patterns of connection that recur statistically more frequently than they would in a degree-preserving randomized graph" (Christensen and Albert 2007:8). That is, the hypothetical solutions of strong anticipation are not 'things' or models of 'things'; they are maps of networked connections in the environment.

Pribram (in Dubois, 2000a) asks, 'how can an anticipatory hypothesis be modeled without a future defined goal'? And the answer was "a hyperincursive anticipatory system generates multiple potential states at each time step and corresponds to one-to-many relations. A selection parameter must be defined to select a particular state amongst these multiple potential states. These multiple potential states collapse to one state (amongst these states) which becomes the actual state" (Dubois 2000a: 28-29). And that is the key – the system itself, operating as a process of local and non-local exploration, provides multiple imaginary solutions – those graphed states of interaction – any one of which may be successful; which one is ultimately 'selected' for actual use may be due to chance, acknowledging the existence of free will or Aristotle's spontaneity in the universe. Dubois continues "the selection process of states to be actualized amongst the multiple potential states is independent of the fundamental dynamics of the brain, independent of initial conditions and so completely unpredictable (and computable)…the free will means that we can choose a state amongst the multiple potential states emerging from the preceding already actualized states….free will does not mean that the mind can make what he wants but that he can choose amongst multiple possible choices" (2000a: 29). The point is – and this is an important point – that any one of these multiple states that are 'offered' to the system by this process of *strong anticipation* may function and flourish. Bongard et al's outline of robust robots is "a robot that actively chooses which action to perform next on the basis of its current set of hypothesized self-models has a better chance of successfully inferring its own morphology than a robot that acts randomly" (2006:1120).

Furthermore, this search process provides a data base with the capacity to evolve. If we use an example of this relation, the internet search engine, we find that "search engines entertain a model of the Internet that *evolves with the Internet*" (Wouters, Helsten, Leydesdorff 2004, emphasis added). Because it operates as an informational network that is indifferent to local space and time "the past in the Internet is constantly overwritten by the search engines" [and] " the present, from where the data is collected, affects search results considerably…[and the system is acting to] continuously reconstruct the past by updating their indices" (Wouters, Helsten, Leydesdorff 2004). Mathematically, we can refer to the strong anticipatory or virtual mode as a provisory of complex information, in that it includes both real propensities or real numbers, which we can understand as actual memories, and imaginary propensities or imaginary numbers, which we can understand as the relational propensities with other morphologies both unformed and formed. The search process acts as an open non-linear non-historical catalogue of solution concepts, as an evolving networked 'search engine' of any and all links within the past and current, direct and indirect, experience of the community. These links might not develop into actual rules of morphological formation (i.e., functioning in quadrant IV); however, their virtual existentiality remains extant – for a while – and the graphic solution may continue to be available for potential selection by another emerging instantiation before being overwritten by the data from new searches. This relation is essential in enabling a system to constructively adapt and evolve and is an overlooked and vital mode of measurement.

This is an analytic, not modeling, process designed to explore data, accessed both directly and indirectly in search of actual and possible patterns and/or systematic relationships between variables. How does it operate? Multivariate exploratory techniques designed specifically to identify patterns in multivariate (or univariate, such as sequences of measurements) data sets select subsets of predictors from a large list of candidate predictors without assuming that the relationships between the predictors and the dependent or outcome variables of interest are linear or monotone. The 3-2 relation acts as a flexible *continuous networking process* rather than as a fixed model. For example, the use of *genetic algorithms*, evolutionary or genetic programming acts as a complex and changeable set of exploratory flexible connections of indexical links past and present, direct and indirect, to both real and imaginary solutions (Beyer 1998, Goldberg 1989, Holland 1975). The genetic algorithm process works to identify systematic relations between variables, offering them as hypothetical future paths. It operates through a number of exploratory and evolving steps to come up with a number of 'best solutions'. Another example of the 3-2 relation is the *data mining* process which browses massive data bases to search out correlations or patterns using a variety of tactics, refining these patterns into multiple hypothetical solutions. Then, the system will itself select one of these solutions to move into the external reality as its ‘proposed model’. Again, “hyperincursion systems create multiple choices and a decision process selects one choice” (Dubois 2000a abstract).

These solutions are presented, not as models – the definition of ‘model’ will be restricted to an abstract image derived from actualities – but as hypothetical networks or ‘maps of possible interactions’. Strong anticipation will develop a number of such hypothetical network maps; these maps may well include outliers or infrequent contact points that would degrade the current robustness of a network if that mapping was currently chosen by the system but those contacts might be useful at a later time. This 3-2 relation provides a system with an immense capacity to ‘browse’ the informational community, both the near and far environment, it enables a system to operate in the unaccountable freedom of the imagination, by operating as a ‘virtual search processor’. As a global relation, its measurements are distributed in space; it completely ignores spatial distances. As internal, these ‘maps of interaction’ remain hypothetical or imaginary rather than actual and, importantly, do not compromise the system’s current functionality. As temporally progressive, the relation links past to future morphologies to achieve a broad exploration of knowledge in both its actualized and hypothetical forms.

The relation provides robust, i.e., immediately functional evolutionary and adaptive capacities. Kauffman claims that “selection is not the sole source of order in organisms” (1993:xiv), and there are “critical limits to the power of selection” (1993:xv). As a network, it provides a wide range of prospective solutions for the system to, in interaction with its informational environment, select as the ‘best solution’. This rejects the Darwinian axiom that a model itself, as a final program, emerges randomly and survives by a reproductive struggle of its individual representatives. Initially, the single solution resulting from a 3-2 exploratory search is theoretically, randomly or freely 'chosen'. This randomness, however, is reduced as the relation gathers and 'fine-tunes' future-oriented hypothetical solutions by constantly comparing them with the state of its current informational identity and the state of its current environment. This means that it is an informed and analytic, rather than random and ignorant, search. The 'best solution', again, is a result of an informational process which first develops a co-domain of hypothetical propositions, and then, negotiates between these prospective solutions and the environment, to select the 'best solution'. "A strong anticipatory system is one in which the anticipated future state is 'generated by the system itself" (Dubois 2000a:4). Any randomness is internal and reduced to zero by the time a 'best solution' is chosen by the system. The emergent model is immediately functional and there is no testing by struggle as required in the thesis of Natural Selection.

Relation 3-1 Quadrant IV

Quadrant IV measures matter in external and non-local or global space and progressive time. Functioning in external or actualized space, it lacks the imaginary propensities of the internal mode. It is coded as 3-1 or Thirdness-as-Firstness, which operates as a 'qualitative Thirdness' (Peirce CP: 5.72).

It operates as an abstract model, or *weak anticipation*, a derived representation of reality. In this relation, the model is the statistical average of the *already-actualized* individual morphological forms existent within measurements that include local space and perfect time, i.e., measurements that include the relation of 2-2. That is, this relation models a known landscape, relying on existent sensory data. It acts to constrain the variability of emerging forms by confining population reproduction within a dominant referential model (the statistical average) acting within a basic Bell Curve or a Power Law. As Kauffman said "in sufficiently complex systems, selection cannot avoid the order exhibited by most members of the ensemble" (1993:16). This referential model functions as a kind of 'attractor-glue' (Paton & Matsuno 1998) to which the emerging nascent instantiations are attracted, and which they then take as a default guide for their development.

An abstract model is comparable to Rosen's description of "an anticipatory system is a system containing a predictive model of itself and/or of its environment, which allows it to change state at an instant in accord with the model's predictions pertaining to a later instant" (1985: 341). Following Dubois, this relation "deals with weak anticipation, because the anticipation is based on a model of the system and thus is a model-based prediction and not a system-based prediction" (Dubois 2000a: 4). A model exists on a secondary level of reality; it is a *post hoc* abstraction, albeit, in the biological realm, derived by the system itself rather than by an external agent and embedded within its morphology as compressed data (DNA). As such, this is 'mathematical reasoning' or deduction, which can be understood as "constructing a diagram according to a general percept, in observing certain relations between parts of that diagram not explicitly required by the percept, showing that these relations will hold for all such diagrams, and in formulating this conclusion in general terms" (Peirce CP: 1.54). As an abstraction existing in progressive time, it is protected for a certain period from variations emerging within the degrees of freedom that arise within the actual local-space experiences. That is, deviations from this model, i.e., actual particular or living variations, would have to reach a critical threshold of statistical value before the temporally slower modeling process of the 3-1 relation acknowledged their existence in its model.

If we examine this relation within the biological realm, we find that a dominant model enables a stable ecosystem. As Brooks points out, "natural selection and other proximal factors are primarily rate-limiting and not direction-giving constraints" (1988:xii). 3The ecosystem cannot waste its energy by constantly having to adapt to myriad new individual morphologies. Natural Selection operates as a model, as *weak anticipation*, for its model emerges within an external "struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life" (Darwin 1963: 51). "Natural Selection, or the Survival of the Fittest" (ibid:64), can be understood as the "preservation of favourable individual differences and variations, and the destruction of those which are injurious" (ibid:64). That is, natural selection operates as a statistical average of already-actualized realities.

Are these two Darwinian steps of randomly generated individual morphological units and a *post hoc* selection of the 'fittest' of these individuals for reproduction, a valid explanation of the development of a dominant model? As Peirce notes, "the universe is not a mere mechanical result of the operations of blind law" (CP:1.160). Although I agree that a dominant model emerges, I reject the Darwinian explanation of model dominance as due to a 'struggle against other types' and I reject the causality of emergence of the actual model as due to random 'slight variations within individuals'. There are different reasons for the functionality of the model and for the emergence of variation.

The operative strength of the *weak anticipation* model developed in this quadrant is <u>predetermined</u> by means of the measurements of the relation 3-2 in Quadrant III *prior* to the emergence of any individuals using that model. The 3-2 relation of *strong anticipation* will develop a number of viable informational directions that can be used as feasible symmetry-inducing configurations for the development of particular morphologies. The system will, as noted, freely 'select' one hypothetical solution. Again, any of these solutions will be functional in that environment and the

3 We understand the relation of 3-2 as a 'direction-giving constraint'.

other solutions remain extant as ‘virtual possibilities’. The eventual dominance of only one model is due to post-emergence acts such as *preferential attachment* where a spontaneous connection sets up an habitual connection that forms the basis for a dominant model (Barabási and Albert 1999**,** Milo et al 2004, Artzy-Randrup et al 2004,**).** The Barabási and Albert model develops itself as a nondirected network, which develops node by node, connecting each new node to existing ones; the probabilities of connections grows by preferential attachment, i.e., by existent connections and therefore “large networks self-organize into a scale-free state” (1999: 2). Another post-emergence basis for one-model dominance is *proximate cause*, where spatial closeness of existent individuals privileges connections. A dominant referential model emerges, not as an *a priori* determination but as a *post hoc* constructed abstraction of a serviceable and efficient interaction. The key point is that the first choice of this operational design which then develops as a dominant model is made within the *strong anticipatory* processes of the relation 3-2 in Quadrant III, prior to the actual *post hoc* domination of that model.

That is, this relation of 3-1, a process of *weak anticipation*, in differentiation to Darwinian Natural Selection theory, does not have the capacity to solve a problem, only to ensure the domination of a chosen solution. Solving the problem remains with the internal mode of *strong anticipation*, the relation of 3-2. However, this 3-1 measurement constrains the emergence of novel properties among the community, for the existing reproductive aggregate is maintained as the governing model. Peripheral variations may appear but are not admitted to the modeling calculations of the prevailing model and thus, fail to reproduce in sufficient strength to overcome that model.

As a symmetry-inducing action, this relation is vital to maintaining the strength of actualized representations of information, enabling this type of information; that is, the *actual,* to dominate *imaginary* or hypothetical constructs. 4This is an important concept – actual measurements must dominate imaginary measurements; actual morphologies must prevail over imaginary morphologies. Rather than using the common and derogative term of 'machine' to refer to these two external relations of Relation 2-2 and Relation 3-1, we might instead refer to these two relations as 'mechanical' and conclude that no system in our universe, whether physico-chemical, biological or socioconceptual, is exempt nor should it be exempt from the robust functionality of these two mechanical relations.

The Evolutionary Capacities of Anticipation: Relations 3-2 and 3-1

Why are two Relations required for evolutionary adaptive capacities? Why can't the single external Relation, 3-1, of Natural Selection, with a model developed by chance and strengthened by struggle, be the answer? The problem of course, is the stability/plasticity dilemma, where a system develops a functional model, sets up that model within immune protections, and then, meets up with new environmental situations which require a different behavior. That is, how can a system that must retain its integrity, react to environmental uncertainty and demands for novel behavior? How can it take risks? If retaining the 'best solution' model and the process of deriving a 'best solution model' are operating in the same domain, then, this is an irresolvable situation. The current model will rapidly weed out any emergence and retention of other options by the reproductive authority of the current statistical average (survival of the fittest). This seemingly deadlocked situation is dealt with by moving the process of selecting a 'best solution' out of the model's domain and into another domain, the internal relation of *strong anticipation*, of Quadrant III or 3-2.

4 In the social realm, such imaginary solutions are termed 'utopian', which means 'no place'.

The 3-2 process of a genetic algorithm provides a search process which offers the biological system several possible solutions to an environmental adaptive requirement – a solution is offered prior to individual morphological articulation, and any one of these solutions will function. The biological system does not have to waste time and energy in coming up with myriad random unworkable solutions to environmental requirements. If we consider the statistical nature of random generation, we have to conclude that by the time that a functional 'best solution' is randomly generated, the species will be long extinct. It is obvious that "in any highly competitive system – whether biological or industrial – the speed and efficiency of organization, and the sophistication of response to changing circumstances are critical determinants of the systems' survival and success" (Mattick and Gagen 2005:857). The internal domain is an analytic and informed process connected to direct and indirect environmental realities. These suggestions do not threaten the integrity of the current model operating as *weak anticipation* until and unless that current model starts to lose its robustness, until its occupants are threatened by environmental pressures. Then, the internal hypothetical solutions become practical options – and one is selected by the system itself – to become the new dominant model.

The neodarwinian answer to this problem is that the new option appears as a result of a *random mutation* rather than an informed hypothesis. It is a basic axiom of this biosemiotic thesis that such a tactic is impossible. Again – by the time a mathematically random option appeared – the species would be extinct. Biological systems require stronger capacities to react to environmental pressures than mechanical randomness. The biological realm as a semiotic system, a complex adaptive network, uses both strong and weak anticipative semiosic processes. The two basic processes of anticipatory modeling enable the biological realm to promote a diversity of morphological evolution and thus, by preventing entropy, enable a robust complexity.

Two Other Relations

There are two other relations, 2-1 or Secondness-as-Firstness and 3-3 or Thirdness-as-Thirdness. Both are important; both are less visible on the two-dimensional Cartesian quadrant and merit a more intensive treatment than can be provided in this paper.

The full imagination, 3-3, is aspatial and atemporal and can be understood as the universal rationality of pure mind, affirming that the universe, while not designed or in any way *a priori* does self-organize energy within evolving complex, consistent, coherent and integrated networks.

The Interface, 2-1, a borderline relation, functions as an initial condition (origin or without the constraints of memory) at the point of intersection of the Y and X cuts of differentiation. It operates in local space – both isolate and closed - and in both present and perfect time. It has properties that are distinct, via its organization within Secondness, and that are vague, via its organization within Firstness. The interface can function alone or can be linked to any of the other five relations. We will not explore these aspects in this paper.

The chaotic or strange attractor is the relation of 2-1 alone. It operates without links in which case the measurement acts as an initial condition of differentiation in a state of high excitation. It is highly volatile and expansive (its internal spatial and present temporal nature) and confrontational (its disconnected external spatial and perfect temporal nature). If it does not find/attract symmetry inducing measurements it will dissipate. It can be understood as a relation of anticipatory exploratory freedom and is more frequent in complex systems. Its two different modes of measurement are continuously entwined in their attempt to link relations; therefore, external actuality is always exploring the new informational potentialities within internal vagueness and vice versa, and symmetry is always exploring asymmetry and vice versa. Within Peircean terms, it can be understood as an act of ‘prescission’, which “is always accomplished by imagining ourselves in situations in which certain elements of fact cannot be ascertained" (Peirce CP 2.428). It is a highly charged anticipatory relation that focuses “attention to one element and neglect of the other” (Peirce CP 1.549).

Conclusion: Biological Semiosis

What does this complex morphological architecture of Six Relations provide? First, the system provides an ongoing freedom of emerging morphological formation, for the undefined nature of internal energy within the second quadrant (1-1) provides an openness to diverse informational organization. The Interface relation of 2-1, with its capacity to pick up this input, define it as origin (i.e., without the constraints of memory) and link that unorganized content to the organizational processes of the other relations, enables novelty and therefore, both evolutionary adaptability and a diversity of individual instantiations in the relation of 2-2.

The importance of anticipative control over incipient morphology in our semiosic world is shown by the fact that there are three relations that provide this function of reflexive analysis. There is the historical memory of the accumulated values of the successfully articulated collective (3-1, a model, the statistical average); an example is natural selection, which focuses on and privileges an actually existent dominant typology. There is the networked memory of virtual propensity (3-2), which functions as an exploratory search engine and permits tacit links which may never be articulated but which remain available for future morphological attempts at formation. Finally, there is the memory of rationality (3-3), which lies, I maintain, at the basis of life, understood as the increasingly complex yet pragmatic logical ordering of energy/matter.

This morphological architecture, made up of six relations integrating different modes of space and time and a triadic semiosic morphology, provides physical and biological systems with the capacity for anticipation. The system can self-direct and examine and evolve the mediative rules that it uses for morphological activities. It is the properties of the anticipative semiosic relations that have enabled the biological realm to dominate our planet.

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