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Diminishing Dualism:
Gregory Bateson and the Case for Heterarchy

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The Cambridge (UK) Declaration on Consciousness, proclaimed on July 7, 2012 at a Conference on Consciousness in Human and Non-Human Animals, states that there is natural intelligence, and by implication, mind in nature. The declaration marks a significant shift from portraying animal agency through a mechanistic lens. Many years before Bateson had argued that the key to eliminating animal-human dualism lies in an understanding of communication processes, that is, recognition and investigation of an implicate order without which animate existence would not survive. The first part of this article will discuss how communication yields real world patterns to which natural intelligence responds. Bateson is supported in this argument by Ruth Garrett Millikan, the founder of Biosemantics, who also demonstrates how the grasping of natural signs in recursive relational patterns generates meaningful interactions. The second part of this paper concerns mapping of multiple levels of organic existence and how a notion of heterarchical order is linked to communication processes in and between these multiple levels. This important switch of reference stems from Bateson transposing Warren McCulloch's ideas about distributed memory. Bateson transforms McCulloch's technical (computer-oriented) insight into a means for mapping redundancy in levels of communication feedback. Recent publications by scholars influenced by Bateson's approach explain how communication processes coordinate non-transitive distribution of multiple layers of organization into heterarchies rather than hierarchies (Bruni & Giorgi, 2015, 2016). They show why the importance of the notion of heterarchy, with its dynamic synchronicity, has grown in recent years, especially in respect of the way in which genetics interrelates to microbiotic, epigenetic and environmental levels of organization. In addition, Nomura, Murunaba, Tomita, & Matsuno (2018) argue that synchronicity requires an altered understanding of temporality in the plant kingdom. An important addition to our understanding of time concerns the inter-subjective timing of organisms, as they negotiate localized coordination. The perspectives of inter-subjective time is one which extends beyond its usual correlates of subjectivity and objectivity, and modifies these perspectives that, until now, have fostered dualism. A final consideration is Bateson's move to diminish dualism through an understanding of holographic coding. Its resonance of downward causation permits communication to be informative in the whole econiche, so permitting re-entry of ecosystemic form in order to resist fragmentation and competition among its parts (Harries-Jones, 2016a). Wohlleben (2016) provides an empirical example of this Gaia-like performance.
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Gregory Bateson challenged the prevalence of dualism in western science in several dimensions, especially its views of the separation of mind from body and of bodily organization inside separated from the outside, as, for example, with Bateson's definition of *organism* as being organism plus environment. Dualism in western science and western philosophy accepted that animal behavior is one of instinct particularly among the lower orders of animal life. Materialist science claimed that few animals have the mental capacity to use predicate knowledge, especially those

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near the bottom of the ladder of evolution: Fish, for example, live their lives expressing little more than robotic interactions (Balcombe, 2016). At the very bottom of the ladder were organisms such as bacteria and viruses. Despite their constant engagement with each other over evolutionary time, viruses were considered to be something other than living organisms (Witzany, 2012). None of these organisms nor animals could meet the criteria of rationality and intentionality that constituted consciousness and intelligent behavior. Any challenge to the contrary provided by farmers, hunters, pet owners and the like was merely anecdotal evidence introducing alternative propositions about *vitalism*. Like Bateson, one astute critic Ruth Garrett Millikan (see below) deplored the inherent physicalism in this approach, and its truncated view of actual processes of perception and natural intelligence. The study of intentionality and meaning in animal life must begin again with very different premises, she maintained (Millikan, 2004).

Perhaps the ultimate rebuttal to dualism requires matching the realm of life, that is, organic molecules, to the realm of non-life, that is, particle physics, and, as the anthropologist and biosemiotician Terrence Deacon states, Bateson never tackled this question (Deacon & Sherman, cited in Hoffmeyer, 2008a, p. 59). While Deacon's own work examines the domains between particles and molecules, and their significance for evolutionary theories, Bateson's epistemological stance held that life in the form of organisms, non-human animals, and humanity (creatura) arose out of the ground of non-life (pleroma), more correctly, out of a world in which the observer is unable to attribute any qualities to it.[2] It is surely valid to contest studies of dualism through tackling basic characteristics crucial for the survival of living systems. Bateson held that many of life's transformations are ordered through sensibility derived from communication and Bateson presented communication as an implicate order, one which certifies the existence of mind and natural intelligence as the very base of sensibility in nature. It was a very different approach to that of forerunners in the 1940's, like Erwin Schrodinger, whose book *What is Life?* was based on an examination of the physical aspects of cells and molecules, comparing their respective measurements to aperiodic crystals.

Bateson maintained all sensibility, other than the physical aspects of reception through seeing, hearing, smelling, or tasting, required a co-expressive aspect alongside physical circuits, and also required a second level of sensibility which is that of contextual meaning. This two-level affair provided meaningful news about animal relationships. Second levels could be classified as meta-level signifiers of signals. At the time he introduced this notion, it appeared to be academic speculation, but today the reality and importance of *meta-signifiers* of information have become well known through the activities of police departments and secret services trolling communication among the public at large, and then drawing conclusions from algorithms of digitized data. How well their alogrithms of digitized information are

2. A shortened version of this article was presented at the 18th Annual Conference of Biosemiotics at the University of California, Berkeley in June 2018. I wish to thank Naoki Nomura and my reviewers for their comments on my lengthened and revised paper.

sufficient in providing appropriate meaning is itself problematic, for communication is many-leveled.

Bateson showed how and why communication cannot be understood as a material manifestation alone, and why all communication requires meta-signifiers. The hidden-from-view aspect of context in communication contexts often arises through a type of Baron Munchausen performance. That is to say contexts are generated through repetitive communicative interactions in localized contexts. For animals, as for humans, the meaning of a communication is embedded in its repetitive occurrence. Much message sending and reception seems to mirror the act of the noble Baron pulling at his hair to check that everything is in order to proceed onward and upward.

Bateson's major publication, entitled *Mind and Nature. A Necessary Unity* (Bateson, 1979), argues that mind is at the very base of animate existence. It took thirty years, until July 2012, before a major scientific meeting acknowledged similar positions and broke from the norms of what Millikan had termed *meaning rationalism*. The Cambridge (UK) Declaration on Consciousness (Low, 2012) stated that non-human animals have the neuroanatomical, neurochemical, and neurophysiological substrates of conscious states, and that the absence of a neocortex does not appear to preclude an organism from experiencing affective states, along with the capacity to exhibit intentional behaviors. In short, it states that there is in the animal world both feeling and natural intelligence. By implication, there is mind in nature. Even then, the Declaration on Consciousness left fish out of its discussion, and the case for fish intelligence had to be put on hold for about four years until the appearance of a Scientific American publication *What a Fish Knows* (Balcombe, 2016).

When the Cambridge Declaration speaks of sentience it employs the term *consciousness* as its guarantee of sentient existence. Yet Bateson always found the use of this term much too vague, and often used as a cover for what was unknown about both meaning and intentional response. That part of neurophysiology devoted to consciousness, or conscious interpretation, was in Bateson's view a relatively small component of mind. Non-conscious neurophysiology is self-organizing, and it is the non-conscious requirements of neurophysiology that maintain our day-to-day existence. Consciousness on the other hand may invoke an individual organism's intentional movements, but is no guarantee of *self-hood*, because very often the intention movements of the conscious individual are carried out in conjunction with others. Hence consciousness per se does not guarantee the ability of an isolated self 's ability to reflect on self-hood, because such awareness of self-hood is usually accompanied through communication with others.

Like Howard Pattee, he rejects the overall appraisal of consciousness as the synonym of mind or as the synonym of subjectivity, and like Pattee (2015) he sought to evoke an epistemic cut at the very base of natural intelligence rather than defining what is or is not consciousness emanating from the cognitive branches of human consciousness. Later we shall see how recent writers support Bateson's view about intentional or purposeful activity.

Natural Signs

If mind lies at the very base of animate existence then, Bateson argues, western science requires a re-orientation of up and down on the evolutionary ladder when dealing with feeling and natural intelligence. In other attacks on dualism he would challenge separation of inside from outside, especially on how the inside mind extends to the outside while outside impact of behavior might, over time, extend to the inside. His reordering conceptions always concern aspects of *up* and *down*, *centre* and *periphery*, or *part* and *whole*. To foreshadow later discussion, his case is that sensibility is activated as and when natural intelligence responds to pattern formations which are, in turn, derived through everyday perception of signs, or through sign-mediated communicative interactions. These patterns are not an isomorphic map of the territory that they survey, far from it, Bateson was a non-Aristotelian: The map is not the territory, but is instead a representation or idea of territory (Harries-Jones, 1995). Generally, the patterns evoke relationships and these relational patterns in turn generate patterns of feedback in relationship which are important aspects of meaning.

Bateson associates pattern recognition with trial-and-error learning. He also associates pattern recognition with analog and digital coding (Hoffmeyer, 2008b). The means of distinguishing signal from noise and then rendering the signal as meaningful lies in the joint presence of dual information codes, that is, digital and analog. The digital code is represented in the discrete coding of Shannon's information theory. The semiotic, or meaning, of the message arises largely through the continuous variability present in the analog code. Analog process generates meanings out of everyday occurrence in communication. Hoffmeyer and Emmeche founded biosemiotics, the study in biology of signs and their meaning, and the journal of the same name, *Biosemiotics*. They agree with Bateson that analog information processes carry the temporal continuities and variability of the message to a responder's sense of expectancy. Thus analog coding carries movement of information in a time-oriented form. Expectancy arises through anticipation of recurrence of events or recursive communication, and analog communication carries news from somebody to somebody, or from some body part to other body part in either resolving expectancy, or creating surprise. Hoffmeyer himself believes that such processes give rise to semiotic subjectivity (Hoffmeyer & Emmeche, 1991).

Analog coding is a significant part of awareness when sound clarifies relationships among animals—either friends or foes. The temporal string of events may occur in a few moments of time yet the grasping of pattern can be quite complex, as, for example, with human expectations anticipating the phrasing of a song. A second level meaning, that of surprise or expectancy, emerges together with the flow of physical biochemical response, since all living organisms are anticipative both to any movement about self and to interrelations with other. Bateson defines this as an aspect of the context of any relationship between message sender and message receiver. For all living organisms, this derivative of pattern recognition can become more complex through repeated interaction.

Ruth Garrett Millikan, the founder of *biosemantics*, develops appraisal of this growing complexity, beginning with how it is possible for an animal to recognize a sign through the medium of recurrence (recursion) of a natural sign. Natural signs occur in a wide variety of conditions and are registered through differing sensory modalities in a run of a day. Meaning arises among animals through trial-and-error in communicative interaction, while interpreting feedback is also an important aspect of establishing context. In any communicative system an interpretable signal enables other organisms to cooperate as cooperative member of a common interpreting system. An example is a clucking hen and listening chick, or a pheromone distress signal initiated by insects or even a plant. Such communication is intentional activity evoking cooperation and coordination.

From her notion of a natural sign, Millikan proceeds to explain how use of natural signs are *apt for use* by sign-users. An intentional sign is not just an iconic representation of some aspect of an animal's environmental domain; it is also a sign for some kind of interpreter and some kind of interpretation. No one can doubt that when a hen clucks it has a definite effect on her chick. The cluck call is not merely a signal of food that is present and available, but like any natural sign, is a locally recurrent sign that is intentional in the common sense meaning of that term—it calls the chicks. As with all intentional signs, it induces cooperation within interpreting systems, in this case a clucking hen and listening chick. However, its relation to these affairs must keep on being specified in local domains, so yielding the necessity for repetition in all communication (Millikan, 2004). Constant repetition of response to the natural sign of a thing can also propose a pattern of events that enables an animal to learn how to track connections in events.

Bateson went on to show how *abduction*, rather than induction or deduction, enables apprehension of difference at many levels and in many contexts. The grasping of difference is grasping a fundamental unit of information. In his classic essay, "Form, Substance, and Difference," he argues that mental worlds are realms of difference in "maps of maps of maps ad infinitum" (Bateson, 2000, p. 461). He continues in a footnote, writing,

> or we may spell the matter out and say that at every step, as a difference is transformed and propagated along its pathway, the embodiment of the difference before the step is a "territory" of which the embodiment after the step is a "map." The map-territory relation obtains at every step. (Bateson, 2000, p. 461)

Differences yield second-order level patterns of *similarities of difference*, and the *difference of similarities*. Such clusters of differences become compressed, and further abstraction enables learning about clusters of difference (contexts). As we shall see below, perceptual recognition of such clusters occur through rhythms of repetition in a surround of circular communications, and through synchronicity.

In his earlier writing he developed his ideas about clusters of difference with respect to logical types, a conception borrowed from Bertrand Russell's explanation of logically grouped patterns (types) generated through induction and deduction. In his

later writing he was to switch to C. S. Peirce's less determinate notion of abduction, as a means for the grasping of differences in pattern. Abduction is closely related to guesswork as a means for resolving abstractions of perception. Abduction enables apprehension of difference in patterns. Peirce's notion of abduction provides an epistemic solution to an understanding of how a second-order level of communication is drawn from patterns of similarities of difference and the difference of similarities. It can also lead to formation of the hypothetical. Further abstraction of pattern occurs when clusters of differences enable trial-and-error learning about these second-order clusters of difference (contexts). Of course, such perceptual appraisal carries with it no guarantee of definitive outcomes, for these ordering properties are only partly related to a physical base, or to any measurements in time or space.

Perceptual appraisal is therefore different from conscious conceptual appraisal. Both Bateson and Millikan hold that the apprehension of natural signs lies somewhere between the propositional structures used by humans, and random trial-and-error behavior. For example, Millikan argues that a squirrel does not conceptualize its purpose when trying to jump from a branch in a tree to a place where nuts are stored, nor does it ever make strict logical inferences about this situation. Rather, the squirrel studies the perceptual situation at length, first from one angle then another, and experiments through trial-and-error until it sees a way it might try to jump. Its own perceptions enable a sort of perceptual trail about behaviors in occurrences or states of affairs which may or may not yield distinct, classifiable conclusions (Millikan, 2004). Yet perceptions may propose that in this instance the jump is doable, and this jump will be either a successful guess or a mistaken guess, which may result in a fall.

Success at appropriate *tracking* is an important means through which learning takes place. Tracking is a supporting condition which informs the presence of events that can be acted upon or acted out in cooperation with others. Perception of these events requires memory of the sequences of events that previously led to their success. Millikan reports that while some animals are quite limited in their recall of these sequences, others are able to construct a representation or map of a territory that they have explored, and are able to remember a very large number of places in which they have cached food. Some even seem able to map a general purpose spatial layout of their territory, and are able to use this spatial representation in relation to more distant places in which they undertake activity. In most cases, these semantic mapping functions are not linear, so *creatura* (Bateson's term) can often recognize distal signifieds without recognizing all or any of the signs on the route. There is always a means through which a semantic mapping can enable a sign of a sign to evoke a more distal affair. This, of course, is a human capacity as well—for example, human beings register only digital patterns on our retina, but seeing through these digital patterns, are able to perceive colors and shapes.

In Bateson's later writing, natural intelligence draws its categories of comparison from the derivatives of pattern, such as patterns of affection, patterns of attraction, patterns of fittedness, but always pattern that evoked other patterned behavior and that spills over varieties of relationship. A natural sign can give rise to awareness of

distinctive perception-action loops or feedback, which in turn yield injunctive rather than descriptive communication. Yet appraisal of pattern connection in natural intelligence does not follow principles of isomorphism, reversibility, identity and hierarchy present in conventions of mathematics. In effect, natural intelligence does not need inductive, nor deductive reasoning, nor statistics from data sets, to resolve the means through which it grasps meaningful patterns.

Heterarchy

Bateson's reversal of upwards and downwards in the ordering of causal aspects of natural intelligence leads him concurrently to an appreciation of heterarchy, or a non-transitive understanding of order. *Heterarchical* means not hierarchical, that is to say, not controlling the constraints of layers fixed in their orientation to each other in which each upward constraint is always more abstractly determinative than the one below. Instead heterarchy embraces the idea of multiple layers that are adjustive to each other. His emphasis on non-transitive layers or levels that coordinate with each other was a result of his association with Warren McCulloch, a friend and colleague in cybernetics.

Warren McCulloch was a notable innovator in artificial intelligence and partly responsible for conceiving how computers of that time could be redesigned to employ what A.I. termed *distributive intelligence*. Subsequently McCulloch began to map computer circuits to simulate patterns of choice in neurophysiological circuits. He soon came to realize that computer programs at that time assumed that when it came to a study of preference or values, the programs would register a scaling of preference or choice in which each step in the levels of choice yielded a ladder of preference and/or value that could be measured and quantified. Moreover, the construction of that ladder was always pursued through the assumption that one end (the top end) is always preferred to all others. The top of the ladder simulated a hierarchy of choice with a clear *summum bonum.* McCulloch noted that a summum bonum approach accorded strongly with preferences in religious practices, but believed such a hierarchy was far too constraining to represent all the choices available in daily living (McCulloch, 1965).

He required computer design that would accord with an alternative dynamics, the dynamics of circular forms embedded in a network that permitted non-transitive levels in choice or preference, with simultaneous sequencing and with high redundancy. The major problem of such a design was that non-linear *looping* in such a network would always threaten to create entanglement of differing values and the loops of which likely would result in outcomes of paradoxical choice. Later, Bateson observed that continuing repetition of paradoxical choice in human affairs would lead to mental pathology. From this insight he began to construct ideas about communication paradoxes as symptoms of mental pathology, or double bind.

McCulloch found an apparent resolution permitting the introduction of crossover patterns in the initial computer design when combined with distributed memory, rather

than a single memory system. McCulloch's resolution required the introduction of what he called a *diallel*, or pathway through cross-over patterns. Diallels took the form of side-by-side loopings alongside each other but which avoided entanglement through differing time series. The design of side-by-side loopings permitted the possibility of placing memory or multiple memories within the loops in a heterarchical rather than hierarchical series.

Using the term *heterarchy* required elaboration of the when's and where's of pattern occurrence, and how patterns are connected recursively to each other at many levels and in many contexts (Bateson, 1968). It also required a greater knowledge of algebraic topology to enable him to convert the implementation of McCulloch's notion of side-by side looped redundancy into the terminology of many-leveled communication. This knowledge of digital design Bateson never achieved, though he approached this idea in his final publications, especially in his posthumously published *Angels Fear,* where he argued the analog case, rather than the digital one, namely that good stories and good metaphor could repair paradox and restore mental balance—the balance inherent in the Arabic term *al jabra* (Bateson & Bateson, 1987).

An understanding of how it is possible to store traces of experience (memory) on many levels in a heterarchical manner completely altered Bateson's understanding of the term *code*. His prior conceptions of code derived from definitions in which elements are organized in encompassing, mutually exclusive symbols, as in his discussion of logical types. But in heterarchical formations, code is grasped in network terms within a non-hierarchical order. This, in turn produces a qualitative shift from coding objects to organization-oriented aspects of any coding sequences. As a result code processing shifts from a singular array of interactions to concentration on multiple sequences simultaneously engaged with each other. From this emerges a startling idea that circularity in preference actually demonstrates a consistency in a higher order of entanglements, rather than giving rise to inconsistencies of value anomaly. In effect, value anomalies are only anomalous when encased in hierarchical orders. The presence of looped cross-overs leads to an understanding of a second-level ordering of meta-stability that western philosophy had not contemplated (Stark, 2011). Equally remarkable is that the idea of recursive (multi-looped) organizations—that is, heterarchy—permits a new understanding of the interrelation of qualitatively different domains. In short, McCulloch's conception of redundancy enables an altered study of the interrelationship of domains that were, originally, considered to be dualistic. Bateson could now feel more confident in defining the unit of any living, biological form as organism plus environment or as exhibiting an ecology of mind.[3]

3. Bateson kept on using the term *hierarchy* in his publications, while knowing that this term did not stand up properly to his own analysis of levels and meta-levels in communication. He knew that communication relations are always heterarchical, especially in human family circumstances. When challenged by a correspondent on what he meant by *higher logical types* in communication, that is an HLT—a higher hierarchical order, he acknowledged that he "had sinned" in not making clear that he was always talking about non-transitive ordering. A lengthy discussion of this admission is available in my book *A Recursive Vision* (Harries-Jones,1995, pp. 246–251).

Synchronicity

So far the discussion of heterarchy has concerned the importance of networks of communication incorporating internal-external interactions both of computer models, and of creatura, as compared with treating inside and outside separately. Yet the latter was the general approach, one which encapsulated internal organization of the body and supported the separation of environment from body, and body from mind. Internally the notion of the Weismann barrier, separating genetic agency from environmental agency in the overall system of heredity, created another inside/outside separation. The latter dualism followed on from Darwin's proposal that adaptation occurred largely as a result of the quasi-mechanistic and statistically supported dynamics of natural selection, though there was also room for the effects of randomness through internal genetic mutations. Bateson's lifelong friend, Conrad Waddington suggested in the 1960s and 1970s that in some circumstances epigenetic factors, i.e., outside or environmental fluctuations, could also affect the gene through long term genetic assimilation of environmental changes. The acceptance of epigenetic alteration of the genome began a long term revision of the gene as the singular template of heredity (Waddington, 1957; see Harries-Jones 2016b for Waddington-Bateson exchange on epigenetics).

Since that time the whole question of genetics as template of life has undergone a radical change. Popular knowledge, may still understand current genomic research as enabling a reading of the book of life, but, as a recent volume of *Biosemiotics* (Bruni, 2016) shows, biologists are now able to distinguish at least four different levels as being involved in ongoing processes of heredity; the four being genetic, epigenetic, behavioral and symbolic (Jablonka, Lamb, & Avital, 1998). In addition others argue that there is a fifth level, that of response to microbiota, a level which is acquired from the mother through the vaginal canal at the time of birth of offspring. Others emphasize a sixth level of reciprocal causation that which occurs between organisms and their environments.

We find Švorcová pointing out that in our current knowledge, human inheritance can occur from germ line to germ line (genetic, epigenetic), from soma to germ line (epigenetic), from soma to soma (symbiotic, behavioral, cultural or symbolic), or from soma to soma via the external environment. Švorcová's conclusion in the Bruni volume of *Biosemiotics*, is that "here is a mutual construction of developmental, ecological and evolutionary niches so that a vastly entangled interspecific community arises out of these multiple flows of information" (Švorcová, 2016, p. 340).

At this point the question arises of how these multiple flows are organized. Are these multiple flows of information considered to be physical events? Or are they informational flows and if informational flows, are they circular? And how do they avoid incompatibility in information preference? If they are physical events, then Luis Bruni argues, their synchronicity or simultaneity can only occur within a very narrow spectrum of causality, with precisely defined coordination outcomes. Most particularly, outcomes must occur with no possibility of error. If, however, the

simultaneity of events are indeed ordered through sign-mediated or semiotic information, then the synchronous circular ordering process permits possibility of choice among coincident processes.

Any choice needs to guard against error, but there are ways and means of avoiding the drastic results of mutually exclusive choices inducing paradoxical outcomes. Bruni and Giorgi note:

> Several examples testify how incompatible alternatives are solved in nature. For instance, to prevent inbreeding, many angiosperm plants are endowed with the capacity to reject incompatible pollen and avoid self-fertilization. This decision-making process is made naturally irreversible through the (active) inhibition exerted by programmed cell death. (Bruni & Giorgi, 2015, p. n/a)[4]

Overall, says Bruni, this new understanding of inhibition of incompatible alternatives in the various levels, genetic, epigenetic, symbiotic, and so forth, has led biologists to give increasing importance to processes of synchronicity, coordination, coincidence, binding and integration in biology and cognitive neurosciences. And this, in turn, has resulted in two major perspectives discussed in systems biology and network studies about synchronicity and coincidence detection. The first treats complexity as a first-order, emerging process, and it pursues an understanding of synchronicity, coordination, binding and the like in terms of a first order process only. It postulates systems and meta-systems in a modular-hierarchical architecture and elaborates second-order process through narratives of hierarchy. The second, an informational and semiotic approach, allows for the interrelation of qualitatively different domains and levels of organization occurring in both first and second-order processes.

A sign-mediated or semiotic approach, insists on a heterarchical architecture that allows for the interrelation of qualitatively different domains and levels of organization in a second-order-emerging process. In allowing for a second-order set of constraints, this approach permits an increase in semiotic freedom as the system grows in complexity. As with any semiotic approach complexity can invoke both digital and analog codes to enable responses that are indeterminate probabilistically, or in an epistemological sense. Bruni and Giogit maintain that such indeterminism in complex systems is ontological as well.

What triggers a selection from this array in response-repertoire is an informed assessment of context by a digital-analogical consensus, a proposal first put forward by Bateson but considerably extended by Hoffmeyer and Emmeche (1991), Bruni (2007), Hoffmeyer (2008a), and Bruni and Giorgi (2015). That is to say, there is a continuous process of coincidence detection in which an indefinite set of digital messages expresses presence/absence, activation/deactivation from different domains and levels of the heterarchy as it binds with an analogical message. And through recognizing similarities and differences in pattern forms, together with interpretation of context, the binding process creates an appropriate response. Such an integrated

4. The author had access only to an unpaginated version of the published paper provided by the authors.

representation may in turn be from a digital representation which combines with other analogical signs into a second-level combination (context). In this way the new analogical sign can also be a digital representation interfacing another domain in a still more complex analogical sign.

Grasping the significance of these several levels in a heterarchical order brings us back to the notion of pattern and how extrapolation from patterns enables organisms to derive their own meaningful existence, or, to use the adventurous terminology of the Cambridge Declaration, *consciousness*. To quote Švorcová: "Organic memory is distributed; it stores its traces of experience on many levels and is restored in every generation by various members of a vastly entangled interspecific community" (Švorcová, 2016, p. 340). The quote denotes a qualitative shift from coding objects to one of organization-oriented aspects of coding sequences. Instead of undertaking bit-by-bit kinetic coding, the shift that Švorcová identifies requires an understanding of patterns in multiple sequences simultaneously engaged with each other.

In an earlier paper, Bruni and Georgi (2015) spelled out in some detail how the older approach to hierarchical ordering treated information processes as kinetic reactions. That is to say, the older approach applied logical operators to informational processes in biological order as if each informational process is biochemical. They point out that the older models treated molecular movements as synonymous with transport of materials, yielding single step-like levels of hierarchy with deterministic (or quasi-transitive) ordering that failed to distinguish the multiple levels of contextual co-ordination. Even today models in artificial intelligence continue to express a similar view of biological processes. Their data and algorithmic structures avoid multi-scale modeling. All become reducible to one and only one comprehensive operational universe of discourse, a single *contexture* molded within a transitive hierarchical order, in comparison with the *polycontextures* of heterarchy. Yet this is an odd choice "since no single factor can account for the complexity of a casual chain in any biological process … [and], it makes no sense to disentangle a multi-causal chain, if every contributing factor may be equally relevant for triggering its activation" (Bruni & Georgi, 2015, p. n/a).

Synchronicity, and the causal consequences of coincidence and synchrony, occur in heterarchies as a result of the interrelation of qualitatively different domains, or, to borrow a term from von Goldhammer and Joachim, as a result of polycontexture (Goldhammer & Joachim, 2007). By relating different qualitative domains or contexts, heterarchical order also permits the emergence of larger interpretative schema with each level. For the meaning of information requires not only two levels of organization, the physical, and the meaningful derived through context, but also perceptual depth in variety—the process of context related to context. Bateson, somewhat earlier, had named such results of increase of scale *larger gestalts* (Harries-Jones, 2016a). As Bruni and Giorgi point out, since biological process is always a multi-causal chain, every contributing factor may be equally relevant for triggering its activation.

The contextual condition that draws from the coincidences of the co-factor, Bruni and Giorgi (2016) argue, results in larger schema relationships that make synchronicity highly significant in causal terms, larger even than the one that Bateson draws about a greater perception of the whole. These relationships provide a scalar increase in the range of semiotic freedom. In a second article in the same volume, Giorgi shows in detail that while prokaryotes control gene expression primarily at the transcription level, eukaryotes have evolved more sophisticated control mechanisms at the epigenetic, post- transcriptional and translational levels. This shows that organisms have gradually evolved from an original simple and reversible gene-to-enzyme hierarchy to a more complex organization in which gene-to-gene relationships are irreversibly regulated with a higher degree of freedom, that is, with a wider range of options in regard to different control levels (Giorgi & Auletta, 2016). Given space or room to ensure inhibition of incompatibilities, the new interplay and coupling between factors across different levels and layers displays what they term *proto-cognitive/volitive processes* (also labeled sometimes as *proto-purposive* and *proto-subjective*) as an aspect of their semiotic freedom.

Other processes of selection and choice, are through a process of re-entry rather than through developmental processes. The constraints that occur in re-entry are time oriented. They occur through the presence of oscillations and synchrony across multiple reciprocal paths that are not pre-specified or determined a priori, but rather acquired through experience. Reentry, therefore, is one instantiation of coincidence detection in temporal integration and coordination of multi-level domains, such as those which are local and those which are global (Bruni & Giorgi, 2015).

Timing And Multiple Time Codes

If we are not able to consider different degrees and kinds of subjectivity with lower and higher levels of semiotic freedom, then, the advent of subjectivity would be a radical evolutionary leap hard to justify: “Thus subjectivity, as an emerging novelty, must be preceded by different degrees of proto-subjectivity (and its cognates: cognition, volition, semiotic freedom, purposeful-behavior)” (Bruni & Giorgi, 2015, p. n/a).

Nomura suggests that there is another way of coming to an understanding of subjectivity. The premise of Nomura is that time itself is a semiotic construction. Organismic perception marks its own agency in time, and the forms that it takes are not exclusively tied to subjective and objective perspectives. Most specifically there is a time domain which occurs as an aspect of incessant mutual corrections and adjustment in synchronicity. In effect, local synchronization displays another temporal marking to Bruni and Giorgi’s notion of subjectivity which they name *inter-subjective time* (Nomura, Murunaba, Tomita, & Matsuno, 2018).

In Nomura et al. the discussion switches from animals to plants so that here subjectivity and its correlate, inter-subjective timing, concerns concordance with others in plant rhythms. As Nomura examines the situation, the on-going updating that

these rhythms require is a consequence of the activity of the *negotiators* as they engage with one another in local acts of synchronization. Since other authors have recognized plants as engaging in many varieties of mutualism, both direct and indirect (Ulanowicz, 1997), Nomura's terminology of *negotiators* is no longer surprising. Nomura argues that inter-subjective temporality, differs from the usual meaning of subjective time—which marks first person agency—because the sense of time, or timing, refers to negotiation with others. The usual aspect of subjective time in the human case, is that it operates through memory and operates through a self in the present tense in relation to own singular activity, but Nomura's inter-subjective temporality is a temporal dimension of coordinate participation.

Nomura and his colleagues call the subjective sense of time A-time, while they name inter-subjective temporality, E-series time. In E-series time a second agency negotiation is always involved. Inter-subjective time also differs from objective time which lies in the domain of observers. Though observer time is able to distinguish before and after events, observer time has no specific verbal tense, unlike the immediacy of inter-subjective temporal activity which can refer to past, present and future.

Inter-subjective temporality in plants highlights inevitable inconsistencies in synchronicity. Participants' coding of inter-subjective coordination creates alignment and tries to maintain alignment interactively in the local setting between second person negotiators. Nomura notes that if one negotiator's movement in local synchronization turns out, retrospectively, to disturb the other negotiators' movements, this requires an inter-subjective negotiation to enable revision of interference. Inter-subjective negotiation among participants in the immediate present also creates a pattern for future stability. It is anticipative. Causal effects of incorrect sensing likely degrade present activity, leading to future breakdown. Another way of registering participant sensing of mistakes is to recognize that all mistakes of negotiated inter-subjective time entrain the future tense into present time and are, in this respect, *retrocausal* (backward causative) in respect of any feedback runaway.

The means by which synchronicity continues to be attained is through changing the *punctuation* of negotiated events. Punctuation is a concept borrowed from Bateson. The term *punctuation* is carefully chosen in order to convey the continuance of any negotiated boundary. This activity of altering punctuation has no direct reference to the push me or pull you of mechanisms of energy either physical or organic; instead it conveys alteration in meaning and signification. Nomura notes that Bateson's terminology about altered punctuation appears in his first book on communication (Bateson & Ruesch, 1951). And while the topic of inter-subjective negotiation remained a constant theme in his writing, it was only later that he gave a specific example of retrocausality that matches Nomura's presentation of re-punctuation of communication. Even then Bateson's discussion of bell ringing (Harries-Jones, 1995), remains an exterior analogy to Nomura's interior set of events. Bell ringing is a feature of the larger Christian churches throughout the world, especially in western Europe and the Americas. It is a means of announcing the call to

prayer. The larger churches have members of the congregation who work out sequences for pealing of the bells, and when they and their colleagues pull on ropes in the bell tower of the church, the peals signify "get ready for the church service." To ring the changes, bell ringers begin by agreeing to ring a known order of an attractive peal of the bells. Their choice is arbitrary, but once chosen they then negotiate an order of transformation of the bell peals. The initial, plus any transformed ordering of the pealing bells, create a *sound-frame* or pattern of which each module is a part. The first order of transformation is then applied to the second order of pealing in order to generate a third, and so on, until successive transformations bring back the series to that in which the peal of the bells started. Bateson comments: "The resulting music is, in fact, the product of a successive group of theoretical operations. It is a sequence determined by a purely relational recipe" (Bateson quoted in Harries-Jones, 1995, p. 181). Yet the pattern is timeless, for the pattern is the thing.

In his example of bell ringing Bateson was attempting to use the topological constructs of group theory instead of his former notion of logical types. He refers to bell pealing as suitable example of a relatively simple performance that yields a theoretical operation. After the careful description of modularity in patterning, such as in bell ringing, topological demonstration of modularity provides an entrance to the study of part and whole sequences, and patterns of their interconnection. When the modules come together, the overall pattern formed is distinctive from each of its individual modules, yet variety of forms present a patterned unity in the modularity of its parts.

The only problem, he maintained, was that the symbolic logic of group theory was limited in its range of examples of how this shift occurs, that is to say, how initial relations—the relations of a timeless and non-paradoxical world—become adjunctive to the temporal nature of causal sequences. What was clear in this theoretical operation is that a comparison of recurrence in redundancies incorporates two steps. The first step is to grasp the relation between part and whole (a relation comparable to level and meta-level). This is followed by a second comparison which contrasts the redundancies of part and whole to the environment of the whole. He notes that two part contrasts usually revolve around comparison of subject and object. The second step then provides a three term contrast. Redundancy expands the contrast to a third domain where perception of part or of whole is compared to a second-order set of processes about the formation of wholes. A previously hidden third term begins to appear in the time interval of the contrasts and comparisons of redundancy. Contrasts emerge. Patterns of redundancies learned in one particular context can now be compared to patterns of redundancies discerned in the formation of the whole. In this way formation of the whole creates a feedback for participants in which the pattern of the whole re-enters the part.

While Bateson did not provide an example of this, the concluding paragraphs of this present article may give significant clues as to how observers approached analysis of bell-ringing examples of redundancy in the hidden life of trees. The re-entry patterns that emerge from the study reveal several processes connecting the whole

forest to individual trees, processes that are justifiably termed *hidden* from normal view.

Nomura and colleagues introduce a type of network-feedback pattern related to circadian rhythms in plants. They call this C-series time (Nomura et. al., 2018). C-series time helps explain Bateson's puzzle expressed above, that is how coordination through bond making may have occurred originally among organisms inside the body. They point out that bond-making can occur through the formation of a loop or circuit through sharing an orbital electron. For example, a molecule can give signs not only for a desired material exchange but also to precipitate bond-making.

The C-time series is timeless and a common example of C-time is as an aspect of circadian rhythms: "In a plant body, most cells generate their own daily rhythms using a gene circuit and behave as cellular circadian clocks" (Nomura et al., 2018, p. 73). In itself, the C-code is an abstract pattern, not instrumental, nor target oriented. C-series time codes neither produce nor assume immediate change, since they are in themselves a timeless static array like a beat in a song without end, but not without variation. The C-series time code is like a metronome of a built-in clock which itself is embedded in a realm of automatic oscillations of approximately 24 hours. They argue that this combination of perpetual oscillation, rhythmic beat plus possibility for altering the punctuation of beats is apparent in many organisms in circadian loops. Thus, the circadian clock is a timing device based on self-sustained daily rhythms generated by gene circuits composed of feedback loops.

Cellular responses also register through analog coding (Nomura et al., 2018). One of their case studies refers to duckweed which undergoes exceptional transitions from light to dark cycles and back again. Another case study is the citric acid cycle. Of this they say that the citric acid cycle is capable of generating and integrating both its own foresight and hindsight through self-governing activity, for each molecule in the cycle is both going to be part of the reaction cycle to others (in the future) and already is under the influence of the reaction cycle formed by others in the past.

Nomura and his colleagues claim that any static beat can give rise to active components of change through the rhythms of the beat contributing to the alteration of punctuation of the on-going reaction cycles in a circadian system. In effect C-series time provides a means for tempo changing. Out of this change an organism in a circadian loop can construct a change in relations. C-series time codes have elements of dynamic feedback in networks that enable the creation of a pre-story. In Bateson's terminology, this would be a transformation of redundancy in patterning.

For Nomura and his colleagues, the sequence begins with a pre-story through which a cell or an organism is able to devise its own pictures about any future transitions. The presumption here is that the organisms are able to picture patterns and are enabled, through anticipation, to undertake a comparative match up of present pattern to possible future transformation of pattern.

Overall, the whole discussion of C-series time codes is a very useful contribution to how anticipation serves to protect the ongoing ordering of semiosis in living systems (which are anticipative systems by definition). C-series coding contributes a

scenario, more precisely a pre-scenario of change before actual change of rhythm occurs. Thus, the circadian clock is rhythmic; the activity of C-net coding aids daily rhythms and precipitates bond making. C-series coding engages aspects of tempo changing through anticipation of future change. It enables repositioning of the time code and in this rhythmic ordering; it enables updates of an interface. It accomplishes this through altering punctuation as altered punctuation of rhythms is about as far as the C-net time series would seem to act instrumentally.

Nomura and his colleagues agree that participant representation of descriptive events in semiotics, and representation of intentional activity (purposeful activity), derive from two different kinds of messaging, for as the Bateson and Ruesch (1951) volume points out, the logical types of messages conform to two different orders. One type of message will report its identity to adjacent communicators (in this case, adjacent molecules), while the other type of message will refer to, and help control, the maintenance of the reaction cycles as a whole. Yet there are inconsistencies when Nomura and his colleagues switch from synchronic accounts of C-series time, to accounting for diachronic C-time events. Here their analysis stops portraying perceptual comparisons of the modular and instead claims to show how diachronic activity results in causative changes of one kind or another.

Of course both Bateson and Nomura may be wrong about plant capability to perceive and compare patterns of redundancy among other negotiators. Or it may still turn out that plants only respond to injunctive messages, whose sources lie in injunctive responses to quantities of mass and energy. Yet Bateson believed that the processes of perceived comparison of redundancies could be extended to plants in the following manner. A year before his death he wrote:

> It is easy to see that individual animals respond to differences in color, temperature etc. … It will be more difficult to demonstrate that plants respond not to quantities of utilities (of energy) but to differences and changes in these quantities. (Bateson in Harries-Jones, 1995, p. 205; see also Bateson, 1979).

The overall conclusions of Nomura et al. declare that in contrast to the Cartesian view of dualism their interactional view in the biological world, with its meaning-making perspective, offers an genuine alternative. Specifically, the four temporal series that they discuss (subjective, objective, inter-subjective and their C-net time series), illustrated through case studies of circadian rhythms increases our understanding of the inter-subjective in timing. Their specific analyses of living time codes do not speculate about higher and lower semiotic freedoms, nevertheless their realm of evidence, both theoretical and empirical, covers a very wide spectrum of reactant cycles.

Holographic Coding

Measurements in hierarchical order begin from the bottom upwards, the whole being an additive function of all the prior steps. The constraints of measurement in upwards

movement can then be reversed and taken apart from level to level onto its downward fragments, for hierarchical forms of material events are reversible. However, all movement of information has to be examined in light of the widely accepted proposition that informational form is not reversible in this manner, and it may exist like patterns in the sand on the sea shore and require reiteration. On the other hand, repetitions in any informational ordering can retain the whole in its parts; they do not fragment and separate part from whole. When Bateson extended his enquiry to ecology and ecosystems he noted that since all living systems are oscillating circular systems, with their resonating oscillations creating systemic integration. Resonating systems have the characteristic that all parts of the system will be changed when any part is changed. Moreover, they are downward causative. In order to reflect this combination of systemic integration, downward causation and heterarchy, Bateson added holographic to his list of codes (Bateson, 1975).

The symmetry of shape has similar variability and transformations to that of resonance. As Bateson pointed out, when human beings look at silk, the pattern at first looks flat, but when interwoven with another layer of the same type of silk seems suddenly to develop a three dimensional depth. Known as the *moiré* effect in weaving, a shimmering pattern emerges as the one form becomes layered on another form, with their interwoven effects seeming to generate its own rhythm. The music to the eyes when two repetitive systems become interwoven, seems to create a third system with greater depth.

In aesthetic perception, local symmetries often seem to balance distribution of form around some point or some time period through synchronization. This suggests that local symmetries form a centre, much like an object. Indeed, when algebraic topologists begin to look at such patterns, they may think of centres as fixed points, an eigenform with its boundaries (Kauffman, 2003). Yet organisms conduct active mapping between domains, and unlike the algebraic topologist, natural intelligence has to deal with judgement along a continuum, not with fixed centres and peripheries, nor with logical sets (Neuman, 2018). We have to go to nature writers to gain more specific knowledge about natural intelligence and its response to symmetry (Pollan, 2001).

We have noted that heterarchical ordering, unlike hierarchical ordering, does not separate parts from a whole. Since wholeness is formed through part-whole relations, both constitute each other in multi-level array, and since the shape of any part is informative of the whole any systemic centering or wholeness is always multi-level. We need to take this into account in natural symmetry. Further investigation makes it easier to understand, in a given time slice, how the rhythms of time-line differences may become many differentiated clusters, and how successive communication in time, may recursively, render sameness in unity. Such investigation also reveals how time-line differences of time-line differences (a second-order difference) become differences that constitute difference at that second-order (not a centre) and so forth to the meta-meta level of difference (Neuman, 2018).

Progressive linkage of patterns of differences in time do not necessarily break the pattern of the whole and so enable creatura to mutually construct conditions in which a whole system, or large part of a whole system, re-enters itself for purposes of generating comfortable conditions for all living organisms in that ecosystem. In contrast to a mathematical or topological mapping, based on rigorous definitions of *similarity* and *equivalence*, natural intelligence should lead the observer to its depth of complexity, for example in nature's enfolding and securing of hybridity, in order to gain greater insight into an understanding of what it is to compare.

Here lies the importance of re-entry in the holographic coding of natural systems. Re-entry permits the whole to return to the part in ecosystems. Constraints occurring in re-entry are acquired through experience and are time-oriented. As Bruni and Giorgi suggest, they occur in the presence of oscillations and synchrony. Reentrance becomes an example of coincidence detection which is both global and local, and which involves multi-level domains coordinated in time across multiple reciprocal paths, where movement is not pre-specified in any manner, and specifically not coordinated a priori.

The evidence for this type of re-entrance arises in Wohlleben's account of an undisturbed beech forest near Aachen, Germany. Here the Environmental Research unit at RWTH (Aachen University) provides evidence of each tree in this forest synchronizing their own requirements for photosynthesis. As Wholleben points out, these research results go against the usual narrative of intense competition for sunlight. The Aachen research results reveal a more nuanced notion of competition. Some trees will grow more quickly or more slowly through their competition for light since each beech tree grows in a unique location, with soil and water conditions often varying in just a few yards. The human expectation, along with scientific research, argues that the difference in growing conditions would affect each tree and that the resulting competition for light is of the same kind as competition in human production of goods. This scenario needs reevaluating because of an astonishing caveat. The astounding results of this RWTH research show that the rate of photosynthesis is the same for all trees in this beech forest.

> The trees, it seems, are equalizing differences between the strong and the weak. Whether they are thick or thin, all members of the same species are using light to produce the same amount of sugar per leaf and similar interaction with regard to nitrate and phosphate sequestration is also taking place underground through the roots. (Wohlleben, 2016, pp. 15–16)

Wohlleben calls this *Social Security* to emphasize evidence of community in the hidden life of trees. Perhaps, it is also a demonstration of the hypothesis of GAIA, that life among living organisms in ecosystems results in ecosystems making comfortable for themselves the continuities of life. Bateson would agree.

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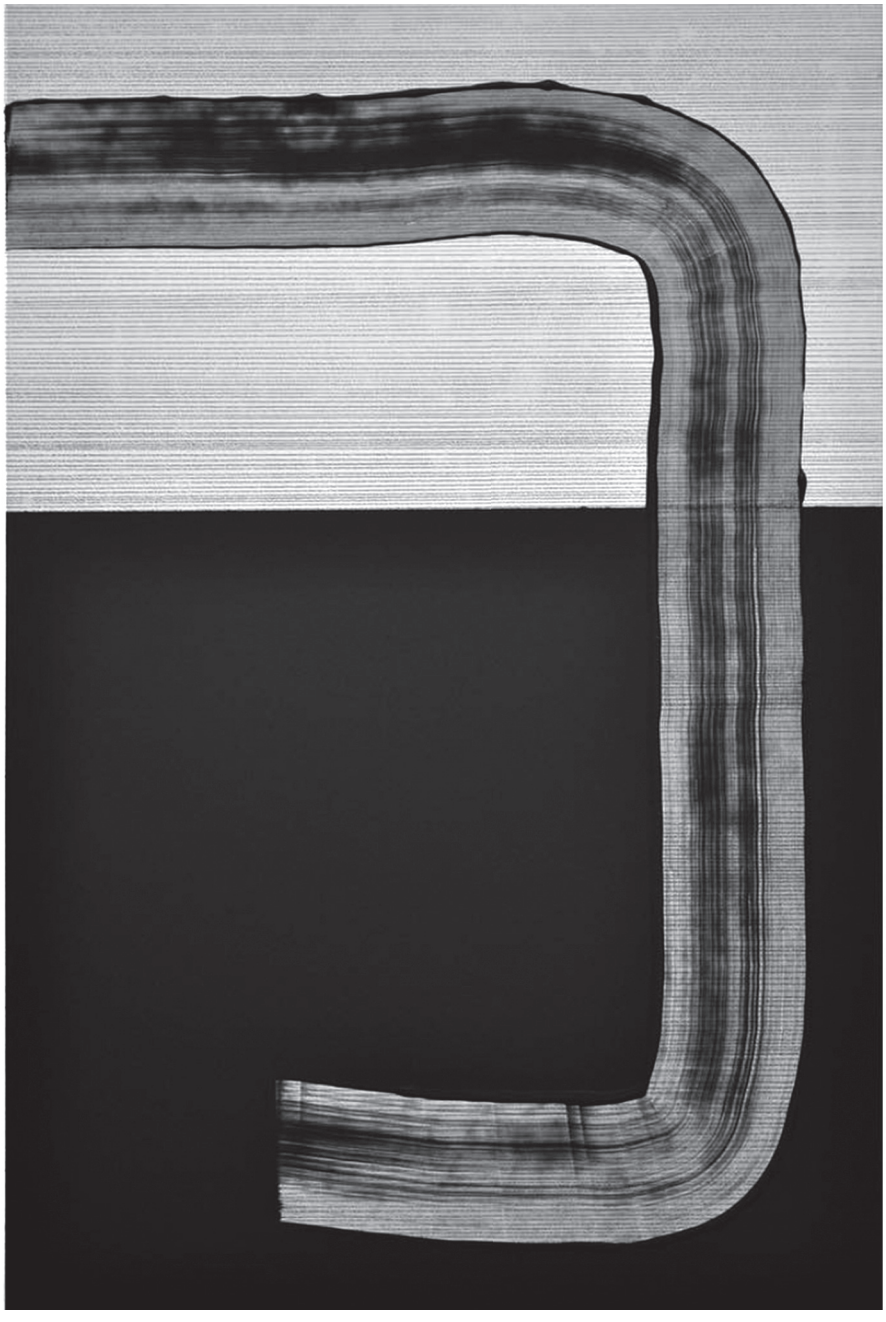

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