Jesper Hoffmeyer
*Editor*

Biosemiotics 2

# A Legacy for Living Systems

## *Gregory Bateson as Precursor to Biosemiotics*

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# BIOSEMIOTICS

VOLUME 2



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Editor

# A Legacy for Living Systems

## Gregory Bateson as Precursor to Biosemiotics

Springer

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# Introduction: Bateson the Precursor

**Jesper Hoffmeyer**

**Abstract** Most scientists tacitly assume that the questions of origins, the origin of life and the origin of language or consciousness, are solvable on the basis of materialistic science, but only few among them seem to recognize the true enormity of the challenge posed by this belief. Bateson was one of those few. And while his thinking has influenced scholars from a wide range of fields dealing in one way or another with aspects of communication and epistemology, mainstream biology unfortunately has shown little interest in such matters, clinging instead to a simplified description of the natural world – a description that has never fully broken free of the Cartesian body–mind distinction and sees the natural world as purely material rather than shaped by processes and organization. Bateson understood that the epistemological errors behind this scientific attitude was also responsible for the inability of science to help us cope with the complex, unruly and messy problems confronting modern societies at many levels. He urged science to search for patterns that will emerge only in a broad-spectrum analysis of communication in all its forms This is the challenge to modern science and philosophy taken up by the authors of this book. The introduction briefly presents each of these approaches.

**Keywords** Gregory Bateson, epistemological errors, biosemiotics, meaning, the complexity revolution

## Introduction: Bateson the Precursor

Gregory Bateson was a precursor not only for biosemiotics, as explored in this book, but for many kinds of rethinking in this century of ideas that were too narrowly dependent on the prevailing epistemological dogmas of the 20th century, dogmas that Bateson claimed to be based on erroneous suppositions. Reading through the chapters of this book, produced by scholars of very different backgrounds one is repeatedly reminded of the sheer multitude of facets that Bateson could bring to bear on his groundbreaking attempt to bridge the Cartesian split in modern thinking. An attempt that is beautifully exhibited in a passage from the

J. Hoffmeyer (ed.), *A Legacy for Living Systems: Gregory Bateson as Precursor to Biosemiotics*

introduction to *Mind and Nature* that Brian Goodwin brings to our attention in chapter 9:

> Now I want to show you that whatever the word "story" means …, the fact of thinking in terms of stories does not isolate human beings as something separate from the starfish and the sea anemones, the coconut palms and the primroses. Rather, if the world be connected, if I am at all fundamentally right in what I am saying, then *thinking in terms of stories* must be shared by all mind or minds whether ours or those of redwood forests and sea anemones. Context and relevance must be characteristic not only of all so-called behavior (those stories which are projected out into 'action'), but also of all those internal stories, the sequences of the building up of the sea anemone. Its embryology must be somehow made of the stuff of stories. And behind that, again, the evolutionary process through millions of generations whereby the sea anemone, like you and me, came to be – that process, too, must be of the stuff of stories. There must be relevance in every step of phylogeny and among the steps (Bateson 1979, 14).

In the post-postmodernist times of today the very term story may perhaps appear suspicious as it certainly was inside the natural sciences in Bateson's own time – and still is, of course. Bateson defined his use of the term story thus:

> A story is a little knot or complex of that species of connectedness which we call relevance. In the 1960s, students were fighting for "relevance," and I would assume that any A is relevant to any B if both A and B are parts or components of the same "story". (*ibid)*

The students days of the 1960s has long been forgotten, but the wish for relevance of our learnings is of course as much sought after by young minds of today as it was in the 1960s, although the conception of what feels relevant to young people is surely now very different. The postmodernist wave did serve us well in pointing to the dependence of our preferred stories upon the contextual matrices of our personal and social lives, but it served us badly in extinguishing all confidence in realism in the sense of a search for knowledge about mind-independent reality. Gregory Bateson, like Charles Sanders Peirce before him, was committed upon such a search, although – as explained in Ty Cashman's chapter – his expressly realist intuition, i.e. that the map (creatura[1]) can somehow depict the territory (pleroma[2]), would never reach an ultimately sufficient explanation. For this to happen he would have had to break free of the Kantian belief in an unknowable Ding-and-Sich and, as we can see in retrospect, to adopt a semiotic theory of reference. Cashman refers to the famous passage, where Bateson, having explained the role of the unconscious tremors (saccades) of our eye-balls, says that: 'The end organs are thus in continual receipt of events that correspond to *outlines* in the visible world. We *draw* distinctions; that is, we pull them out. Those distinctions that remain undrawn are *not*. They are lost forever with the sound of the falling tree which Bishop Berkeley did not hear.' But if we must 'draw distinctions' and 'pull them out' for the differences to be there in

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[1] Creatura is defined as "the world of explanation in which the very phenomena to be described are among themselves governed and determined by difference, distinction, and information" (Bateson and Bateson 1987, 18).

[2] Pleroma is the world of nonliving matter. This is the world descibed by physics and chemistry in which there are no descriptions (Bateson and Batseson 1987, 17).

the first place they are hardly part of pleroma at all. Apparently, says Cashman, we do not really in this process get from pleroma to creatura, it is creatura all the way through. In order to corroborate Bateson's realist intuition it is necessary to integrate our own acts in the analysis, says Cashman:

> … *in action* our hands have direct access and they can move and change the pencil [the object] directly. This is a most important fact to keep in mind for epistemology. Because direct effects upon the Pleroma by our pleromic hands can influence the indirect cognitive access we have that is dependent upon neural encoding. That seemingly infinite distance between my map and the territory is bridged by the *direct* connection between my hands and the territory. I can never feel the pencil directly, but I can break it directly.

Most biologists tacitly assume that the questions of origins, the origin of life and the origin of language or consciousness, are solvable on the basis of materialistic science, but only few among them seem to recognize the true enormity of the challenge posed by this belief. Bateson was one of those few, and by making the interface between Pleroma and Creatura one of his main research objects he confronted the challenge head-on. Bateson was no less committed upon central values of the scientific approach than were his fellow scientists: 'in scientific explanation' he said 'there should be no use of mind or deity, and there should be no appeal to final causes. All causality should flow with the flow of time, with no effect of the future upon the present or the past. No deity, no teleology, and no mind should be postulated in the universe that was to be explained' (1987:12). In chapter 1 Mary Catherine Bateson emphasizes the importance Gregory ascribed to his communication with biologists and his attempt to make biologists discover the patterns that will emerge only in a broad-spectrum analysis of communication in all its forms. Mainstream biology unfortunately has shown little interest in such matters, clinging instead to a simplified description of the natural world – a description that has never fully broken free of the Cartesian body–mind distinction and sees the natural world as purely material rather than shaped by processes and organization. As Mary Catherine observes, this kind of scientific illiteracy strangely mirrors the more well-known spiritual kind of illiteracy that nourishes religious fundamentalism: 'Fundamentalists think their beliefs are "true" in a simplistic way, while others think they are "false" in a simplistic way' (p. 32).

The 2005 Copenhagen Bateson Symposium,[3] that initiated the process which lead to this book, was one of those rare occasions where an attempt was being done to bring Bateson's work to bear on modern science as well as on our understanding of the sacred. A third column in the conference dealt with the relation between Batesonian thinking and Peirce inspired biosemiotics. The combination of these three themes proved to be highly inspiring for all parts and it was decided to produce a book that particularly addressed this sadly neglected dimension of Gregory Bateson's legacy.

While most readers of this book may already have some acquaintance with Gregory Bateson's thinking from his major books, *Steps to an Ecology of Mind* and

[3] Financially supported by Copenhagen University's priority area "Religion in the 21st century".

*Mind and Nature*, his deep reflections on the nature of the sacred, which were worked out in the final years of his life in a collaborative effort with Mary Catherine Bateson and posthumously published as *Angels Fear*, may be less well-known (Bateson 1972, 1979, Bateson and Bateson 1987). In chapter 1 of this book Mary Catherine Bateson offers a reinterpretation of her fathers work – especially as concerns the sacred – enlightened by an anthropologist's eye for the mess of apparently religiously inspired warfare all over the planet combined with other less publicized versions of fundamentalism such as e.g. free market economic fundamentalism, Marxist fundamentalism and narrow minded scientific fundamentalism.

Biosemiotics has been around as a research area for at least 20 years but has only in the last few years attracted more widespread recognition (Sebeok and Sebeok 1992, Hoffmeyer 1996 and 2008, Barbieri 2007). Biosemiotics, as the word says, is concerned with studying the sign-character[4] of the processes that takes place inside or between living systems (from the single cell to full organisms and further to populational or ecological systems). In chapter 2 I set myself the task of explaining why Gregory Bateson, who never himself used the term biosemiotics, was nevertheless one of its greatest pioneers. For science to integrate sign-hood into its explanatory repertoire it must first recognize the ontological reality of 'relative being', i.e. the causal autonomy of pure relations. The chapter explores the phenomenon of relative being across the pleroma–creatura interface with examples ranging from celestial bodies to the 'broken wing trick' of killdeers.

The pleroma–creatura distinction not only poses the epistemological problem of how processes in pleroma can possibly be known to us, or to other living beings, and thus become part of the creatural world, as explored by Ty Cashman in chapter 3 of this book (see above); the distinction also poses the problem of emergence: how could living things appear out of pure pleroma? In chapter 4 Terrence Deacon and Jeremy Sherman suggests that a missing link, the autocell, could have been an important stepping stone in the process leading from the non-living to the living. Autocells are self-assembling molecular structures that derive their individuality from a synergistic relationship between two kinds of self-organizing processes that reciprocally depend upon one another's persistence. Autocells, however, are not yet full-blown living systems since they lack several features that are generally considered criteria for being alive such as the possession of the replicative molecules of RNA or DNA, and differential survival through replications. The autocell hypothesis is open to empirical test but, as Deacon and Sherman admit, such support for the autocell model has not yet been obtained. The model nevertheless does demonstrate that there is an unbroken continuity from thermodynamics to evolvability. Self-organization theory is an important tool that was missing from the scientific horizon in Bateson's own lifetime, but which now can be shown to corroborate one of his most important ideas.

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[4] Following the semiotics of the American scientist and philosopher Charles Sanders Peirce a sign is something that refers to something else (its object) through the production of an interpretant (an interpretive process) in a receptive system.

Another of Bateson's often quoted ideas is the thesis of connectedness, often placed under the umbrella of 'the pattern that connects':

> What pattern connects the crab to the lobster and the orchid to the primrose and all the four of them to me? And me to you? And all the six of us to the amoeba in one direction and to the back-ward schizophrenic in another? (Bateson, 1979: 8)

In chapter 5 Julie Hui, Ty Cashman and Terrence Deacon undertakes an in depth analysis of the main methodological strategy behind this thesis of a general connectedness among nature's patterns across organizational and evolutionary levels, the method he called *double-description*. The analysis takes us into a clarification of the concept of abduction, which Bateson explicitly borrowed from Charles Peirce. Through a process of abduction Bateson identified potentially informative similarities and used these to discover higher-order rules by a process of comparison between several abductively identified patterns. Another tool for Bateson's method of double description was the concept of logical types that he borrowed from Russel and Whitehead's work. Bateson claimed that the product of double description belongs to a higher logical type than the phenomena that were abductively compared. The similarities reached by abduction are here seen as cases on which to build an inductive inference that brings us to a higher logical type. By introducing insights from molecular genetics the paper suggests that even Bateson's seemingly far-fetched claim of a unifying pattern connecting the crab–lobster pair to the orchid–primrose pair may be seen to hold true: 'The general developmental logic of duplication and differentiation is effectively a unifying pattern underlying the generation of biological form in organisms with respect to environmental constraints' (p. 90).

In chapter 6 the focus turns to Bateson's ideas as they pertain to current molecular biology. The misguided belief in the autonomy of the gene as the controlling agency in the processes of life that characterized much of the early work in molecular biology and biotechnology has now gradually been replaced by a growing preoccupation with the signal processes responsible for the integration of gene functions into the whole matrix of cellular and organismic life (such as, for instance, obeying boundary conditions as determined by the state of the organ or tissue in which the cells are situated, or with controls induced upon cells from neighboring cells as well as from more distant sources, such as the psychoneuroimmunological system). When seen from the vantage point of biosemiotics it is clear that the power of modern biotechnology is based exactly on its ability to hitchhike upon the semiotic controls that are native to the cell or organism. The biosemiotics of biotechnology has been studied by Luis Bruni (Bruni 2007) who in chapter 6 shows how much 'the general ideas that … [Bateson] was postulating for the study of communication systems in biology fit … with the astonishing findings of current molecular biology' (p 95). Bruni points out that after 50 years of 'informational talk' we find an entangled set of concepts and terms, such as 'recognition', 'signaling factors', 'quorum sensing', 'cross talk' and so on, all of them concepts that implicitly presupposes 'an understanding of causality, that has had difficulties in conforming to the view of nature established in classical physics and dynamics, because the "information" implied in biological processes is context-dependent and entails systems with the capability to sense and sort out elemental differences as well as complex patterns of differences, i.e., entails a semiotic process.' Had scientist given themselves a chance to understand Gregory Bateson they would certainly have been better equipped to deal with this.

Chapter 7 deals with Bateson's ideas seen on a background of modern *process ecology*. The crux of process ecology, as Robert Ulanowicz describes it in this chapter, is found in the way it understands the origin of *agency*. 'In the conventional view' Ulanowicz says, 'agency is considered to originate only with objects, but we now perceive … [an] inversion of affairs. A *configuration of processes* strongly influences which objects remain and which pass from the scene. I would suggest that such configurations are at the crux of Bateson's "*creatura*" '(p. 129). Ulanowicz illustrates his point by the case of so-called "indirect mutualism" as found for instance in the aquatic macrophyte, *Utricularia*, a genus comprising several carnivorous plant species that catch and degrade zooplankton. Zooplankton species on their side are attracted to Utricularia plants because the leaves of these plants support the growth of a layer of phytoplankton on which the zooplankton grazes. The system forms an ecological autocatalytic cycle because any increase in the biomass of one of the three groups of species will lead to an increased biomass of each of the other species (see Figure 7.1 p. 126). Ulanowicz shows how the establishment of this kind of *ecological autocatalytic cycles* deeply influences over-all ecosystem structure and, among other things, influences the direction that processes of natural selection will take in the system. This example obviously belies one of the cornerstones of the Newtonian ontology that is still very much operative in the biological mindset: *atomism*. That atomism is indeed part of the modern biological mindset is nicely illustrated by a quote from the well reputed American scientist Carl Sagan who 'in wrapping up his television show on biological evolution that highlighted such megafauna as dinosaurs saw no inconsistency whatsoever in declaring, "These are some of the things that *molecules* do!" '(p. 123). Sad to say, I do not remember ever having heard university biologists protest against this widespread kind of ideological[5] science-based TV.

Process ecology, in direct opposition to the prevailing Newtonian scientific ideal,[6] reveals that nature may be understood as open, contingent, historical, organic and granular. And Ulanowicz ends his chapter by observing that a change in our general scientific outlook towards such a view from process ecology will open new agendas for dealing with old controversies such as the problem of 'free will', of 'origin of life', and of finding ways to access the Sacred without violating our well-founded scientific knowledge.

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[5] Ideological in the sense of an unadmitted (unconscious?) partisanship for a Newtonian metaphysics.

[6] Newtonian in the sense of sticking to the view that natural systems are causally closed, atomistic, reversible, deterministic and based on universal laws. As Ulanowicz takes care to point out 'nobody fully accedes to all five postulates. Almost every scientist, however, clings to one or more of the tenets'. (p. 124)

In chapter 8 Theresa Schilhab and Christian Gerlach presents recent empirical evidence in support for one of Bateson's central ideas from *Mind and Nature*, an idea he referred to as (a beginning of) *empirical epistemology*. In Bateson's writing: 'The processes of perception are inaccessible; only the products are conscious and, of course, it is the products that are necessary. The two general facts – first, that I am unconscious of the process of making these images which I consciously see and, second, that in these unconscious processes, I use a whole range of presuppositions, which become built into the finished image – are, for me, the beginning of empirical epistemology' (Bateson 1979, 35). As some readers may remember, Bateson illustrates this point by reference to Adalbert Ames persuasive demonstration of how easily humans are fooled by optic illusions; Bateson comments that after the demonstration he and Ames went to find a restaurant for lunch, and 'my faith in my own image formation was so shaken that I could scarecely cross the street, I was not sure that the oncoming cars were really where they seemed to be from moment to moment' (*ibid*, 40).

Not surprising perhaps, considering the epistemological preferences of prevailing scientific traditions, the standard view in neuropsychology up to now has been the opposite of Bateson's. Here the problem appears in the form of the distinction between so-called *implicit* and *explicit learning* where, in our context, implicit learning stands for unconsciously acquired skills whereas explicit learning refers to consciously acquired skills that, accordingly, are accessible to awareness. 'The standard view is', writes Schilhab and Gerlach, 'that implicit and explicit learning are separately engaged as they attend to different tasks and seem to occupy distinct neural regions.' (p. 135)

Schilhab and Gerlach go on to describe results obtained in *functional imaging studies* that substantiate the Batesonian claim that unconscious perception seem to result in conscious products. Subjects were asked to categorize drawings of natural objects or anthropogenic artifacts (such as animals, plants, tools, etc.) as either 'natural' or 'man-made' whilst concurrent activation of cortical regions was recorded. 'The results imply a positive effect of extended naturalistic practice on processes responsible for categorizing items in an object recognition task – knowledge traditionally thought of as explicit. The results therefore provide evidence of how implicit learning might influence explicit knowledge at the neural level' (p. 135).

From a biosemiotic or Batesonian view this result is of course very much as expected. Unfortunately it often takes hard empirical evidence to persuade scientists of the obvious, i.e. to skip the Cartesian inclinations lying implicit in their schooling.

The necessity of transcending the latent Cartesianism of modern science is further developed in chapter 9 by Brian Goodwin. As Goodwin once has put it: 'Developments in science mean that we now need to learn a more participatory way of relating to reality than the approach of prediction and control that has worked so well for selected aspects of nature … we need to learn how to engage appropriately with the natural magic of the world. Most of the natural systems on which the quality of our lives depend are complex, uncontrollable and unpredictable, though their behavior is self-consistent and therefore intelligible to scientific study' (Goodwin 2003).

To give just one example in confirmation of the need for a different approach Goodwin mentions that fact that 'in the hair cells of the inner ear of the chick there is a gene that can be translated into 576 different proteins, each one altering the tuning of cells to sound frequencies … The single sequence of bases in the DNA that contains the information for making these proteins is read in many different ways by alternative splicing, the different versions of the protein being produced in hair cells in different positions of the inner ear, in systematic spatial order' (p. 146). Goodwin adds that in the fruit fly, it has been estimated that the number of different messages that could arise from a single 'gene' sequence is 38,016!

On this background science historian Evelyn Fox Keller's comment on the genome project seems appropriate: 'Contrary to all expectations, instead of lending support to the familiar notions of genetic determinism that have acquired so powerful a grip on the popular imagination, these successes pose critical challenges to such notions… As the human genome project nears the realization of its goals, biologists have begun to recognize that those goals represent not an end but the beginning of a new era in biology' (p. 147).

Goodwin points to the many findings of general principles that now increasingly leads to the view that physical, biological and cultural evolution are undergoing a process of unification, and he posits this 'unifying insight' as the most significant result of the complexity revolution that has swept through physics, biology, and the humanities in the past 20 years:

> What may be emerging here is the formulation of a new principle of creativity in natural/cultural processes that manifests as the generation of coherent wholes. We are familiar with this in culture since all our creative activities including science, literature, art and craft take the shape of stories and forms that seek coherence and wholeness as their signature. Nature can now be seen to do likewise. The result is that the nature/culture boundary, long cherished by humans as that which distinguishes humanity from mere animals or mechanical nature, erodes. Evolution emerges as a process whose intrinsic tendency is to generate coherent wholes with meaning (p. 150).

Brian Goodwin's concern for the urgent necessity of changes in science that might help us cope with the complex, unruly and messy problems confronting modern societies at many levels was of course already Bateson's concern, and in chapter 10 Peter Harries-Jones explains Bateson's seminal ideas on an 'ecological aesthetics' and shows how they might have helped the environmentalists of today to get a better grip on the worryingly ambiguous relation between the quest for beauty and the quest for healthy ecological management practices, as exhibited for instance in UN's *Millennial Ecosystem Assessment*. Aesthetics in Bateson's view was a meta-context related to contexts of meaning. As such it enables us to perceive the recursive and holistic aspects of ecology and lets us uncover the underlying order of ecology. Harries-Jones emphasizes Bateson's greatest contribution to ecological theory as the conception of an ecological system as a system of information composed of many levels of communicative interaction: 'Ecological events undergoing change do not occur individually, or in patches, but express some sort of unity of ecological interactions through feedback. An injured ecosystem will display characteristics of injury in its communicative and interactive order, Bateson maintained, before succumbing to the various entropies of biomass and energy' (p. 161).

Beauty, on the other hand, in the ordinary sense of "what looks good" is a culturally dependent concept which needs not at all be consistent with long term considerations of ecological health. Bateson's concept of ecological aesthetics, on the contrary, is concerned with the second-order level where aesthetic considerations are seen in their relation to the inner dynamics of the ecological system. And, as Harries-Jones emphasizes in his conclusion: 'The formation of an ecological aesthetics is Bateson's evident attempt to draw natural science towards understanding that 'meaning' in ecological order cannot be derived simply from rational investigation into its material manifestations – energy and biomass.'

The reader will have noticed that the Batesonian understanding of the-pattern-that-connects as primary in the sense that the connected parts or structures are never independent of the pattern that connects them (in time and space) but are, on the contrary, only fully understandable when seen in relation to that pattern, runs through all these chapters as a red thread. And in chapter 11 Don Favareau demonstrates the importance of this insight at yet another level of biosemiosis, that of human Talk-in-Interaction. Favareau starts by reminding us of one of Bateson's metalogues *'Why do Frenchmen?'* in which D (daughter) asks: 'When they teach us French in school, why don't they teach us to wave our hands?' F (father) admits that he doesn't know but then suggests that this is probably one of the reasons why people find learning languages so difficult. And then, after a pause, comes the qualification: F: 'Anyway, it's all nonsense. I mean the notion that language is made of words is nonsense … And all the syntax and the grammar and the rest of it is nonsense. It's all based on the idea that *"mere" words exist – and there are none.'* (Bateson 1979, 13, emphasis mine).

This metalogue was written as early as 1951, and although Bateson unfortunately did not elaborate much further on his provocative statement it is clear that he considered words as derivative of the interactive activity of human communication, rather than as fixed units of language. However, only a few years later (in 1957) came Noam Chomsky's influential new approach to the study of language that, as Favaraeu puts it, placed linguistics 'squarely within the province of the genetically determined alleyways of the 'individual brain' (p. 171). Chomsky's aptly termed 'Cartesian Linguistics' approach with its belief in a 'universal grammar' and in an innate 'Language Processing Module' says Favareau 'became the default way of understanding and investigating human language structure for the next thirty years – having by now become so mainstream as to have become literally synonymous with the academic discipline of 'linguistics' itself' (*ibid*).

Once again we have here a case of how scientifically schooled minds of the second half of the 20th century instinctively felt attracted to the Cartesian kind of thinking (not the least perhaps because of its amenability to research on computerized models) while tacitly rejecting the Batesonian approach. Only 30 years later, in the 80s would a new approach gradually evolve to turn the focus away from the Platonian, top-down, mentalist approach to language and towards the interactivist view of language as based on talk-in-interaction rather than on written texts. This approach goes by the name of *conversation analysis* or, more broadly, *interaction analysis*, and the description of the surprising results obtained through this kind of research takes up the major part of Don Favareau's chapter. Through video takes of linguistic interactions in real-time, communication has been shown to contain numerous formerly unnoticed markers that need analysis at the 0,1 second level. Favareau concludes by the statement that:

> The production of an interactively coordinated stream of speech, … itself provides a kind of carrier wave or "reference signal" capable of allowing separate participants to mutually synchronize their linguistic behavior. Thus the development of the foundationally interactive skill that allows one to rhythmically and motorically micro-attune one's attentions and actions to the oscillations of another participant's rhythmic behavior (and to, in so doing, initiate a reciprocal alignment) may play a critical role in enabling the kind of recursively contingent back-and-forth of communicative interaction of the type that we have been examining here (p. 2).

Favareau thus argues that these deeply interactive human practices help constitute a public 'ecology of mind.' Unfortunately, as we said, the mainstream conception of human languaging has up to now been cast rather in terms of the Chomskyan image of a human mind rooted in innate – and thus deeply private – skills. In chapter 12 Gregory Mengel confronts the question of the cultural mythology that has nourished the persistent scientific preferences for portraying nature – and thus human nature – as fundamentally ruthless, blind and antisocial. Reconsidering the much ridiculed Scopes Monkey Trial in the United States of the 1920s he offers an interpretation of the battle between Creationists and Darwinists in which the conflict behind this trial stands out as not primarily a disagreement of facts but rather a disagreement about *meaning*. As Mengel writes: 'the anti-evolution movement in the United States was not simply an effort to protect a literal reading of Genesis, but a reaction against particularly objectionable interpretations of Darwinism. This is partially a consequence of the metaphors chosen by Darwin and his successors and the historical circumstances that motivated those choices.' (p. 214). Understandable as it may seem in retrospect the early Darwinists saw their mission as that of turning upside down the natural theology of William Paley and to tear apart the naively romantic view of nature. But what happened in the process was that 'Metaphors originally meant to expunge teleology from scientific explanation have been reified into a metaphysic of mindlessness and brutality… I argue that misplaced concreteness has hardened these metaphors into a largely unexamined philosophical stance that I call *metaphysical* Darwinism' (p. 214). And further: 'Roughly, metaphysical Darwinism suggests that the universe is ultimately a collection of meaningless physical events; and biological nature, as a subset of those events, is the province of fundamentally mindless competitive processes by which accidentally self-perpetuating assemblages of passive matter are fine-tuned by external pressures' (p. 222). As Mengel can easily show this worldview is by no means determined by facts of evolution but reflects – no big surprise – ideological preferences of mainstream natural science.

Bateson's ecology of mind, his insight that the organization of ecological systems is formally analogous to the organization of those systems typically classified as minds implies 'that mind is not a thing, but a kind of pattern, a metapattern that is particular to living systems' (p. 224). And of course, if evolutionary theory had departed from this understanding – rather than sticking to outdated anti-Victorian battle fields – it would necessarily have circumvented the well-known deadlock of a scientific fundamentalism mirroring the Christian version of fundamentalism. For ‘evolution in this framing is neither utterly mindless, nor providential; it is creative. Interaction among living systems brings forth patterns of relationship that then establish the conditions for novel forms of interaction, and so on’ (p. 222). Emergence and biosemiosis are the keys to an evolutionary theory, that would allow *meaning* and *communicational intent* to be part of nature’s creation.

The final two chapters of this book has a somewhat different focus from the rest of the book. Here the camera is turned away from the analysis of Bateson’s work as a contribution to the search for coherence and wholeness which, as Goodwin put it above, has been the most significant result of the complexity revolution that has swept through physics, biology, and the humanities in the past 20 years. Instead these chapters take up a more detailed look at the interface between the philosophies of Gregory Bateson and Charles Peirce, especially as concerns their understanding of the workings of mind and of the nature of the sacred. Neither Bateson, nor Peirce, had much sympathy for religion as such. Thus, as pointed out by Søren Brier (chapter 13) Peirce, who explicitly acknowledge his own belief in a personal God, was nevertheless recorded by Joseph Brent, his biographer, to claim that ‘Religion per se seems to me a barbaric superstition’ (quoted in Brier’s chapter). And although, as Mary Catherine says, Gregory ‘regarded religion as an important human effort to understand the living world that might encode insights yet to be explored in other contexts’ he did not subscribe to a religious viewpoint in the ordinary sense of that word: ‘I do not believe in spirits, gods, devas, fairies, leprechauns, nymphs, wood spirits, ghosts, poltergeists, or Santa Claus. (But to learn that there is no Santa Claus is perhaps the beginning of religion.)’ (Bateson and Bateson 1987, 55). In positive terms the following quote may perhaps convey the essence of his ambiguous relation to religion:

> When we recognize the gap between *cogito* and *sum*, and the similar gap between *percipio* and *est*, “faith” comes to have quite a different meaning. Gaps such as these are a necessity of our being, to be covered by “faith” in a very intimate and deep sense of that word. Then what is ordinarily called “religion”, the net of ritual, mythology, and mystification, begins to show itself as a sort of cocoon woven to protect that more intimate – and utterly necessary – faith (*ibid*, 96).

Bateson and Peirce were both of the persuasion that religious feelings are deeply engrained in the question of the workings of the human mind, and they also shared a belief in the human mind as an instantiation of a broader ‘pattern that connects’ in Batesonian terms or ‘nature’s tendency to take habits’ in the terminology of Peirce. And these are the questions confronted in the last two chapters although from very different scientific platforms.

In chapter 13 Søren Brier, who has a background in ethology and second-order cybernetics and is now working to develop the area of cybersemiotics, recognizes the relationship between the two thinkers as concerns their belief in mind as immanent in nature and in placing the sacred as inherent to the pattern and dynamics of the thus conceived mind in nature. But he also – and approvingly – sees Peirce as the deeper thinker in that he, through his metaphysical conception of Firstness as feeling, is able to construct a theory of meaning that explicitly includes the 'inside aspect', the experiencing, of mind processes (p. 251).

Deborah Eicher-Catt, the author of chapter 14, describes herself as a 'communicologist', communicology being 'a coherent theory and methodology … which explores the existential or phenomenological ground from which subjectivity and intersubjectivity emerge among human interlocutors as a semiotic… process. Communicology's historical roots lie within the *Geisteswissenschaft* (human science) tradition' (p. 258). Eicher-Catt pursues a more integrating reading of Bateson and Peirce in which Bateson's epistemology of the sacred is interpreted in the light of the triadic frame of relations offered by Peirce. 'Their philosophic paths "interface",' she says and suggest that this 'interface constitutes a heuristic philosophic matrix that advances our understanding of *the sacred* or "the pattern which connects" as essentially a communicative phenomenon that is open to scientific interrogation.' Both philosophers, she says, emphasizes the necessity of honoring the interface between mind and nature 'as a site of potential communicative accomplishment. As a result, such a synthesis allows us to explore how we might theoretically frame *the sacred* as a way of *knowing* about self, other, and world within a highly complex context of information networks and multi-layered systems of human signification and meaning in which we live as human beings.'

Throughout the 20th century reductionist science has had an unquestionable path of success which has made it all too easy for it to dismiss eventual concerns leveled against it by critical theorists as being speculative ('philosophical') or based upon irrelevant religious or ideological presuppositions. In its very victory, however, science has gradually come to confront more and more complex natural systems of human concern such as human health (as something more than absence of disease), planetary climate or ecological integrity, and even human intelligence and consciousness. These 'real' systems are nothing like the idealized (isolated) systems of classical physics on which scientific reductionism based its self-confidence in the first place. As argued in many of the chapters in this book it now dawns upon us that the dynamics of complex systems confronts science with a need to adopt a very different mindset. One should never underestimate the capacity of science for imaginative ways of reframing its explanatory strategies, but there can be little doubt that such a process of reframing is indeed now in progress in many areas. It must be hoped that this process will also imply an increased concern for the inbuilt epistemological errors that were so far-sightedly pointed out in Gregory Bateson's work. The chapters in this book are meant as tools for this necessary and urgent process.

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# Chapter 1
# Angels Fear Revisited: Gregory Bateson's Cybernetic Theory of Mind Applied to Religion-Science Debates

**Mary Catherine Bateson**

**Abstract** Gregory Bateson intended his posthumous book Angels Fear as an approach to the scientific explanation of natural phenomena in the living world based on cybernetics that would not be so narrowly mechanistic that it triggers a fundamentalist reaction. This issue is newly urgent in the contemporary context of global religious conflict, resurgent fundamentalism, and the intelligent design debate. A redefinition of mind in terms of process and organization sufficient to analyze both evolution and learning, and an application of the Russellian theory of logical types to explanatory systems are central to his approach.

**Keywords** Gregory Bateson, evolution, intelligent design, mind, metamessages, systems theory, fundamentalism, cybernetics, double bind, schizophrenia, logical types

## Introduction

The interdisciplinary conference brought together in Copenhagen in August 2005 by Professor Jesper Hoffmeyer was a fitting climax to the Gregory Bateson Centennial. First, because my father sought ways to make what he was saying accessible and useful to biologists, but second, because the broader interdisciplinary conversation was essential to preserve the weave of Gregory's thinking. For biologists to discover what may be useful in his work it is necessary to consider writings that are primarily oriented to other disciplines, about, for instance, mental illness, where much of his thinking about communication can be found, or religion. Gregory regarded religions as efforts to understand the living world that might encode insights yet to be explored in other contexts, as exemplified in his comparison between Genesis, in which order is imposed on the natural world by god, and a New Guinea origin myth

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in which order is immanent in the material world and it is disorder that needs to be defeated (GBateson 1972:343. Subsequent references to Gregory Bateson's publications abbreviated as GB). His primary approach, even in discussing matters that his colleagues declined to discuss, was as a scientist, but he regarded a sense of wonder at the natural world as a valuable corrective to the limitations of science.

## Bateson's Redefinition of Mind

The rule when Gregory began work as a scientist, as he expressed it, was perfectly clear: "in scientific explanation, there should be no use of mind or deity, and there should be no appeal to final causes. All causality should flow with the flow of time, with no effect of the future upon the present or the past. No deity, no teleology, and no mind should be postulated in the universe that was to be explained" (Bateson and Bateson 1987:12). The turning point for his thinking at the Macy conferences on cybernetics, was reflected in the title Warren McCulloch gave to the second conference in 1946: "Teleological Mechanisms and Circular Causal Systems." In that title there is already an expression of the particular epistemological exploration that engaged Gregory for the rest of his life: cybernetics could be looked at as a way of understanding what looks like final cause or purpose in systems where self-corrective feedback loops provide for an "effect of the future on the present." If causation does not always flow with the flow of time, we need a way of talking about it without postulating an external agent or deity.

Because of this characteristic, particularly in living systems, Gregory defied taboo by redefining the word "mind" to refer to material systems so organized that they have the immanent capacity for self-correction. Gregory listed six "criteria of mental process" in *Mind and Nature*: "A mind is an aggregate of interacting parts … triggered by difference … requiring collateral energy …, [and] circular (or more complex) chains of determination … [resulting in] transforms (i.e. coded versions) of events … disclosing a hierarchy of logical types immanent in the phenomena" (92–126). I mention a seventh in *Angels Fear* that we discussed just before his death, the uneven distribution of information (85). He might have argued that this was entailed by one of the others but I put it forward because of his emphasis on the importance of parts of any system not having full information about other parts. An examination of this list reveals that although Gregory is speaking of material systems dependent on physical energy, the process involves non-material abstractions and communication: triggering by difference, coding, and logical types.

## Bateson as a Scientist

Today I want to discuss these issues in relation to *Angels Fear*, the volume that I completed after Gregory's death, which he saw as his most daring approach to the conventional limits of scientific attention. I inherited the task of dealing with

Gregory's intellectual legacy, as well as the intellectual legacy of my mother, Margaret Mead, and several other scholars for whose work she became responsible along the way, so I have had considerable opportunity to think about how to treat such material. It may be that having a multiple responsibility has shaped my approach – but I decided very early on that I was not going to accept the position of Anna Freud, a woman of undoubted brilliance and conscientiousness, who became protector and arbiter of orthodoxy for the work of her father, Sigmund Freud. The creation of an orthodoxy around Freud's work was a misapprehension of the way he wove ideas and of the way he developed and expressed them, which has had a negative effect on psychoanalysis. Nowadays in the United States, Freud's writings seem to be read primarily in literature departments, free from the pressure to maintain an orthodox interpretation, but with little concern for their ongoing scientific usefulness.

Our responsibility, I believe, in reading Gregory Bateson as a scientist, is to avoid the impulse to orthodoxy that is antithetical to science and to find a pathway through the unorthodoxy of his expression. Gregory's writings offer a way of looking at phenomena that is grounded in science and suggests interesting and important questions. He hoped that he might address some of the ways in which scientific explanation inspires technological exploitation but fails to inspire behaviors that might, for instance, preserve species diversity and slow climate change. The "pattern which connects" (1979:8) proposes not only similarity but identification – even empathy.

At the same time, unearthing the value in this work and integrating it with ongoing thinking in anthropology, biology, and psychiatry can be daunting. Often what we see in Gregory's work is an uncompleted process, where he himself was still groping for the next step in his phrasing. The challenge is not so much to stand guard over the exact words but to continue to develop and test the thought. This is the challenge I had to deal with in putting together *Angels Fear*, selecting from a stack of manuscripts that only vaguely fit together and did not reach the goal he was searching for, so that it was important, as I wrote additional material, to preserve the tentativeness of it. For instance, I am convinced that Gregory's "metalogues" gave him a literary device for exploring ideas without committing himself to the structured exposition that a more usual form of essay would have required. The metalogues, by their fluidity, proclaim the search that was still in flux. Although some parts of the metalogues did actually happen, and although I imitated them sometimes in actual conversation with Gregory and have written some since, they are a form of fiction.

## Kinds of Messages

I am going to start with a story that deals with the relationship between scientific and other kinds of discourse. As Gregory asserted, "… thinking in terms of stories must be shared by all mind or minds, whether ours or those of redwood forests and sea anemones" (1979:13). In the early 80s, I was teaching a course in the anthropology department of an elite American college, Amherst College, with the title "Peoples and Cultures of the Middle East," and I showed a documentary film of the annual Muslim pilgrimage to Mecca.

(Parenthetically, many readers will remember Gregory's story (1987:72–3) about Sol Tax and the question of whether it was appropriate to film a ceremony of the Native American Church in order to defend the sacramental use of peyote, so it is important to note here that although it is forbidden for any non-Muslim to make the Meccan pilgrimage or to enter the Holy Cities, there are a number of documentary films made by Muslim film makers. I don't believe that the issue in the Sol Tax story is the use of technology. I think the issue is the conscious use by believers of words and actions ostensibly directed toward spiritual beings to direct an argument toward political authorities, a behavior which is fairly routine in American politics. Many ethnographers have filmed rituals, including Gregory, who is still regarded as a pioneer of visual anthropology and of the use of film to record and analyze patterns of behavior. It is an oversimplification to focus on the technology *per se* as a desecration. The question is what is said and enacted, to whom, and in what context.)

In any case, I showed in my classroom a film of the Meccan pilgrimage, and after the class a young woman from an evangelical Christian background came up to me, with tears running down her face, and said to me, "It never occurred to me that they *believed* their religion." This was, to me, a very shocking thing to hear, so I want you to pause and be shocked for a moment, before I try to unpack her statement. In fact, I think she misstated her reaction – but at the same time, she revealed a fundamental misconception in all the Abrahamic religions – Christianity, Judaism and Islam – which continues to give us trouble to this day and has indeed become more severe. What she intended to say was not that she had thought Muslims were *lying* when they affirmed their religion. I think that what she meant was, "It never occurred to me that their *experience* of their religion was comparable to my experience of mine." The medium of film had allowed her to empathize with an experience and recognize it in an unfamiliar and exotic context.

Gregory would have pointed out that we are mammals and that we respond in terms of relationships. But of course, this young woman had been brought up with the idea that religion is about *beliefs* that are either true or untrue, not about experience or about relationship. Christianity and Islam have both, at different times in their history, been preoccupied with accuracy of interpretation, avoidance of heresy, and the insistence that believers should concur on specific beliefs. They have asserted that the "truths" of different religions are mutually exclusive and in competition, what I sometimes call *zero sum truth* (M.C.Bateson 1994: 193). My student erred in her understanding of the *kind* of message communicated in religious discourse. The classification of kinds of messages occurs at a different logical level from the message itself, and often contextually. Thus, for those familiar with theater, words spoken in the context of a theatrical performance are responded to differently from the same words spoken elsewhere.

We are constantly dealing with communication at multiple levels, where some kind of *metamessage* classifies a particular communication as report or speculation, humor or poetry, or, in the case of Gregory's film about river otters, combat or play (1979:125). Without this level of understanding, interpretation is impossible. Gregory's interest in the ways in which messages are modified by context and by other messages, which was elaborated in the application of the Russellian theory of logical types to schizophrenia (1972:194), became fundamental to his thinking about all biological communication including that involved in epigenesis. But back to Abraham, who must have been a fairly literal-minded chap – a bit like the schizophrenic Gregory spoke about, who eats the menu card instead of the dinner. At some level – assuming that any of this happened, of course – Abraham took the admonition: "You must be willing to give all that is most precious to you to god" *literally*. And off he went with a sharp knife to sacrifice his son.

## Bateson and Religion

Gregory used to quote Kipling's lines, "There are nine and sixty ways of constructing tribal lays, And—every—single—one—of—them—is—right." (Kipling 2002). That is, I think, a fairly interesting way of talking about religion: to say that there is something that human religions are trying to get at that matters. And they get at some of it in many different ways which include vast amounts of nonsense, much of it dangerous, but we perhaps do not yet have a better way of getting at it, whatever *it* is. For Gregory, that something could be approached by describing mind in cybernetic terms and recognized aesthetically in the similarities of living systems, the pattern that connects.

Gregory was profoundly ambivalent about what we generally call religion, but deeply concerned with the alienation created by the Cartesian mind–body partition that has been so liberating for science and yet leads to a whole series of isomorphic dualisms separating the sacred from the secular and our species from the rest of nature (M.C.Bateson 1972). He said that he "had always hated muddle-headedness and always thought it was a necessary condition for religion" (1979:209). He grew up exposed to religious texts, reading the Bible in order – it was hoped – to avoid "empty-headed atheism" (1979:343), and exposed to the art that surrounds religion, great master drawings and above all the works of William Blake collected by his father. There was an extraordinary Blake water color of "Satan Exulting over Eve" hanging in the dining room in his childhood (now in the Tate Gallery in London). According to David Lipset (1980:105), William Bateson, the pioneering geneticist who was Gregory's father, was not a great student of the prophetic books of Blake – but Gregory went on to read them and other religious texts and poetry, puzzling over the content as well as the aesthetic value. Gregory grew up in a family that sturdily insisted that orthodox religion was nonsense, and at the same time he was stimulated by exposure to religious images, metaphors and poetry that demanded a different kind of understanding.

Gregory planned the book that became *Angels Fear* to discuss religion and aesthetics as ways of knowing that might prove to be indispensable to human survival and to that recognition of the larger interactive system of the biosphere he called *wisdom* (M. C. Bateson 2004:39–40). “The *sacred* (whatever that means) is surely related (somehow) to the *beautiful* (whatever that means)” (1979: 213). For him, as a scientist, to begin to talk about religion and aesthetics was to step onto dangerous ground – *Where Angels Fear to Tread* – places he felt it was essential to venture, but where he was going to get into trouble with his colleagues, and he knew it. Yet the exclusion of certain ideas – the Cartesian partition of ways of knowing – seemed to him damaging.

## The Intelligent Design Debate

We are still troubled by the invocation of deity to explain living systems. Most natural scientists devoutly try to avoid teleological language to this day. In the United States, however, we are seeing another of the waves of religious revival that have occurred in American history, which is shaping American policy in disturbing ways. Much of it looks absurd from Europe: absurd that the Americans were preoccupied with the sex life of a president and even more absurd that we are now debating yet again whether evolution should be taught in schools, or if mentioned whether it should be treated as scientific knowledge – that is to say, what metamessage children should be given about the nature of what they are being taught, including whether it should be presented as one of several alternatives. President Bush, earlier this summer, said in a press conference that he believes Intelligent Design should be taught in all schools. I.D. is not quite Creationism, but is very similar, because of the suggestion that the complexity and apparent purposefulness of organs such as the eye can only be explained by postulating a designer shaping his creations toward particular ends.

Intelligent Design, of course, takes off from William Paley (1794), whom Darwin and, two generations later, Gregory read at Cambridge. Paley argued that just as, when you look at a watch, you can recognize that it is designed and made by someone for a purpose, so too you can look at the natural world and infer the existence of a creator. The advocates of Intelligent Design do not insist that it all happened in seven days and they don’t insist that species don’t change over time and so on, but still they see a need for an outside intelligence. They make an effort to present their ideas with the style and format we associate with science, thereby mislabeling their message, and at the same time try to label the accumulated evidence for evolution as speculative.

### *Learning and Evolution as Mental Processes*

The question of teleology (design) brings me back to the final chapter of *Mind and Nature* (1979:145–186), in which Gregory talks about the “two great stochastic processes” that combine randomness with selectivity. Having in many different ways, in the course of that book, discussed the mind-like properties of natural systems, he compares evolution with learning. And it strikes me today that he is saying that of course there is something that looks like intelligent design in evolution, because the mind-like properties of systems are unfolding. In this sense one can see mind at work in the structure of the eye, or in the structure of the cell and what have you. *But in this understanding the mind is not external*. Mind is a characteristic of the unfolding organization and process, immanent and emergent.

When Gregory spoke about the two great stochastic processes – learning, involving trial and error and involving something like reinforcement to determine what is retained, and evolution, where natural selection has the same effect, he was proposing yet another aspect of the pattern which connects all living things, recognizing in our own mental processes of thought and learning a pattern which connects us to the biosphere rather than an argument for separation. This recognition is inhibited by the dualistic assumption that what happens in the natural world is mechanical. It is inhibited in a deep way by the Cartesian body–mind distinction, as if the natural world were purely material instead of being shaped by process and organization. Having over simplified our description of the natural world, we open the door to a compensatory leap from the recognition of the complexity around us to the insistence on a mind external to it – a deity – shaping it. "Miracles," said Gregory, "are dreams and imaginings whereby materialists hope to escape from their materialism." (1987:51)

## The Fundamentalist Error Today

It is probably no coincidence that at the same time that these old epistemological debates resurface, we are seeing a renewal of apparently religiously inspired warfare all over the planet, and we are seeing a resurgence of the kind of understanding of faith that was expressed by my fundamentalist student who believed in the literal truth-value of religious texts. We are seeing not only Islamic fundamentalism, not only Christian fundamentalism, but also Jewish fundamentalism, Hindu fundamentalism, and patches of Buddhist fundamentalism (although Buddhism has some built in protections). Fundamentalism is not limited to "religions" however – it arises in Marxism and psychoanalysis, and, most seriously in America today, in free market economic fundamentalism and the strict construction of the Constitution, constitutional fundamentalism.

So a pattern of thinking – this style of taking things literally rather than regarding any text as having multiple levels of meaning with the interpretation changing over time, always depending on the context – is becoming a widespread epidemic. Both Christians and Muslims are increasing in numbers, and in many places, especially Africa, the forms of Christianity and Islam that are spreading are the most literal and the most supernaturally oriented, without the polite reinterpretation of texts as myth or metaphor that is fairly common among believers in the West.

Much of this has developed since Gregory's death, but I remember arguing with him in the 1970s that fundamentalism is by definition a modern pathology. Certainly the ancients took the creation story as true. But, without the modern concept of scientific knowledge as a particular kind of knowledge that is established and modified in specific ways, truth had a different, more ambiguous meaning. Fundamentalism attempts to give to non-scientific ways of knowing the status that is given to science, but it omits the openness of science to new evidence that is essential to that status.

Although what is happening in the United States these days looks fairly strange from the vantage point of Europe, what is equally worrying is that so many educated people throughout the industrialized world have simply become deaf to religious language, and have no access to thinking about the meaning of religion in people's lives and motivations. Fundamentalists think their beliefs are "true" in a simplistic way, while others think they are "false" in a simplistic way. Scientifically educated people have not only ceased to believe particular doctrines but they have lost the capacity to empathize with those who do, transforming methodologies and useful heuristics, like reductionism, into ontologies. We need to be equally on guard against multiple kinds of illiteracy, for aesthetic and spiritual illiteracy may be as dangerous as scientific illiteracy.

Some of the pathologies of contemporary life may be due to the loss of kinds of knowledge that are now unacceptable because of the way they are coded and mixed with muddle-headedness. The rise of fundamentalism in a secularizing world is reminiscent of the Gospel story (Matthew xii:44–45), where a man is cleansed of an unclean spirit who then comes back with seven others more evil than himself and, finding the man's soul swept and garnished, moves back in with his companions. Sometimes the cure is worse than the disease. I think that the only defense against what I take to be a dangerous and erroneous set of attitudes towards religion is a much more flexible understanding of the possible meanings of *faith*, as contrasted with belief, in people's lives, and in the lives of scientists. There is an apparent symmetry of mutual blindness.

There is still however a need for an integrative level of scientific description such as Gregory found in cybernetics. Perhaps our view is necessarily dependent on multiple alternative descriptions – we may even need a little help from some of the nine and sixty tribal ways to understand the world. It has been a mission of anthropology to collect and make available these multiple visions. What we ask of science is first of all, that it always include a degree of tentativeness and openness – and second, not that it be *true* but that it *fit* the evidence, which is very different. One could ask the same kind of questions of mythologies of many sorts. Do they fit? Do they offer an interpretative frame for the adaptation of a cluster of human beings in a particular environment?

Much of Gregory's portion of *Angels Fear* was written at the Esalen Institute, in California, where Gregory went to live after his cancer, in the year before his death. In one essay written there, titled "Neither Supernatural nor Mechanical" (50–64), Gregory says he is horrified both by conventional scientific and technological views of the world and by the supernaturalism of Esalen. "The problem is not, however, entirely symmetrical," he wrote, "I have, after all, chosen to live at Esalen, in the midst of the counterculture, with its incantations, its astrological searching for truth, its divination … My friends here love me and I love them … The beliefs of the counterculture and of the human potential movement may be superstitious and irrational, but their reason for being … was a good reason. It was to [generate that buffer of diversity that will] protect the human being against obsolescence" (51–52). The bracketing of a portion of the previous sentence indicates an insertion that I made in editing, for one of the strangely attractive features of Esalen is the *comfort* with which a huge miscellany of beliefs manage to co-exist. No zero sum truth there. Gregory feels sure that his counterculture friends are talking nonsense, but perhaps the nonsense is connected to something worth knowing, which might promote a degree of sensitivity or empathy with other organisms and a degree of perception and response to the pattern which connects.

## Logical Types in Mental Process

Gregory's postwar research on communication was carried out in the context of psychiatry, with a focus on pathology and its etiology. The research of the Bateson group started out oriented towards solving the problem of schizophrenia, yet all the time that they were talking about schizophrenia they were also talking among themselves about humor, about poetry, and about religion, all of which involve switching back and forth between logical types – but the work was published as research on pathology (1972: 194–200). They identified the double bind in families, defined in relation to the logical types, as a possible cause (or trigger) of schizophrenia, yet once the work is taken out of its immediate context, it becomes clear that the double bind is pervasive. Double binds are by no means limited to the families of schizophrenics and indeed they may be characteristic of all multiply coupled and embedded systems such as we discover in the natural world (M.C.Bateson 2004), and do not always result in pathology.

On the one hand, religion seems to depend upon *logical type confusion*, so it is fairly easy to connect religious experience with psychopathology. On the other hand, religious traditions look like ways of dealing with the limitations of other kinds of knowledge and the need to function at many different levels, with inevitable conflicts and ambiguities between them. It may, for example, be possible to describe a condition like obesity in strictly physiological terms, yet an understanding of the diverse and multiple causation of different cases of obesity will range from genetic to socio-economic and ideological factors, with multiple possibilities for contradiction and inappropriate intervention at different levels. It is not easy to integrate biomedical understanding with explanations of psychological and social processes. As individuals, we can hardly help experiencing knowledge as fragmented. Scientific method depends on cutting questions down to size by breaking them into manageable pieces. Scientists necessarily focus on parts of the whole and, like laymen, must take most of it – the findings of others which they have not confirmed – on faith in the markers of scientific communication.

Inevitably, in periods of great scientific progress, there is a tendency to exaggerate that progress, and we are in a period today when some scientists and much of the general public seem to believe that focusing on the DNA molecule is the answer to everything and, more ominously, to the control of everything. Yet genetic causation also depends on the transmission and interpretation of messages at other systemic levels, and on complex contextual conditions that convert what appears to be a lineal causal system into a circular one. As with political power, causation always goes both ways. The general public is, in a curious way, buying into a form of biological fundamentalism that is itself dangerous because of the metaphors of unilateral control that it proposes. Overemphasis on “master molecules” and “selfish genes” is as likely to lead to authoritarianism as is monotheism.

## Discussion

There are many kinds of ignorance that lead to maladaptive and destructive behavior, including the distorted perception that Gregory connected with conscious purpose and a variety of distortions connected in other ways with religion, such as the initial rejection of attempts to slow global warming and the Kyoto Treaty by Evangelical Christians because we are in the last days and the world will end shortly. At Burg Wartenstein Gregory proposed that it might be useful to construct a typology of error (M.C.Bateson 1972:49–50). Both in our empty-headed school committees and in our dogmatic economists, in fact in many professions and sometimes in scientists as well as in religionists, there is a form of ignorance that is newly dangerous, and we are all at risk of slipping into it.

It may be impossible to arrive at an internally consistent understanding of the world that integrates the details at every level – and certainly impossible for an individual. But thinking in terms of systems offers a different kind of holism where we can see the similarities between ourselves and systems of many kinds, not only organisms but ecosystems and human communities, and we can see them living, responding, and changing. The details must be left to specialists but the patterns still connect.

It is important to keep on trying to understand the limits of science – and at the same time, not to become too arrogant about the understanding that has been achieved. Gregory says of scientists, “We are arrogant about what we might know tomorrow but humble because we know so little today” (1979:270). We need somehow to build a bridge that allows people to deal with the limits of what they can know scientifically, and still have a mythic and aesthetic sense of their world. Fundamentalism is for many an adaptation to a sense of loss, and loss properly inspires compassion. The student I described earlier came to mind, after I had not thought about her for 20 years, because she was devastated, her foundations were shaken by her recognition of the deep feeling and passion of others. But her foundations were built on a fallacy, and the name of that fallacy is not Christianity, it’s not Islam, it’s not even religion – it’s a fallacy about the truth values of religious statements that may still be valuable for an integrated life. Gregory was convinced of the possibility that systems theory and biology might meet in a description of the natural world that would persuade our species, no longer looking outside that world for explanations of its wonders, to treat it not only with respect but with reverence and recognition.

Gregory was pursuing the use of cybernetics to describe natural systems as wholes in ways acceptable to science, which would still evoke wisdom and a sense of the sacred. In doing this he developed two interrelated analytic tools both for science and for popular understandings of science. One of these was the use of communications theory and the logical types. The other was an understanding of the mental characteristics of systems created by communication, within and between organisms.

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# Chapter 2
# From Thing to Relation. On Bateson's Bioanthropology

**Jesper Hoffmeyer**

**Abstract** The rapid increase in our technological mastering of more and more intimate and everyday aspects of life has created an acute sensitivity towards the huge lacunas left over by rational knowledge and technology. The present "turn towards the spiritual" has probably very much to do with such feelings of disturbance. From a Batesonean view the roots of these lacunae are to be found in fundamental epistemological errors in the preferred schemes of conceptualizations in western culture – a never decently surmounted dualism one might perhaps say. One central point here is the persistent reification of *relation*. Relations come in many kinds, but science invariably treats relations as dependent variables, dependent that is on *things*. Giving primacy to process and relation over things Bateson implicitly cleared the way for a semiotic kind of final causation, which however he would perhaps not himself have accepted, because his understanding of final causation implied an inversed – and totally contra factual – temporal ordering. The very systemic characteristics he found in aesthetics in natural systems seems however to point the way to other possibilities for understanding final causation. Possibilities which can be made fruitful in a biosemiotic reframing of technological challenges as well as in our feelings of belonging in a big "pattern that connects".

**Keywords** Relative being, semiotic freedom, intentionality, semiotic causation, emergence

## A Deep Symmetry

One reason why Gregory Bateson's thinking never did find the broad audience it deserved may be that he very explicitly placed himself in a position few people are prepared to consider possible. Bateson's ideas hit a strange blind spot in western thinking.

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On the one hand we have a scientific approach to the study of life that takes for granted that natural laws exhaustively explain all of reality. On the other hand we have a humanistic approach to which human intentionality, conscience or "first person experiences" remain central and which maintains that the core of these phenomena evades description in terms of natural laws. Thinkers of the latter opinion often take the poverty of the scientific world view *vis-à-vis* these aspects of the world to imply that a religious or spiritual position is necessary. Conversely, and symmetrically, adherents of the scientific world view routinely suspects religious or spiritual motives behind any criticism of the scientific world view.

None of these mainstream views seems much inclined to consider that a third possibility exists, a position that sees human mind as a particular instantiation of a nature that is in a deep sense itself *minded*. A view, in other words, which holds that neither human mind nor nature at large is reducible to deterministic natural laws. According to this third position, the position taken by Bateson and before him by Charles S. Peirce – let us term it *the bioanthropological position* – nature is not the mindless kind of thing the natural sciences have stubbornly tried to reduce it to and there is therefore no reason why human mind should not be seen as a naturalistic phenomenon in no particular need of religious or spiritual explanation.

Bateson's choice of a living place in the final years of his life – in Esalen, a spiritual centre for the counterculture of the 1970s north of San Francisco – may seem strange for a man who had dedicated so much of his life to the world of science, but as he himself explained in "Angels fear" he did not feel comfortable with the value systems and manners of scientific culture:

> I am appalled by my scientific colleagues, and while I disbelieve almost everything that is believed by the counterculture, I find it more comfortable to live with that disbelief than with the dehumanizing disgust and horror that conventional occidental themes and ways of life inspires in me (Bateson and Bateson 1987, 52).

Bateson very explicitly rejected the sorts of miraculous events believed in by the counterculture of Esalen:

> The trouble is that belief in a claimed miracle must always leave the believer open to *all* belief. By accepting two contradictory kinds of explanation (both the ordered and the supernatural), he sacrifices all criteria of the incredible. If some proposition is both true and false, then *all* propositions whatsoever are and *must* be both true and false. All questions of belief or doubt then become meaningless (*ibid*, 54).

But he also saw that superstition and materialism were in a strange way symmetrical beliefs:

> Miracles are dreams or imagenings whereby materialists hope to escape from their materialism. They are narratives that precisely – too precisely – confront the premise of lineal causality (*ibid*, 51)

Materialism and supernaturalism are in Bateson's view logically opposite ways of responding to the same central misconceptions deeply buried in our Cartesian heritage. First and foremost the idea that there are two distinct explanatory principles in our world, "mind" and "matter", forcing us to chose beetween the causality of mind (supernaturalism) or the causality of matter (materialism) in our explanations.

This primary error became reinforced by another idea also introduced by Descartes, the idea of using intersecting coordinates to represent two or more interacting variables or represent the course of one variable over time. This idea has of course been extremely successfull and it is indeed hard to imagine scientific knowledge without it. Cartesian coordinates constitute the very fundament for analytical geometry and thereby for the calculus of infinitesimals and the scientific emphasis on *quantity*. There is of course nothing wrong about using coordinates to describe material phenomena in our world. But the very success of this procedure may have blinded scientists to its shortcomings. Phenomena such as contrast, frequency, symmetry, correspondence, relation, congruence and conformity are not easily described in terms of quantities if at all – they are, as Bateson noted, variables of zero dimensions and cannot be located (Bateson 1972, 408) – and yet all communicative processes in nature depend upon discontinuities of this kind. Bateson writes:

> The two ideas are intimately related. And the relation between them is most clearly seen when we think of the mind/matter dualism as a device for removing one half of the problem for explanation from that other half which could more easily be explained. Once separated, mental phenomena could be ignored. This act of subtraction, of course, left the half that could be explained as excessively materialistic, while the other half became totally supernatural. Raw edges have been left on both sides and materalistic science has concealed this wound by generating its own set of superstitions. The materialist superstition is the belief (not usually stated) that quantity (a purely material notion) can determine pattern. On the other side, the antimaterialist claims the power of mind over matter. That quantity can determine pattern is the precise complement for the power of mind over matter, and both are nonsense (ibid, 59).

To illustrate this claim Bateson asks the reader to consider the relation between classes and things. Take for instance chlorine, which is a name for a *class* of molecules but is not itself *a* molecule or a thing. Now, if you mix chlorine and sodium a chemical reaction will take place leading to the formation of common salt. Nobody denies the truthfulness of this statement. The problem is that the statement is not directly about the material world but only about *classes* of molecules. So, the question is: are there such things as *classes* in the material world?

Bateson's answer to this question is surprising, and may not be understandable at all inside the Cartesian framework where causative agents are always positive events or conditions: impacts, forces and so on. As Bateson notes, this is not so in the creatural world (on the *pleroma–creatura* distinction, see next paragraph), where effects are caused by *differences* in some parameter sensed by the organism. A telling example is that of the frog which will not see an insect sitting right in front of it as long as the bug doesn't move. The moment it moves, however, the frog immediately sees it and probably catch it too (Lettvin, Maturana et al. 1959). "Every effective difference" says Bateson "denotes a demarcation, a line of classification" (Bateson 1972, 457). Classifications then are indeed natural phenomena, but only in *creatua* not in *pleroma* (note 1). This answer does in a way lay out much of the epistemological fundament for what should later become biosemiotics (a term Bateson never used himself of course):

> In the world of living things, the Creatura of Jung and the Gnostics, there are really classes. Insofar as living things contain communication, and insofar as they are, as we say, "organized",

> they must contain something of the nature of message, events that travel within the living thing or between one living thing and others. And in the world of communication, there must necessarily be categories and classes and similar devices. But these devices do not correspond to the physical causes by which the materialist accounts for events. There are no messages or classes in the prebiological universe.
>
> Materialism is a set of descriptive propositions referring to a universe in which there are no descriptive propositions (*ibid* 61–62).

Thus the life sphere is characterized by proccesses of communication, or semiosis as we would say today, and this is where patterns belong. But the causative universe of materialistic science does not possess the apropriate tools for describing such processes.

The misunderstanding that quantity determines pattern owes much of its credibility to the apparent naturalism of the Cartesian coordinates, which tended to conceal the constructed nature of any graphic or functional representation of natural processes. The laws of gravity, for instance, do persuasively describe certain aspects of our world, but this does not mean that the laws are natural in the sense that they are part of nature. The laws are patterns made up by scientists, they are mental phenomena. Patterns don't exist unless *somebody* draws them.

And here is the core of Bateson's idea, a far-reaching idea indeed: living systems are communicative systems by themselves, and they must therefore deal with classes of some sort, or, in other words, they draw patterns and – I would add – in this sense they essentially are *somebodies*. Consequently somebodies – ourselves included – are natural beings, not supernatural observers describing the world "from nowhere" (to use Thomas Nagels incisive expression (Nagel 1986)).

## Creatura and Pleroma

This brings us directly to what I think may be called the main focus of Bateson's whole work wether in biology or in athropology, understanding the process of knowing, or epistemology: "the interaction of the capacity to respond to differences, on the one hand, with the material world in which those differences somehow originate, on the other". Or, expressed in the terminology Bateson chose for his discussion in *Angels fear*: the interfaces between *Pleroma* and *Creatura* (Bateson and Bateson 1987, 20) (note 2).

Pleroma is the world of nonliving matter. This is the world descibed by physics and chemistry in which there are no descriptions. A stone does not respond to information and makes no injunctions. The stone is affected by "forces" and "impacts", but not by difference:

> I can describe the stone, but it can describe nothing. I can use the stone as a signal – perhaps a landmark. But *it* is not the landmark. I can give the stone a name; I can distinguish it from other stones. But it is not its name and it cannot distinguish. It uses and contains no information."It" is not even an *it*, except insofar as I distinguish it from the reminder of inanimate matter (*ibid*, 17).

Creatura on the other hand is "the world of explanation in which the very phenomena to be described are among themselves governed and determined by difference, distinction, and information" (*ibid*, 18). *Angels fear* was published in 1987, seven years after Gregory Bateson's death, and his daughter, Mary Catherine Bateson, who had worked closely together with him in writing the book before his fatal disease would bring his life to an end, took care to point out in brackets that Creatura and Pleroma are not, like Descartes' "mind" and "matter", separate substances:

> On the one hand all of Creatura exists within and through Pleroma; The use of the term Creatura affirms the presence of certain organizational and communicational characteristics which are themselves not material. On the other hand knowledge of Pleroma exists only in Creatura. We can meet the two only in combination, never separately. The laws of physics and chemistry are by no means irrelevant to the Creatura – they continue to apply – but they are not sufficient for explanation (*ibid*, 18).

The Creatura–Pleroma distinction is indeed quite subtle, and from Bateson's unpublished manuscripts it appears that he had worked on it for quite some time (Harries-Jones 1995, 95–97). In *Angels fear* Bateson explicitly accepts the Kantian understanding of *Das Ding an Sich* as an inaccessible, and accordingly he also thought that we can only know the non-living material universe of *pleroma* through the communicative contexts we ourselves establish, the appearances of *pleroma* so to say, not *pleroma* itself. Harries-Jones explains: "As *creatura*, we may assume that *pleroma* has its own regularities – inertia and change, cause and effect, connection and disconnection – but the regularities of *pleroma* remain, in the last resort, inaccessible directly" (*ibid*, 97).

The creatural theory is probably the nearest thing Bateson ever came to formulating the ontological assumptions underlying his scientific work. Reading it again so many years later, and this time with an eye to the Peircean perspectives of his thinking I found it hard not to equate *creatura* more or less directly with Peircean *thirdness*. *Creatura*, like *thirdness*, is an anlytical tool for ordering the world's phenomena into categories, and more concretely *creatura* and *thirdness* both encompasses the mediating, lawful and evolutionary aspects of our world. To place *pleroma* in the Peircean categorical system is less obvious. Taken in its Jungian sense from *Septem Sermones ad Mortuos* as the totally unstructured realm, the "nothingness" or the "fullness" of the eternal or infinite, *pleroma* might perhaps be equalled to Peircean *firstness*, i.e., potentiality, indeterminacy or chance. As examples of *firstnes* Peirce gives the smell of rotten cabbage or the scent of a rose, but also the instantanious feel for a mathematical proof or a melody. *Firstness* necessarily is vague because it is pure quality and doesn't imply a referent. Think of blueness as such, i.e. without fixing the color to any blue object. Again *firstness* – like *pleroma* – need to manifest itself in order to be grasped, but the moment it manifests itself it is already embraced by *secondness*, i.e. reaction, resistance, existence or quantity. *Pleroma* like *firstness* can only be cogitized through its appearences in our cognitive system, so *pleroma* might perhaps be said to correspond to *firstness* in its being in itself, but to *secondness* to the extent pleromatic phenomena are distinguished and described theoretically or practically.

Peirce's categorical system needed three and only three categories corresponding to the logical distinctions between predicate (*firstness*), subject (*secondness*) and copula (*thirdness*). Bateson also, according to Harries-Jones, like Jung, recognized that the drawing of a distinction such as *creatura* in the middle of the supposed unity of *pleroma* would logically require a "third position" from which this distinction could itself be viewed. This led Jung to the idea of the mystic gnostic figure of God Abraxas, who is a level higher than the opposed qualities of unity and distinctiveness. Bateson, however, did not follow Jung very far along this track, preferring to see *creatura* and *pleroma* as explanatory principles rather than ontological categories. This was a fortunate choice I suppose, but it must also be admitted that it leaves the Batesonian system a little naked. One would like to escape the implicit dualism of *pleroma* and *creature* not only by epistemizing the two terms. For this distinction does indeed seem to confer upon us a deep sense of understanding – and not just a tool for obtaining such understanding. Let me suggest that a solution to Bateson's dilemma at this point might be to give up the Kantian idea of the inaccessibility of the world's *pleromatic* existence

Peirce did not accept the idea of the thing-in-itself as an unapproachable limit concept for our understanding. He rather, as John Deely explains, saw "the realm of what exists 'in itself' and what exists 'phenomenally' or 'in appearances' " as "laced together, in fact, in experience and in cognition as such, by the action of signs in such a way that we can come to distinguish and know the one as part of the other by the critical control of objectivity that is the heart of science and philosophy alike beyond their differences of orientation" (Deely 2001, 613–14). Peirce escapes the Kantian deadend of modern philosophy exactly because he does not follow modern philosophy in thinking that thought operates with concepts or ideas, claiming instead that thought operates on *signs*. This difference is radical: concepts refer, signs signify. Signs are neither sensible things nor concepts, they are pure *relations*, i.e., irreducibly triadic relations connecting a sign vehicle to its object through the production of an interpretant; and this triadic relation is itself independent of the concrete physical status of the sign vehicles, the objects to which they might refer or the source from which they derive, be it nature or mind.

Thus, according to Peirce, Bateson's *pleroma* would not be inaccessible, but would as the subject matter for physics and chemistry gradually become better and better known to mankind as that primary substratum of the universe out of which life and human mind had gradually emerged. How this could happen is exactly what science and philosophy should now work together to solve. Some beginnings in this direction can be found (Pattee 1977; Salthe 1993; Weber 1998; Hoffmeyer 1999; Kauffman 2000; Hoffmeyer 2001; Deacon forthcoming). And in this sense the existence of *creatura* would not presuppose some mystical "third position" from which to distinguish it from mindless *pleroma*, Rather the distinction of *creatura* from *pleroma* should be seen as an in-built possibility inherent to our universe only to become fully realized through the unfolding of the sharpened evolutionary potential of *creatura*.

## Relative Being

The interface between *pleroma* and *creatura* cannot be dealt with in classical biology for the simple reason that *creatura* or *thirdness* refers to aspects of the natural world that fall beyond the accepted ontology of natural science, and all attempts at explaining these concepts are therefore likely to be met with suspicions of mysticism. Even though most biologists do probably recognize that communicative processes are part of natural systems, they instinctively figure these processes in terms of the involved biochemical and genetic processes supposed to result in the communicative behaviors. To talk of messages or distinctions just blurs our minds. This is the reductionist credo ruling nearly every department of biology throughout the whole world. And the simple question asked from these quarters when confronted with Bateson's writings (or biosemiotics) normally is: what's all the mess about?

What it is all about, I think, is a quite simple thing, namely the reality of *relative being*. Relative being is a strangely obvious thing, which is nevertheless generally dismissed by science as not really "real". For example Jupiter has a number of moons circling around it; but the relation between the moons and the planet is not seen as anything real in itself, it doesn't add anything to a strict analysis of the properties of the individual celestial bodies themselves. The simple genitive case seems neatly to exhaust the whole relation: the moons are indeed Jupiter's. And it is of course true that in principle a relation could be drawn between any two physical objects in the world, and in all but a very few cases such relations would turn out to be absolutely uninteresting, whether seen from the point of view of science or from the point of view of ordinary people's everyday life. However, not all relations are of this kind; and to give an example of "relative being" which cannot easily be dismissed as ficticious let me suggest "parenthood". For all we know king Frederik the Ninth of Denmark was the father of Queen Margrethe the Second, though His Majesty passed away a long time ago, and we have no doubt that Margrethe will pass away too at some time in the future. Yet, due to royal destiny their relation will in all likelihood persist for a very long time as a relation of parenthood, father to daughter. This kind of "relative being" seems to have a reality of its own which cannot be reduced to the individual persons that substantiates the relation, and such relations have been called *ontological relations* (Deely 1990; Deely 1994; Deely 2001).

But are there ontological relations in nature? Bateson's work can be interpreted to answer this question in the affirmative. *Creatura* is exactly the domain of *pleroma* where relations are truly ontological, in the sense that these relations are not just descriptive devices but are in fact functional in an autonomous way. Relations in *pleroma* may also sometimes be thought of as functional, as for instance in astrology. Thus the multiple relations existing between the planets of our own solar system has indeed been intensely studied by scientists of the past, and they remain a matter of great concern to a lot of people believing in varieties of astrological theory. Since no likely mechanism whereby, say, a conjunction between Mars and Venus (as seen from Earth) could possibly influence the destiny of individuals or nations on Earth has been suggested, such a belief is generally rejected by scientists as superstition. We have absolutely no reason to believe that those relations have any distant causal effects on the world qua relations. In this case – as in *pleroma* in general – it makes good sense to talk about related things rather than relations, and maybe the general unwillingness of science to accept relations as ontologically real owes much of its strength to the ancient – and now strangely revived – struggles science had to fight against dogmatic beliefs connected to mystical or religious persuasions.

When we turn to *creatura*, however, relations tend to become considerably more autonomous things. The shoulder, for instance, is a ball-and-socket joint that enables a person to raise, twist, bend, and move the arms forward, to the sides and behind. The head of the upper arm bone (humerus) is the ball and a circular depression (glenoid) in the shoulder bone (scapula) is the socket. A soft-tissue rim (labrum) surrounds and deepens the socket. The head of the upper arm bone is coated with a smooth, durable covering (articular cartilage) and the joint has a thin, inner lining (synovium) for smooth movement. The surrounding muscles and tendons provide stability and support. Here are a whole assembly of relations which are all remarkably adjusted to each other. The primary functional relation of course is that between the shape of the ball of the arm bone and the contour of the shoulder socket, and we can assume that this relation has indeed been functionally modulated by natural selection all along the way from the evolutionary origin as appendages or fins in fish. Clearly these relations are of quite another kind than the pleromatic relations pertaining to the planetary system. The relation in fact is so central to the function of the animal that one can hardly imagine the one bone change without a corresponding change occurring in the other bone. Or, if this should happen by an unfortunate mutation, the resulting individual would be crippled and leave little or no offspring. If on the other hand, a mutation should occur that affected both bones in a coordinated way, conserving their internal relation, the resulting individual might perhaps manage quite well in the competition. In this case, the relation as such does indeed seem more real than the individual bones making up the relation. And this state of affairs may well be the rule rather than the exception in the realm of *creatura*.

Quite generally, living systems have evolved a capacity for making anticipations: they must decide when to grow and when to withhold growth, when to move, when to hide, when to sing, and so on, and this way of adjusting the behavior depends on a capacity to predict the future at least to some limited extent. For instance: is it likely the sun will shine or not, is it likely that little flies will pass by if I make my web here, will the predator be fooled away from the nest if I pretend to have a broken wing etc. Of course, in most cases it will be the instinctual system of the animal rather than the brain that makes this kind of prediction, but the logic is the same: the animal profits from its ability (whether acquired through phylogeny or through ontogeny) to identify trustworthy regularities in the surroundings. And most – if not all – trustworthy regularities are indeed relations. For instance, the relation between length of daylight and the approaching springtime that tells the beech when to burst into leafs; or the play of sun and shadows which tells the spider where to construct its web; or the relation between clumsy movements and an easy catch that tells the predator which individual prey animal to select, and thus tells the bird how to fool the predator away from its nest.

Now, in the first two of these examples (the beech and the spider) a certain organismic activity is released as a response to pure (non-semiotic) natural relations, so-called *categorical relations*, whereas in the third example the bird produces a fake categorical relation (clumsy behavior as expectedly related to easiness of catch) and then takes advantage of the semiotic or ontological relation established by the predator when it lets itself be fooled by a false sign. In this case, in other words, the bird fools the predator because it somehow (genetically or ontogenetically) 'knows' how the predator is going to (mis)interpret the seeming categorical relation. Observe that, in this case, the predator may not always be fooled, we are not here dealing with normal (efficient) causality, but with semiotic causality: the predator may misinterpret the sign (the faked clumsy behavior), but it also may not.

Anticipation is of course a semiotic activity in which a sign is interpreted as a relation between something occurring now and something expected to occur later, like the dark cloud alarming us to an upcoming thunderstorm. From its very first beginnings in Augustine's writings in the fourth century the sign is conceived as something awakening us to infer something else: In Augustine a *signum* or "a sign is anything perceived which makes something besides itself come into awareness" (quoted from Deely 2001, 221). Deely suggests that Augustine happened on this definition as a "lucky fault" (*ibid*, 216) due to his reluctance to learn the Greek language. The Greek term for sign, semeion, was taken by the Greeks to imply "natural signs", whereas "cultural signs" were termed symbols or names, and this categorization of signs of natural and human origin into distinct groups might well, had he mastered the Greek language, have hindered Augustine from abstracting the formal relational character of the sign from its embeddednes in different concrete realms of reality. Still Augustine's definition is too narrow in its focus on perception, since elements of awareness may well be signs also without being perceived. Augustine nevertheless pointed to the core of the matter when he defined a thing as "what has so far not been made use of to signify something" (*ibid*, 221), implying that things may well be signs but they need not be so, and also implying that the essence of the sign is its formal relational character of evoking an awareness of something which it is not itself, thereby implying the full triad of sign, object and interpretant (here the altered awareness). The evoking of such a triad is of course by no means exclusive for the workings of human awareness but is rather, as was later realized, a purely logical relation to be established in any system capable of autonomous anticipatory activity, i.e., by all systems belonging to *creatura*.

Just as predictability must precede prediction, a system of useful dyadic relations must first have been realized on planet Earth while it cooled down. Only then more sophisticated systems could survive based on a complicated capacity for anticipation that is, for bringing themselves in relation to the pre-established set of relations under the formation of true triadic or semiotic relations. And while the underlying system of dyadic relations may well be understood in terms of the things related, the emergence of true triadic semiosis in the shape of living beings and their activities established kinds of causality peculiar to this new form of *relative* *being*, causalities which are way too sophisticated to be decently grasped through the simple dynamics of dyadic relations between things.

Natural selection is also ultimately dependent upon predictability if durable changes shall be produced. If niche conditions in generation$_{n+1}$ were not to some extent like niche conditions in the generation$_{n,}$ "selected" properties in one generation would induce no systematic advantage in the next. In natural selection a relation between the composition of phenotypes in the population or lineage and the actual ecological and semiotic niche conditions framing the life of this population is acted upon by individuals in such a way that a collective quasi-rational "populational" interpretant is the outcome in the form of an altered pool of genomes brought forward to the next generation. Here the niche occupies the logical position of the sign vehicle, the changing composition of phenotypic properties in the population is the object to which those niche conditions refer the lineage, and the interpretant is the changed genome composition of the lineage in the next generation. Through hundreds of millions of years such a mechanism is thought to bring about coordinated adjustments, like the one pertaining to the upper human arm bone and the shoulder socket.

Describing natural selection as a semiotic process implies that the apparent finality (or teleology) of the process becomes non-contradictive. Semiosis or sign action is always embedded in sensible material processes and for that reason has a dynamic side that allows the communicative process to run, as well as a complimentary or mediating side. The first of these sides is governed by the compulsive force of efficient causation; the second expresses the controlling agency of semiotic causation. And semiotic causation, bringing about things under guidance of interpretation in a local context, might be seen as a modern way of conceptualizing the kind of causation Aristotle called final causation, i.e. that cause"for the sake of which" something exists or occurs. Anticipation through skilled interpretation of indicators for temporal relations in a context of a particular survival project (or life strategy) will necessarily guide organismic behavior towards a local end.

Inside materialistic biology, however, the apparent finality of selection remains strangely unaccounted for. Darwinists normally escape the finality-problem by pointing out that selection only exhibits an "as if" teleology, or *teleonomy*. In explaining the purposeful nature of adaptive traits, one does of course make reference to the consequences of those traits for fitness; but, as has often been remarked, the consequences that explain the existence of adaptive traits are the consequences those traits *have had*; they are not the consequences that they *will have* or *can have*. And since the consequences precede the effects, there is no violation of the general scheme of efficient causation implied. And yet, Darwinists all the time talk about properties or types of traits as having been selected for, but the fact that it is not particular "traits" but rather "types of traits" that are selected for does nothing to detract from the obviously teleological nature of the process. At least it must be asked why some *types* of traits are "preferred" by nature (or natural selection) and not other "types". Are not preferences inconsistent with a non-teleological nature?

As Short has recently concluded in a sharp analysis of the finality of Darwinian selection:

> What I am suggesting is that we take seriously the currently popular talk of "selecting for" a property or type of trait (Sober 1984). Taking it seriously means accepting that talk at its face value: it describes evolutionary processes as shaped by types of outcome and it explains outcomes by citing the types those outcomes exemplify. But a type of outcome that explains its own exemplification is what translators of Aristotle have named a "final cause", as Darwin appears to have recognized (Short 2002)

Seen as a semiotic process, the finality of natural selection contains no mystery. Lineages are reproductively integrated systems of individual organisms and as such they certainly interact with the world in pursuing their own supraindividual interests – in fact, to do so would seem to be the whole idea of being equipped with anticipatory capacity.

We conclude that not only is it absurd to deny the reality of *relative being*, because *relative being* rather than things (individual creatures or populations) is what evolution persistently optimizes, but by denying this reality one is prevented from developing a proper scientific understanding of biosemiosis and purposefulness. Instead, science has felt challenged to show that these phenomena are pseudo phenomena (epiphenomena), and that there is therefore no contradiction between our own existence as human first person beings and the purely material universe that created us. People whose intuitions contradict this understanding have had to go elsewhere to cope with their need for understanding how they could possibly belong in this universe. Increasingly natural science has come to look like an esoteric order of believers keeping the reality of non-believers at arms distance behind the walls of power based on a shared narrow ontology (reinforcing itself through the ever repeated memory of the preceding centuries of victorious revolt against the dogma of the Christian church), a consensus about what belongs and what does not belong to reality. How natural scientists manage to know so surely that they are part of a nature that in itself knows nothing is to me a complete mystery.

## A Minded Nature

In his book *Mind and Nture* Bateson elaborated an ingenious set of criteria that, if satisfied, would imply that a given system had mind, and he claimed that "the phenomena which we call *thought, evolution, ecology, life, learning*, and the like occur only in systems that satisfy these criteria" (Bateson 1979, 102). The criteria reflected his attempt at synthesising his theory of life with cybernetics and with the theory of logical typing as derived from Russel and Whitehead's *Principia mathematica* (Russel and Whitehead 1910–13). While these criteria have done much to sharpen our dicussions of what should be meant by the term mind, they also in a strange way detract the idea of mind from more classical conceptions of mind as embedded in the subjective intentionality of life. Bateson's criteria may well explain how mental systems actually do work in cybernetic terms, but the subjectivity of life, the first person experiential world, seems as absent from these criteria as they are absent from the more materialistic models he rightly criticised. This may be because Bateson like Peirce would argue that subjectivity cannot be translated into the individuality of the individual or the choices of ego, a "self" or an "I" (note 3). Indeed, as Harrison-Jones has pointed out: "In anthropology Bateson is regarded as one of the very few early anthropologists who recognized desire and feeling as pertinent to the (then) highly normative discipline of anthropology … I think one has to understand cybernetic criteria in Bateson's writing, not so much as a mechanism of mindedness, but the context within which all "subjectivity" finds "itself" (Harrison-Jones, personal communication). In the Peircean understanding of mind, of course, human mind is just one very particular and concrete instantiation of a principle which is central to our universe as a whole and which, by operating on the sportings of chance, is ultimately responsible for the bifurcations in our universe and for the increasing semiotic freedom and diversification of life on Earth.

In Stuart Kauffman's recent book *Investigations* an important part of the analysis turns on the question of the non-ergodicity of the universe, meaning that the universe never had the time it would have needed should its present state of affairs in any way be representative of its in-built possibilities (Kauffman 2000). The persistent movement of the universe into the "adjacent possible" precludes its ever reaching a state that depends on statistical likelihood. Instead, the universe is historical, for "history enters when the space of the possible that might have been explored is larger, or vastly larger, than what has actually occurred" (p. 152).

And Stuart Kauffman brings his analysis to the following far reaching claim: "our biosphere and any biosphere expands the dimensionality of its adjacent possible, on average, as rapidly as it can" (Kauffman 2000, 151). Kauffman is fully aware that this "burgeoning order of the universe" cannot be reduced to matter alone, to entropy (or the negation of entropy, for that matter), to information, or to anything that simple. The propagation of organization and the subsequent growing diversification of the world is taken care of in Kauffman's terminology by *autonomous agents*, and these agents are, as we shall see, semiotic creatures. An autonomous agent may be defined quite rigorously as an "autocatalytic system able to reproduce and able to perform one or more thermodynamic work cycles"; and in earlier work Kauffman had shown how such agents will be expected to self-organize given the kind of world our Earth system belongs to (Kauffman 1993). In *Investigations*, Kauffman explicitly observes that this definition leads to more intractable questions of "measuring" or "recognition". For if work be defined as "the constrained release of energy", where will the constraints come from? At least it will take work to produce them, and this is not all:

> autonomous agents also do often detect and measure and record displacements of external systems from equilibrium that can be used to extract work, then do extract work, propagating work and constraint construction, from their environment (Kauffman 2000, 110).

and since a measurement is also always an act of interpretation, this immediately brings us to the core of biosemiotics and also poses the question of the origin of life in a new way which shall not, however, be further explored here (Von Neumann 1966; Pattee 1977; Hoffmeyer and Emmeche 1991; Hoffmeyer 1998; Hoffmeyer 2001; Ulanowicz 2002).

Kauffman's and Bateson's work stands in no contradictory relation to each other here, rather they reach into different aspects of that universal principle which Bateson called mind, and it will be one of the great tasks of biosemiotic analysis to bring these findings under a single consistent theoretical umbrella.

As a first and very preliminary approach to such analysis, let me suggest here that the systematic growth of *semiotic freedom* in our biosphere is a concrete expression of Kauffman's "expanding dimensionality" of "the adjacent possible" as this principle pertains to the Earthly biosphere. Semiotic freedom may in fact be singled out as the only parameter that beyond any doubt has exhibited an increasing tendency throughout the evolutionary process.

Semiotic freedom was introduced in *Signs of Meaning in the Universe* (Hoffmeyer 1996) as a measure for the depth of meaning or the degree of sophistication of communicatory or interpretative activity. Let us for illustration consider first a case of relatively low semiotic freedom: courtship display among water mites of the species *Neumannia papillator*. Here, the male exhibits a behavior called "courtship trembling", in which he will walk slowly around the female in the water vegetation while vibrating his legs. This behavior almost certainly has arisen as an icon for the vibrations produced by prey animals swimming in the surface water. The female will often respond to male leg-trembling as if to prey, orientating itself to the source of the vibration and clutching the male in her forelegs. Male leg-trembling frequencies are well within the range of vibrations produced by the prey (copepods), and starvation experiments have shown that hungry females are more likely to orientate to and clutch at courting males. "It thus appears that male mites are capitalizing on female sensory adaptations for the detection of prey", writes Johnstone (Johnstone 1997). Courtship trembling is an obvious case of what we elsewhere have termed *semethic interaction* (from *semeion* and *ethos* = Greek for, respectively, sign and habit) (Hoffmeyer 1997), i.e., a behavioral interaction between two or more agents in which habits and signs reciprocally scaffold each other. Thus one agent evolves the habit of interpreting the habits of another agent as a sign for releasing a distinct activity or habit that may then, in turn, become signs for a third agent, etc. In *N. papillator*, the prey animal's involuntary vibrations have become incorporated into male courtship behavior as an icon "destined" to release a distinct behavioral pattern in the female, allowing reproduction to take place. Whereas the courtship ritual is thus nicely scaffolded through a semiotic relation, the distinction between the leg-trembling as an icon for prey-behavior and for prey itself is still uncomfortably weak, as witnessed by the fact that hungry females respond more enthusiastically to the icons than do less hungry females.

Biological evolution can only proceed from what is already there, and the creation of "leg-trembling" as a scaffolding device for mating in water mites is typical. The evolutionary process may of course continue to modify the semiotic scaffolding devices it inherits in multiple ways, as may, for instance, be observed in the evolutionary line of balloon fly species belonging to the family *Empididae*. In these species, Sebeok tells us:

> the males gather in swarms, carrying captured insects as “wedding presents”. The male offers his gift to a female, which sits peaceable sucking it out while the male inseminates her. As soon as copulation is completed, the female drops her present, but if the empidid bride is still hungry, she may consume her amorous groom next (Sebeok 1979, 18).

It has been shown that the packaging of these gifts vary greatly from species to species, and in one of the species the male even risks to approach the female “empty-handed”. In an early evolutionary stage the female is offered just the juicy insect as such as gift, while in later stages the insect is wrapped in increasingly more silken thread, until the gift has reached the state of a real balloon. In the succeeding stages, writes Sebeok, the prey steadily diminishes in size, hence in food value, while the balloon increases commensurably in complexity (*ibid*, 19). Sebeok notes that in the last of these stages, where the balloon is in fact empty, the link between the sign vehicle and the object for which it stands has become “arbitrary”, and that in this case the sign “meets every viable definition of a symbol” (*ibid*, 19). It is interesting that balloon flies are sometimes used to illustrate so-called *phylogenetic inertia*, i.e., the tendency for structures or behavioral features to be conserved within a certain evolutionary line even when there have been significant evolutionary divergences between species. Thus in the balloon fly line even the most recently evolved forms that are nectivorous (eating nectar) still offer balloons as “wedding gifts”. In other words the balloon, empty here of course, remains a tool for courtship, even though insects have no longer any concrete meaning to the flies as food objects. Seen from a semiotic point of view this could hardly be called inertia, however, since the passage from an iconic mating sign to a symbolic mating sign constitutes a radical jump in semiotic freedom. All traces of the original dyadic relation have now been erased, and a purely triadic relation has taken over.

In both cases discussed here, as in invertebrates quite generally, I assume (note 4), emiotic freedom is still very limited and should not be seen as a property of single individuals but rather as a property of the species or the evolutionary lineage. The symbolic character of the balloon in nectivorous species of *Empididae* is only true when considered as a species-specific behavioral trait having developed in the lineage as a kind of historical convention. At the level of the single individual fly, on the other hand, there is almost no semiotic freedom at all, since its behavior is fully controlled by the rather deterministic instinctual reflex systems. It should be noticed, however that behavioral determinacy is not complete. Thus, the occasional mutant that, for some reason, has developed a less rigorous release mechanism for mating behavior may, under rare exceptional conditions, survive and thereby contribute to the establishment of a bifurcation of the lineage, a nascent speciation event.

At later stages of evolution semiotic freedom becomes increasingly individualized. One major step in this process is the much celebrated transition from a reptilian world to a mammalian and avian world. Mammalian and avian species in general seem to master significantly more sophisticated ecosemiotic settings than do reptilian species. The Swedish ethologist Sverre Sjölander has pointed out that while for instance a dog need not have a full picture of the hare all the time for hunting it efficiently, a snake will stop hunting its prey whenever it disappears from view (Sjölander 1995). The snake may well go on searching for the prey at the spot where it disappeared, but it will not calculate the eventual path the prey may have taken. The dog, on the other hand, will proceed away guided by an anticipation of where the hare would be expected to turn up next. "Thus it seems as if the representation or construct of the hare is 'running' in the internal world in a way corresponding to the actual hare in the actual world" writes Sjölander, so that "the sense organs are just used to correct the representational happenings and not to create them" (*ibid*, 3). In the snake, on the contrary, hunting appears to be guided by a succession of quite independent sense modalities. Thus striking of prey is governed by sight (or temperature sense organs); location of the struck prey is detected by smell, and the swallowing procedure is governed by touch. This lack of true intermodality in the snake makes it "hard to imagine that the snake can harbor some form of a concept of a mouse in its brain" (*ibid*, 5). The snake apparently can not integrate its sense modalities to form a central construct.

A moving animal in a moving world is confronted with a perpetual need for making split second choices of behavior. Such choices evidently will serve survival the best if they are based on some kind of anticipatory calculation which integrates inner body parameters such as emotional states, fatigue, hunger, memory into a range of external parameters as registered by the sense organs. As long as the animal has a survival strategy based on simple activity schemes in a predictable space of challenges these behavioral decisions may well be accounted for in terms of instinctive patterns of sensorimotoric reflex circles. Such a direct connection between a stimulus and a corresponding behavioral act is perhaps what takes place in the snake so that in its Umwelt there are indeed no mice, but only things to be searched for, things to be stroked, and things for swallowing. In animals dealing with more complex patterns of challenges, a direct coupling of stimulus and behavior is no longer sufficiently flexible. Instead, the brained body as a holistic intentional unity must now make decisions based on split-second evaluations of unforeseeable events. Judging from the efficiency of modern computer programming in producing virtual realities, there is probably no *a priori* reason why brains could not have solved this problem by a sophisticated elaboration of the reflex circuit principle. But while computers are designed to obey strategies decided by the programmer, organisms had to develop designs obeying their own interests; and this is where the computer analogy may mislead us. Organisms must integrate their life project into their calculatory potential. The body as flesh and blood, therefore, from the very beginning, has to be part of the anticipatory and inventive brain models. We shall suggest this is the reason why nature invented the trick of producing an experienced holistic virtual reality, an internal icon more or less isomorphic in its properties with those parts of the real world that the animal couldn't safely ignore (note 5). The exciting (threatening, attractive, etc.) aspects of the outer world in this way became internalized as inner threats, attractions, etc., thereby assuring the necessary immediate emotional bias in all choices of action. The hard problem was not just to calculate the path of action but to make sure this path of action was the most relevant given the esoteric life project of the individual animal, and this is the point where the emotional apparatus must be brought to play. The iconic inner experience works as a holistic marker focusing the enormous diversity of calculations upon a single path of action (further discussed in Hoffmeyer 2006, whence the preceding paragraph was taken).

The core of semiotic freedom lies in the gain of *interpretance* it conveys. Interpretance may be defined as *the capacity of a system for responding to signs through the formation of 'meaningful' interpretants*. High interpretance allows a system to "read" many sorts of "cues" in the surroundings and act upon them in ways that, in the given context, must be assumed to serve the proliferation of the system. In general, the prosperity of systems with high interpretance derives from the advantages a system may obtain by scaffolding of its behaviors or its developmental and physiological processes by means of semiotic controls. Semiotic controls widen the space of scaffolding by introducing indirect mechanisms, omens so to say, in addition to ordinary causal effects, fleeing from smoke, for instance, rather than from the pain inflicted upon the organism by the fire itself (the risk of substituting semiotic causality for efficient causality, on the other hand, is that signs, e.g., smoke, may be faked, whereas burns are the real thing, danger). The emergence of higher-order interpretance means that the system or agent acquires the ability to respond suitably to complex cues that might not be noticed or even be noticeable by lower-level systems. Thus, as we saw, mammals, but not reptiles, are generally capable of interpreting the speed and direction of movement of the prey animal as a complex sign telling them where to search for it in case it disappears from view. Contrary to reptiles, mammals seem capable of making a central construct of the prey animal in their minds or Umwelts, and this is an activity of classification or digitalization. As Bateson told us, the alternation between digital and analog processing is the key to emergence of higher level organization: "to get from the *name* to the *name of the name* we must go through the *process* of naming the name" (Bateson 1979, 206). Or, in a biosemiotic terminology, the emergence of higher-order interpretance departs from situated iconic and indexical semiosis (analogical codings) as we find it in reptilian hunting.

Considering the extent to which Bateson's whole thinking turned upon relations between entities (or agents) rather than on the entities themselves, one may wonder why he did not take up the semiotic thinking from Peirce. His famous conceptualization of information as rooted in "differences that make a difference" comes so close to a genuine triadic Peircean sign as to be nearly indistinguishable. While we leave this question for the Bateson scholars to solve, we shall now end this discussion by noting that as soon as we accept the reality of sign processes, of relative being, we also immediately see the deep significance of Bateson's lifelong attempt to determine the pattern that connects… nature and culture. Semiosis is constitutive to both of these realms, evolution and thinking are made up of the same stuff, and the name for this stuff is relative being.

## Notes

1. One should perhaps not exclude, that differences might have causal effects *qua* differences in complex chaotic systems, like vortices or typhoons, where shortlived lifelike properties might perhaps be said to arise.
2. Bateson explicitly remarks that he uses these two terms in the sense given to them in Carl Gustav Jung's *Septem Sermones ad Mortuos* (Jung 1967 (1916) ), rather than the sense given to them in Jung's later works where archetypes were included in Pleroma.
3. I am grateful to Peter Harries-Jones for having pointed this out.
4. Octopuses may be an exception.
5. John Deely has pointed me to this very apt formulation of the Uexküllian position on neutral aspects of the Umwelt.

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# Chapter 3
# What Connects the Map to the Territory?

**Tyrone Cashman**

**Abstract** Bateson left an unresolved ambiguity in his explanation of the relationship of the mind to the world, the map to the territory. This ambiguity is related to his failure to develop a theory of intentionality, reference, 'aboutness.' However, he left us all the tools necessary to resolve this ambiguity and to lay the groundwork for a theory of intentionality. In using these tools, a different emphasis is placed on the relationship between change and difference. A proposal is made for an understanding of the rudiments of abstraction. Finally, the ambiguity is addressed and the groundwork of a theory of intentionality proposed, through an understanding of the distinction between (a) the indirect access of creatural mental process to the pleromic world and (b) the direct access of our pleromic hands to the pleromic world. It is through the interplay and alternation of indirect perception/cognition of the world and direct action on the world in manually operated experiments that Bateson's problem of 'maps, of maps, of maps, ad infinitum' is solved and a theory of mediate realism can be derived from his work, linking to an understanding of the roots of intentionality.

**Keywords** Map, territory, abstraction, difference, ambiguity, *Ding an sich*, epistemic cut, mediate realism

## Bateson's Large Synthesis

During his long career as a scientist, Gregory Bateson worked on problems in anthropology, psychology, evolutionary biology, and communication theory. A number of his insights were taken up and developed further in the individual disciplines. But the large, trans-disciplinary synthesis that, in his own mind, was his major contribution to science received little attention from the mainstream scientific communities.

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In our judgment, one reason that these innovative ideas and their synthesis were not carried forward was due to a deep ambiguity in their formulation, and perhaps to an ambiguity in Gregory's own mind about them. The Core Ideas might be briefly stated as these:

1. The Map is not the territory. Information is not energy. Creatura is not Pleroma.
2. It is pattern that connects elements in the biological and mental world.
3. The minimal unit of mental process is a negative feedback loop.
4. There is a hierarchy of logical types in the phenomenal world.
5. Evolution is a form of mind and mind is a form of evolution.

This paper will focus on an ambiguity in the first of these core ideas, an ambiguity that may have ultimately affected the others. Gregory spent a great deal of time clarifying the difference between the world of energy and the world of information. Later, he tried to point out the 'pattern which connects' elements within the world of information. In this paper we will focus on the question of what *connects* the map and territory, the world of information and the world of matter/energy. This connection has to be the first and most vital connection for an epistemologist, and Gregory considered himself an epistemologist. So we will start there.

## What Goes from Territory to Map?

Descartes in the 17th century had proposed a way to distinguish mind and matter that set the tone for studies of mind and nature ever since. Descartes distinguished thought, feeling, emotions, sensation, awareness from all those aspects of the universe that operate mechanistically. This second category, mechanistic matter, included the stars, galaxies, rocks and all machines. In addition, for him, it included the birds, flowers trees, all animals, indeed, every living thing, expect for humans. Even the human being was to be understood as a mechanical system, with the sole exception of his/her immaterial mind, which Descartes assumed produced all the thought, feeling emotions, sensation, awareness in the universe. Thus the boundary between mental process and the merely material universe was drawn *inside* the human brain, at the boundary of the pineal gland. Everything outside the immaterial mind attached to the pineal gland of a human being was pure mechanism. This way of distinguishing mind and matter has lasted up to our time.

Gregory proposed to us that the Cartesian line was ineptly drawn. There is, indeed, a line between the world of ideas, of thought, of information, of sensation and the world which operates simply by mechanical pushes and pulls. But that line is to be drawn between the world of 'sticks, stones and galaxies' and the world of organisms, ecosystems and the biosphere. Once there is a one-celled organism that can sense its environment and react in ways that lead to the survival of its own integrity, there is mind, there is mental process.

However, in a similar vein to Descartes', Gregory was concerned to show that the world of living things *is* radically different from the world where all changes occur due to energy, forces, impacts, i.e., to pushes and pulls. To help frame the mind/matter distinction in this new way, he borrowed a pair of terms from C.G. Jung and the Gnostics: 'Pleroma' and 'Creatura.' The world of Pleroma is the world as studied by physics and chemistry, a world which operates by forces, impacts, attractions and repulsions. The world of Creatura, is the world of living systems, *insofar as* their operations require news of difference and circular patterns of information flow.

He made very sure that we grasped that information is not a force, an impact, a push or a pull – that it is something of another order altogether. Something else entirely is going on, he insisted, with information processes than with energy events, although information can never float free from the world of energy, impacts, forces, etc..

## An Unresolved Ambiguity

In the presentation that he gave as the Korzybski Memorial Lecture in 1970, Gregory first made explicit how various pieces of his life's work and thought fit into a truly large synthesis. He remarked that it was at that point that he realized why he had felt impelled to move from discipline to discipline during his career, that this synthesis had been the larger theoretic understanding that he had been seeking.

In this presentation he said:

> Now let me leave evolution for a moment to consider what is the unit of mind. Let us go back to the map and territory and ask: 'What is it in the territory that gets onto the map.' We know the territory does not get onto the map. That is the central point about which we here are all agreed. Now, if the territory were uniform, nothing would get onto the map except its boundaries, which are the points at which it ceases to be uniform against some larger matrix. What gets onto the map, in fact, is *difference*, be it a difference in altitude, a difference in vegetation, a difference in population structure, a difference in surface, or whatever. Differences are the things that get onto the map.
>
> But what is a difference? A difference is a very peculiar and obscure concept. It is certainly not a thing or an event. This piece of paper is different from the wood of this lectern. There are many differences between them – of color, texture, shape, etc. But if we start to ask about the localization of these differences we get into trouble. Obviously the difference between the paper and the wood is not in the paper; it is obviously not in the wood; it is obviously not in the space between them, and it is obviously not in the time between them. (Difference which occurs across time is what we call 'change.')
>
> A difference, then, is an abstract matter. [*Steps*, 457–548]

The ambiguity that Gregory presents here is extreme. Parsed out logically, his claim is self-contradictory. The logic goes like this: What gets from territory to map are differences. Differences are abstractions, i.e., do not exist in space and time. But whatever exists in the territory exists in space and time. Therefore there are no differences in the territory that can get onto the map.

Although Gregory does not explicitly admit this paradox, his later comments show that its logic is working on him.

> But what is the territory? Operationally, somebody went out with a retina or a measuring stick and made representations which were then put upon paper. What is on the paper map

> is a representation of what was in the retinal representation of the man who made the map; and as you push the question back, what you find is an infinite regress, an infinite series of maps. The territory never gets in at all. [*Steps*, 460]

In this paragraph there is a second confusion, between the territory itself and the differences in the territory. Obviously the territory does not get onto the map. I have a 'map' of my coffee cup in my brain, but if the cup were in my brain I would die. Gregory has claimed that although the territory does not come across, the *differences* in the territory come across to the map. Yet in this passage he does not speak of the territory at all, nor of its inherent differences, nor even of differences of light on a flesh-and-blood retina, but only of differences in a retinal *representation*. He is as much as saying that differences start in the retinal representation. They do not come from the world.

> The territory is *Ding an sich* and you can't do anything with it. Always the process of representation will filter it out so that the mental world is only maps of maps of maps, *ad infinitum*. [*Steps*, 460]

If he believed what he originally said, he would have noted that beyond the first map there are real differences in the real territory which 'get onto the map.' But once having claimed that *difference* 'is an abstract matter,' he cannot. Having thus brought himself to a dead end, he backs up and takes another tack.

> Kant, in the *Critique of Judgment*, – if I understand him correctly – asserts that the most elementary aesthetic act is the selection of a fact. He argues that in a piece of chalk there are an infinite number of potential facts. The *Ding an sich*, the piece of chalk, can never enter into communication or mental process because of this infinitude. The sensory receptors cannot accept it; they filter it out. What they do is to select certain *facts* out of the piece of chalk, which then become, in modern terminology, information.
>
> I suggest that Kant's statement can be modified to say that there is an infinite number of differences around and within the piece of chalk. There are differences between the chalk and the rest of the universe, between the chalk and the sun or the moon. And within the piece of chalk, there is for every molecule an infinite number of differences between its location and the locations in which it might have been. Of this infinitude, we select a very limited number, which become information. [*Steps*, 459]

This time he explicitly accepts a Kantian frame of reference, wherein it is assumed that form and difference derive from the knower, are contributed by the mind to the perceived object, are not fully part of the territory before it is *known*. Kant's notion here of 'potential facts' will turn up nine years later, in a footnote in Gregory's book, *Mind and Nature*, as 'latent differences.'

Once within the Kantian frame, where all formal aspects of nature are observer-dependent, he can talk freely about differences in the territory. But this time the problem is that there are an infinite number of them. So what gets from the territory to the map is now a highly selected sample of the differences in the territory.

How this selection is accomplished is explained later in *Mind and Nature*.

> The eyeball has a continual tremor, called *micronystagmus*. The eyeball vibrates through a few seconds of arc and thereby causes the optical image on the retina to move relative to the rods and cones which are the sensitive end organs. The end organs are thus in continual receipt of events that correspond to *outlines* in the visible world. We *draw* distinctions; that is, we pull them out. Those distinctions that remain undrawn are *not*. They are lost forever

> with the sound of the falling tree which Bishop Berkeley did not hear.* They are part of William Blake's 'corporeal': 'Nobody knows of its Dwelling Place: it is in Fallacy, and its Existence an Imposture.'

We only pick up differences when we actively 'draw a distinction.' Whatever 'latent differences' are not actively taken up by the senses do not make a difference. Therefore they 'are not.'

This not only says that differences must make a difference to be part of Creatura, but it indicates that the link between Pleroma and Creatura is dubious. If a difference does not make a difference (to someone or something?) it is *not*. With one hand he says there are latent differences in the territory, and with the other he says they '*are not*.'

So, how can we know that the territory, the Pleroma, exists at all in the way we distinguish it? Gregory never resolved this conundrum, it seems, with the result that, although he never slipped off into subjective idealism himself, those who survived him in the American Society for Cybernetics, e.g., H. Maturana, F. Varela, H. von Foerster, E. von Glasersfeld, did.

Gregory ended by clinging to epistemological realism as an act of faith, neither abandoning it nor finding a way to support it intellectually. Those who survived him played Fichte to his Kant.

The more he tried to make the distinction between energy and information clear, the more impossible it became to explain how Creatural beings could know the Pleroma.

## How to Resolve the Ambiguity

Although Bateson never succeeded in showing what connects the Pleroma to the Creatura, he gave us virtually all the necessary tools for doing so ourselves.

For him, differences exist only in creatural maps of the world. Latent difference, differences that do not make it to maps '*are not*.' So let us investigate for ourselves what actually comes across from the territory to the map.

I first heard Gregory speak on Long Island in 1974, at the Lindisfarne Association. Gregory was saying, then, that it is *difference* that gets from the territory to the map. And that difference is perceived through movement of the world relative to the sense organ, or vice versa. He showed what he meant by taking a piece of chalk and grinding the end of it onto a spot on the blackboard, thus leaving a little mound of chalk on the board. He said that if he brought his finger directly

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* The bishop argued that only the perceived is 'real' and that the tree which falls *unheard* makes no sound. I would argue that latent differences, i.e., those which for whatever reason do not make a difference, are not *information*, and that 'parts,' 'wholes,' 'trees,' and 'sounds' exist as such only in quotation marks. It is *we* who differentiate 'tree' from 'air' and 'earth,' 'whole' from 'part,' and so on. But do not forget that the 'tree' is alive and therefore itself capable of receiving certain sorts of information. It too may discriminate 'wet' from 'dry.' [*MN*, 97]

down on the little mound, he could not feel the chalk at all. But if he passed his finger along the blackboard from left to right and passed over the little mound of chalk he could feel it very distinctly. I came up to him after the talk and asked him if it is not rather ‘change’ that comes across. He responded, ‘Change is difference, plus a clock.’

Many years later I concluded that the right way to say that point is: ‘Change is difference, minus abstraction.’ So, let’s do a thought experiment on what gets from the territory to the map. It can’t be *difference* because, as Gregory pointed out, difference does not exist in space and time and the Pleromic territory is entirely in space and time.

Gregory showed us that what comes across from the territory to the *senses* is *change*, a change in the way the sense organ and the territory are disposed to one another.

Gregory had been impressed with Warren McCullogh’s experiment published as, ‘What the Frog’s Eye Tells the Frog’s Brain.’(Lettvin, McCullogh, et al., 1959) The frog’s retina only sends signals to its brain if the image on the retina moves. If an insect sitting in front of a frog begins to fly or leap, the frog will begin to see the bug, and maybe catch it. Otherwise the frog will see nothing.

The earlier quote regarding micronystagmus is important here, since it shows that our eyes, like the frog’s, require motion in order to see anything – but that our eyes have their own slight constant tremor that allows us to see stationary objects in front of us.

So, it is change in the environment that is what the sense organism is sensitive to.

Now, changes are essentially temporal and spatial. They occur in some place during some period of time. Changes, then, are not ‘differences, plus a clock.’ Difference is change, plus abstraction. Difference is change, minus space and time. Change actually and fully exists in the world of space and time.

This is step one on our way from territory to map. A real spatio-temporal change in the environment causes a real spatio-temporal change in one or more sense organs. Does this get us across the boundary between Pleroma and Creatura? Probably not quite. The physical retina and the physical pads of my fingertips are certainly Pleroma. They can be analyzed in terms of physical forces and causal impacts as much as any part of the world can. But they are either included in Creatura as well, or are on the very threshold of Creatura.

What happens next brings us fully into Creatura. But, observe, even this may not be leaving Pleroma behind.

## Abstraction

If difference is abstract, then how does abstraction come into existence?

It is the tradition of modern philosophy, following Descartes, who followed the neoplatonic scholastics and St. Augustine, that the generation of a concept, which is a full-blown abstraction, requires the existence of an immaterial substance to generate it. This immaterial substance would have to be free from existence in space and time just as the abstraction is.

Bateson got very close to resolving this ancient philosophical problem, but not close enough. If we combine the tools he left us with the neuroscience of today, we may be able to resolve this issue now.

When does abstraction begin? Gregory gave us the tool to understand this. Gregory taught us to notice the importance of collateral energy in the generation and propagation of information.

In the case of the retina, when changes in intensity of various wavelengths of light pass over the rods and cones, the neurons connecting them with other parts of the brain fire. The firing of a neuron is a case of the triggering of collateral energy. The neuron has its own energy in the ions of sodium and chlorine marshaled separately along its length. When the energy of the light on a rod or cone *changes*, the neuron is triggered. A stimulation of the nerve end starts a ripple which runs up its length using the neuron's own energy.

What, then, happens to the energy of the stream of photons that passed across each rod or cone? It is dissipated as heat within the eye once it has triggered the neuron's response. The energy of the light that, in changing, triggered the response, is left behind.

This, we propose, is the first level of abstraction.

The ancients and mediaevals were astute in naming the process of going from the world to cognition-of-the-world, 'abstraction.' It means literally, 'to drag away from,' *abs-traction*.

The action of the neuron, using it own energy, energy that is collateral to the (changing) energy of the light falling on the retina, has abs-tracted the change from a change in solar photons to a change in neuronal bips. If the light is high intensity (many photons) the number of firings-per-second is high. If the intensity is low, the firings are few. But in both cases, the energy of the photons is left behind. The changes are *abstracted* from the energy.

Now, if we are asked what comes across from the territory to the map, we would say *changes*. Changes in the environment are transformed into changes in the neurons, which are then transformed into changes in the firings of complexes of neurons.

These are still transforms of change, from one type of spatio-temporal change to another. Pleromically, these are changes in one kind of energy, triggering changes in a collateral energy.

But *functionally*, these are transforms of *difference*. What comes across from the light on the retina to the visual cortex is transforms of difference, the energy and the original change in illumination is left behind, only the differences in illumination are retained.

This is initial abstraction. There are other types, too. When I hold a cup of hot coffee in my hand, my finger pads are physically made to curve in an iconic match to the curvature of the cup. Certain nerve endings embedded in the finger pads are triggered by this change of shape in the pads.

At the same time, the skin of these finger pads is warming up because of the transfer of heat (speed of molecules) from the porcelain cup to the fingers. Other specific neurons, that are unaffected by shape, are sensitive to changes of heat in the fingers. They are triggered to fire by the warming of the fingers. If, in addition, I squeeze hard on the cup, still other neurons in the finger pads, and in the joints of the hand, are triggered in response to the increased pressure.

All of these different neurons respond in the same way to increased intensity of what they are differentially tuned to, e.g., heat, pressure, shape, etc. They fire more often per second in response to greater intensity of their specific input no matter what kind of input it is.

Nothing of the *quality* of shape, or of pressure, or of heat gets into the neuron. There is no difference in the bips that pass up the different neurons. Different types of sensation are all transformed into the same code.

But the brain can tell *which* neuron is firing at a certain intensity and because of this it is able to generate a sensation of heat from bips in one set of neurons and a sensation of pressure from an identical series of bips arriving from a different set of neurons. The fact that different sets of neurons are tuned to different changes in the environment makes it possible for an extremely simple code to produce a rich and complex map.

This narrow-gauged tuning produces another type of abstraction, abstraction according to specific quality. It leaves behind a wide range of stimuli (unless their impingement happens to be extremely intense.) The specific tuning of a neuron brings the brain a specific difference, from the environment.

## Summary

Abstraction occurs when all wave lengths but one are tuned out – are ineffective at triggering a particular receptor. Abstraction occurs when all external stimuli – light sound, pressure, temperature, texture of touch, odors and tastes, all are reduced to on/off events, to more or less rapid firings of neurons.

But primarily – more fundamentally than all these – we move across an important threshold when collateral energy takes over and leaves the original energy of the stimulus entirely behind.

## The Epistemic Cut

But let us look more carefully. If we have successfully crossed from the Pleroma to the Creatura, we must have crossed what some have called, the ‘epistemic cut.’ (Pattee, 2001)

Previously, we used the phrase: ‘But, functionally, these [changes] are transforms of difference.’ The little adverb, *functionally*, is the pivotal word here. The triggering of collateral energy is not by itself Creatural, nor is it abstraction. Consider an avalanche of snow in the Alps. Where snow has accumulated precariously on a mountainside, a small amount of movement such as a rock thrown at the right spot, or even just the loud report of a firearm, has been known to trigger an avalanche. This is not 'difference making a difference.' This is a small amount of physical energy unleashing a large amount of potential physical energy available in the overhanging snow bank.

So, too, the way the increased pressure of this pencil on my fingers unleashes the potential energy of the 'pressure neurons' going up to my brain is perfectly Pleromic. It is just an energy event. You can say there is a primitive abstraction in it because the original energy is left behind. But we cannot find any evidence in the physical processes themselves of an epistemic cut.

We are not yet at the point where there is difference that can make a difference as long as we look only at the triggering of collateral energy. We must look wider and see that 'functionally, these changes are transforms of difference.' The way the triggering of neuronal firings is different from the triggering of an avalanche is that the neuronal firings are part of a large circuit of neural firings that will most likely eventuate in motor neuron firings stimulating actions back out upon the part of the environment that originally stimulated the sense organ. If the cup is too hot for my fingers, the very rapid neural firings will eventuate in my putting the cup down (or dropping it) to prevent my skin from a possible burn.

There is no way to distinguish neural triggering from an avalanche until a *whole circuit* comes to be. An 'epistemic cut' requires that the neural triggerings be 'about' something. What they are about is the original stimulating change in the environment. Once the circuit is complete and the organism moves to seek or to avoid, to act upon in some way the original object that stimulated the senses, then it is clear that the loop of changes in the neural circuit is, in a rudimentary sense, 'about' the original stimulating object. When the object of stimulus becomes also the object of response, when it both starts and ends the process, the process *points to* that object.

At this juncture we can say that what came from the territory to the map were *differences*, differences embodied and embedded as spatio-temporal changes in the interface between the environment and the sense organs. These embodied *differences* in the territory become re-embodied in the neuronal firings of sensory neurons, and re-embedded in subsequent neurons after each synapse-crossing.

This is why Gregory gave so much thought to circuits of differences.

But it is not clear that Gregory worked out a theory of 'aboutness,' of intentionality, of reference. He was perhaps limited by the strictly syntactic nature of Shannon-information. Yet he had all the tools in his hand.

## Ding an Sich

Perhaps the largest question in epistemology is: How can we know anything if we cannot know the *Ding an sich*, the thing-in-itself? Or, another way of putting it: If we cannot know the *Ding an sich*, do we know the natural world at all?

Gregory tended to say that we know images of the world, not the world itself. An epistemology of mediate realism says that we do not know$_{\text{our}}$ images of the world, but we know the world itself *through* our images of it. Gregory cannot come to an epistemology of mediate realism because he has no developed theory of reference, no theory of intentionality or 'aboutness.'

Let's parse this problem more finely than Gregory did. The notion of the *Ding an sich* goes back to the scholastic philosophers of the 13thcentury who used the phrase *in se* vs. *quoad nos*, a pair of philosophical jargon terms that are understood in relation to each other. Any being or entity that is understood *quoad nos* is understood as it relates to us. We might say that the sun is a disk, *quoad nos*, as far as we are concerned, i.e., from our point of view. But the sun is a sphere *in se*, in itself, i.e., not relative to any particular observer.

But there is a subtlety here that must be examined.

When we use the phrase 'in itself', *in se, an sich*, we seem to mean the object or event without its relationships to other things. But the question is, is any object or event real without its relationships to other things?

Of course there is a difference between the relationship to a perceiver, i.e., the causal relationships that trigger perceptions, and the relationships that a thing has altogether, the sum of its relationships to everything (as Kant and Bateson point out). But, is it not the case that we organisms perceive objects and events by means of the relationships that the objects and events have to other things?

The white egret is seen at dusk by virtue of the characteristic way light relates to the molecular patterns of its feathers. The crow is harder to see at dusk and may be missed entirely – because of the characteristic way its feathers absorb rather than reflect streams of photons. We perceive the mass of a paperweight by holding it in our hand. This perception is possible due to the attraction, the relationship, between the paperweight and the mass of the earth. Our perception of the mass of the object is due to the intrinsic gravitational relationship between it and the earth.

It is due to their relationships with other things that objects are able to be perceived by organisms with senses. But the fact that material objects have relationships to each other: reflectivity, resistance, momentum, gravitational mass, chemical reactivity, vibratory speed, resonance, etc, is not extrinsic to them. It is intrinsic. To think any other way is to imagine an essence, as in the Aristotelian/scholastic tradition, an *essence* which is different from and mentally separable from the perceivable 'accidents,' color, texture, shape, reflectivity, etc. This philosophy of essentialism has been left behind, undermined by scientific evidence during the 20th century.

Therefore, any thing *in itself* is a thing *with* its relationships. The idea of a thing without its relationships to other things is clearly just an idea. Such a thing cannot exist in the real world. It is an abstraction of the mind. So, we must conclude that the thing in itself, the *Ding and sich*, has relationships. And it is precisely through (by means of) these relationships that the perception and thus cognition of the object occurs. Therefore, we *can* know/perceive the thing-in-itself, but of course, indirectly, through the medium of the senses and central nervous system.

The philosophical texts that have for centuries claimed that the thing *in itself* cannot be known are the result of a trick of words, a subtle assumption that the *real* things out there are somehow stripped of their relationality. As we have seen, a little reflection shows that this is absurd. The relationality of things in the world is intrinsic to what they are *in themselves*. Therefore, any *Ding an sich* that cannot be known only exists in our minds. The *Ding an sich* that cannot be known is precisely not a real thing in the world, but a mental construct, a figment of the conceiving mind. All *Dinge an sich* in the concrete world can in principle be known. Yes, known as *Dinge an sich*, as things in themselves.

However, they cannot be known directly, i.e., immediately, because nothing can be known without the mediation of the nervous system. But still they can be known *in themselves*, that is in their intrinsic relationships, through relationships that are inseparable from their intrinsic qualities, characteristics.

## The Hands and the Mind

We do not know the outside object directly. But, if not directly, do we know it at all? That is the next question? Or, do we only know images in our minds?

As mentioned above, Gregory tended to think we only know the images constructed by the brain. And he had no consistent or coherent theory of what, if anything, comes across from the territory to the map, from the Pleroma to the Creatura.

We have suggested that there is a missing element in his overall theory, the lack of which leaves him in this lurch. He has no developed theory of reference, i.e., he has no way of discussing 'aboutness' or intentionality. But there is also another missing element, of equal importance. He does not distinguish between cognition of the Pleroma, which is necessarily indirect, and action upon the Pleroma, which is direct. Yet, a case can be made that he was right on the edge of both of these understandings during the last 10 years of his life.

We have concluded that the map is not the territory and become aware that I can never feel or see or hear directly the pencil that is in my hands. At most I feel changes in shape of my finger pads, in the position of my joints and muscles, and the moving of light and shade on my retinas. The pencil itself remains out there beyond my fingers and eyes, and seemingly beyond my ability to reach it cognitively. Once we have reflected on this fact it seems that there is nothing we can do. In fact, Gregory wrote exactly that, '… it is the *Ding an sich* and there is nothing you can do with it.'

But here he was simply wrong. The opposite is true. Exactly what we can do is *do something with it*. In *feeling* shape, pressure and temperature, our hands have only indirect access to the pencil, mediated by the central nervous system. But *in action* our hands have direct access and they can move and change the pencil directly.

This is a most important fact to keep in mind for epistemology. Because direct effects upon the Pleroma by our pleromic hands can influence the indirect cognitive access we have that is dependent upon neural encoding. That seemingly infinite distance between my map and the territory is bridged by the *direct* connection between my hands and the territory.

I can never feel the pencil directly, but I can break it directly.

Francis Bacon was the first to propose clearly that access to the secrets of nature will only come through experimental manipulation of the material world by means our hands and our instruments. As long as philosophers kept their hands off the world their observations could only go so far. The history of philosophy in the West is basically the history of four or five large theories. Over the last twenty three centuries, philosophers have proposed modified forms of these theories again and again.

But when the hands were finally brought into the quest for understanding, experimental science began an unending series of *new discoveries*, building each on one another progressively.

## How Does It Work?

When we simply observe the world through our mediated observations, we can think that it is only our images and concepts that we know, not the world. But when we test our images and concepts by directly changing the material world that we seek to know better, we observe how these changes we produce in the world change our images in turn. We can conceive of how the objects we are observing might be constructed, and then directly dismantle them to see if we were right, or not.

It is the direct contact, the direct intimacy, of our pleromic hands with the pleromic world that gives our creatural images purchase on that world and renders our images and concepts veridical – if not by thorough-going validation, then at least by falsifying many of them and leaving those which we cannot experimentally falsify, after many attempts, as therefore likely to be pretty much as we conceive them.

It is through the simplicity and directness of action on the world that the weakness of our indirect cognitive access to the territory is strengthened. It is through the interaction of sensory observation and manipulation, followed by the invention and manual construction of instruments to improve our sensory access, followed next by more observation and manipulation that our maps progressively converge upon the world itself.

Thus, we become legitimately confident that we do not perceive merely our images, but we perceive the world *through* our images. Our knowledge of the territory will never have the transparency imagined by the naïve realist, but it begins to have what can be called ‘a functional transparency.’ Ultimately, we *do* see, hear and feel the world – but indirectly. It is the directness of manipulation that confirms the functional transparency of our images.

We can thus, at last, conclude with Gregory, but now unambiguously, that there are *latent differences* in the Pleroma. We admit that we draw them out with our senses, but not with our senses working alone. The combination of the senses and our ability to change the world which will in turn change our images, which new images we can then use to guide us in changing the world again – these are the elements of a realist epistemology.

Gregory knew this, but did not perhaps perceive its importance as a confirmation of knowledge. His classic story of the man, the axe and the tree offers this lesson. But Gregory, focusing on the circuit of creatural differences, seems to have missed the lesson that when the pleromic axe changes the pleromic tree the creatural mental process begins to have purchase on the world.

> Consider a tree and a man and an axe. We observe that the axe flies through the air and makes certain sorts of gashes in a pre-existing cut in the side of the tree.
>
> If now we want to explain this set of phenomena, we shall be concerned with differences in the cut face of the tree, differences in the retina of the man, differences in his central nervous system, differences in his efferent neural messages, differences in the behavior of his muscles, differences in how the axe flies, to the differences which the axe then makes on the face of the tree. (*Steps*, 464–5)

The second lack in his theory, the missing explanation of reference can also be seen to be remedied by the twofold process of observation, manipulation, new observation, new manipulation – indirect, to direct, to indirect, to direct. It is through the directness of manipulation that the image is seen to be *about* the object in the world.

What assures us that our images are in fact *about* the object in the world is that our sensory images track the changes in the world that the hands initiate. What assures us that our constructed concepts of what the world is like are truly *about* the world is both the way the concepts guide action, and the way that, through this ability, they can be falsified by the results of manipulation in experiment.

As Gregory always maintained, it is the circuit that makes the mind.

I propose that something like this is the theory that Gregory was trying to articulate. By the end of his life it seems that he knew he had failed. An indication that he felt he had not achieved a theory of mediate realism is that, although he never gave in to subjective idealism, in the pages of his final book he gives in to fideism.

> It is commonly thought that faith is necessary for religion – that the supernatural aspects of mythology must not be questioned – so the gap between the observer and the supernatural is covered by faith. But when we recognize the gap between *cogito* and *sum*, and the similar gap between *percipio* and *est*, 'faith' comes to have quite a different meaning. Gaps such as these are a necessity of our being, to be covered by 'faith' in a very intimate and deep sense of the word.
>
> Then what is ordinarily called 'religion,' the net of ritual, mythology, and mystification, begins to show itself as a sort of cocoon woven to protect that more intimate – and utterly necessary – faith. [*AF*, gb, 96]

## Conclusion

There were a few linked issues that are both relevant to his work and linked to each other that Gregory did not address, amidst the very large number that he did. Along with *aboutness* and *reference* which he did not work on, there was *action*. At an informal seminar not long before his death I asked him to speak to a philosophy of action. He responded, 'Well, you know I have never been much for action.' I suggested, then, that he might speak to a philosophy of non-action. He looked at me, and remained silent.

These issues of intentionality and action go together. As I have pointed out, his blind spot about action led him to miss the role of the direct access the hands have to the territory. In describing the man with the axe, he focused on the circuit of differences, i.e., the creatural aspect, not the ability of the pleromic axehead to directly change the territory.

We know the territory is there beyond our maps because it resists us. It resists our efforts to do things and our efforts to know things. But it does not resist absolutely.

The interaction of hand work and mind work has given us virtually all the understandings of nature that the sciences have offered. Each year, each decade we know more – not just a little more, but much more. Although it is true that the interaction of the pleromic hand and creatural mind brings our images into a closer fit with the territory only *asymptotically*, the clear evidence of *continually improved and improving* knowledge due to their interaction is the ultimate warrant for realism.

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# Chapter 4
# The Pattern Which Connects Pleroma to Creatura: The Autocell Bridge from Physics to Life

**Terrence Deacon and Jeremy Sherman**

**Abstract** By his own standards Gregory Bateson was unsuccessful in his lifelong quest to explain how the informational or living realm (creatura) could emerge out of the energetic or physical realm (pleroma). Drawing upon recent insights in self-organization theory, the authors suggest a missing link connecting the realms; a simple spontaneously arising, non-living, yet evolvable molecular system called an "autocell" consisting of the reciprocal linkage between an autocatalytic cycle and a self-assembling encapsulation process (modeled on viral encapsulation) where the molecular constituents for the capsule are products of the autocatalysis. Autocells are shown to have the rudiments of individuality, end-directedness, function, and valuation; thus bridging the critical initial gap between pleroma and creatura.

**Keywords** Gregory Bateson, origins of life, protocell, autocell, autocatalysis, self-organization, evolvability, teleology, emergence

## Introduction

In a previous paper in this volume, Ty Cashman calls our attention to Gregory Bateson's abiding, yet ultimately unanswered question: What connects creatura to pleroma, the realm of life to the realm of non-life, the informational realm to the energetic realm, mind's realm to matter's realm? This is not, however, a division that the majority of scientists and philosophers today recognize as particularly troublesome. Since Descartes, Western traditions have focused on the split between

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soul and body, consciousness and biology. But to Bateson, evolution and learning were contiguous and the distinguishing features of mind were evident in all living processes. For him, the critical "epistemic cut" was identified between energetic and informational processes, and since life has at its base an informational character the crucial distinction must be drawn at the life/non-life transition. Though he never directly attempted to address questions about this transition, understanding the pattern of causality that connects non-life to life, physics and chemistry to biology, is implicitly the core mystery that stands behind his larger enterprise. While many, if not most of our colleagues remain more interested in the emergence of consciousness, and treat the emergence of biology from chemistry as a nearly solved problem, we believe that Bateson's insight points to an unrecognized fallacious presumption in this viewpoint: that life is reducible to mere chemistry and physics and information to patterns of energy exchange. In this essay we show that a careful and complete modeling of the transition from pleroma to creatura can clarify what these reductionist assumptions miss and provide an unambiguous connection linking the energetic to the semiotic realm.

Among Bateson's many methodological innovations, one of the most important is a focus on relationships rather than things, distinguishing the material-energetic realm of physics from the informational realm of life and mind. Information is a relationship between things in which one thing is shaped over time by another thing. Any "piece" of information is an irreducible relationship between a sign vehicle, a sign source, and a sign interpreting process. "The difference that makes a difference," makes that difference to something about something. A piece of information is therefore three things with relationships in their interstices. We, as signal recipients, detect a difference in the sign vehicle. The difference we detect makes a difference to us—it changes us. It makes a difference to us with respect to something that we take the sign vehicle to be about—a sign sender, the difference we make is with regard to the sender.

This is intuitive enough. It becomes counterintuitive when we recognize that so long as we think of sign senders and sign recipients as like us, we are smuggling black boxes into our schema—homunculi who send and interpret messages. To avoid this preformationist assumption, we must recognize, following the philosopher Charles Sanders Peirce, that what inteprets a sign is not some external locus—i.e. not some undefined "mind" standing outside the semiotic process—because all mental processes, according to Peirce, *are* semiotic processes. To avoid this homuncular assumption, then, he argued that signs are interpreted by other signs ("interpretants") generated in response by a sign-production process. This leaves open the question of what constitutes a sign-producing process,[1] but clearly locates

[1] Peirce ultimately defines this in terms of his broad concept of "habit" and this paper attempts to offer a minimalistic account of what this entails at the biological level.

the ground of interpretation within the semiotic realm.[2] This means that a semiotic relationship is not a relationship that can be understood in isolation, but is intrinsically a transition point within a process.

Many of Bateson's successors interpreted his last gropings as tipping toward a commitment to subjective idealism, an assumption that minds are independent homunculi, connected to the pleroma only by an article of faith. Others, Cashman and ourselves included, believe that Bateson's "pattern which connects" offers a way to bridge this gap deemed by the idealists to be unbridgeable.

We argue that implicit in Bateson's distinction between creatura and pleroma is a necessary assumption that creatura emerged somehow from pleroma. To understand the pattern that connects the two realms, then, we must ultimately answer a very specific question: How could creatura get started in an exclusively pleroma universe? Or, to translate into the more familiar biological framework, how could life have emerged here or anyplace in a universe that doesn't already possess life's attributes of relationship, function, and evolvabality—a universe governed solely by the known forces of physics and chemistry? Until this question is answered we cannot hope to fully grasp Bateson's "pattern which connects."

## The Problem with Protocells

Conventional inquiry into this challenge often employs a reverse engineering approach. Researchers identify the minimal characteristics of life (nucleic acid replication, cell membranes, and so on), and the elements of living systems that embody those characteristics, (DNA, RNA, lipids, and so on). They then imagine scenarios in which by chance alone, these essential constituents of cells might come into proximity and "come alive." The current experimental work on the origins of life that is considered most promising, involves laboratory efforts to actively construct minimal cell prototypes, as if to provide what engineers would call "proof of concept."

If the goal were to engineer life, then building a successful prototype would be half the battle. But engineering is precisely what a pre-life universe lacks. Origin of life researchers attempting to reconstruct new life from the scraps of living cells are not filling in the un-engineered missing link between physics and biology, but simply trying to put Humpty-Dumpty together again, with a few pieces left out. This may

[2] This way of describing Peirce's enigmatic and often mischaracterized process of "interpretants interpreting interpretants interpreting interpretants …" recognizes that semiosis is necessarily a physical process and is not merely mind-dependent in some disembodied sense. Nor does interpretation require some special (and undefined) interactionist story to connect semiosis with physical causes and effects. This also helps to dispel the separation of semiosis from cognition that some semioticians (e.g. Gören Sonesson) want to impose on the domain of semiotics, which would also implicitly exclude biological processes from semiotic analysis. We here argue that this is too restrictive because it would produce a sort of biological/mental dualism and also treat mental processes as non-semiotic as well. Both of these assumptions produce far more confusion than clarity.

show that life is not some ineffable essence, but does not show how life's properties can emerge spontaneously from a lifeless world. So in this effort, while recognizing the circularity of arguments from intelligent design, origin of life researchers unwittingly employ reasoning similar to that of intelligent design's defenders. They act as foresightful watchmakers in their effort to prove that life is the product of a blind watchmaker.

Indeed, the reverse engineering approach to the origins of life parallels watch making. Watchmakers assemble parts that already have been shaped for a specific function. They kick start the resulting product and it becomes animated. Protocell research assembles components of life that have evolved with particular functions, and imagine how nature might bring them together, and then assume that once together, they would come alive.

In two respects, the accretion of life from non-life is more challenging than the reverse engineering approach would suggest. First, the elements to be brought together could not have been previously modified to work together, as are the molecular complexes of cells. They can only be those that can be spontaneously produced in a lifeless context irrespective of one another or any living function. Second, although protocells made of parts salvaged from once-living cells may come to function in an integrated fashion, any such synergy traces to their long evolution not to any spontaneously emergent complementarity. A bricolage constellation of once-living components thus provides little insight into the transition from non-life to life. Protocells are in this way more like reanimated frankensteinian cells.

The true proof of concept requires demonstrating how critical properties of life could emerge by the spontaneous interactions among inorganically generated molecules. These properties include forming a complex that maintains its individuality despite perturbation and the ability to replicate itself indefinitely if conditions are right. This approach is a far more difficult alternative than reverse engineering from a known end-point, and yet it inevitably involves fewer components in simpler combinations owing to the requirement that it must have arisen spontaneously. To meet this challenge requires vigilance to avoid what could be called the *Amnesiac Watchmaker Syndrome*—reverse-engineering from life, and then assuming that the engineering effort was irrelevant, as though we found this to be spontaneously produced.

In this paper we offer an exemplar proof-of-concept model that shows how properties of creatura could spontaneously emerge from mere pleroma. We propose a generic model of the transition to life that could apply anywhere in the universe; one that gets a cold start in relentless thermodynamics and molecular coincidence.

By cumulative standards, every step in the transition from non-life to life must be accounted for. Working forward to life instead of backward from life, it becomes obvious that anything approaching the complexity of even the simplest contemporary terrestrial life-forms could not possibly emerge de novo from inorganic chemistry and physics in a single transition. Our emphasis will therefore be on exploring the realm between non-life and life; forms that are not living but nonetheless possess properties that would bias chance increasingly toward the self-maintenance and reproductive capacity that would be the necessary precursor attributes of anything evolvable.

The challenge for a non-engineering cumulative approach like ours is demonstrating not only how precursor elements might fall together, or even stay together but more importantly how they might become necessary to each other. In the abstract, we might describe this alternative to reverse engineering as searching for the possibility of spontaneous combinatorial synergy, but this is not quite sufficient. The concept of synergy is ambiguous. A weak interpretation of synergy is as a state in which each part is of some benefit to another. A strong interpretation of synergy is as a state in which each part is wholly dependent upon the others. The alternative must be held to the more stringent standard of strong synergy; with components that are both co-dependent and also co-productive.

By this standard, of all of life's features, the feature that is most central, and that must arise first is the reciprocally productive coupling of component products. As the 18th century philosopher Immanuel Kant argued, "The definition of an organic body is that it is a body, every part of which is there for the sake of the other (reciprocally as end and at the same time means) … An organic body is one in which each part, with its moving force, necessarily relates to the whole (to each part in its composition.)" (Kant, 1790)

In sum then, our goal in what follows is to see pure happenstance produce minimal evolvable products, a population of forms that would be differentially sustained over time depending upon environmental conditions.

The spontaneous co-productive approach to the origins of life also may provide important insights concerning the nature of other emergent transitions as well. Often emergence is treated as a problem for the philosophy of science; one of defining what we mean by sharp inexplicable transitions between the explanatory regimes of physics, chemistry, biology, and consciousness. Emergence occurs when the net effect of the interactions among parts of a system produces a significant shift in the characteristics and behavior of the whole system. If we can provide a complete step-by-step description of one such transition, we should be in a better position to make sense of others—especially as this is a paradigm case. So again, we may be able to improve upon mere descriptive or reverse-engineering analyses of emergent transitions, such as that leading to mind, by comparison to this constructive model. Beyond merely exemplifying emergence, then, we would hope that traversing this one transition, will pave the way to a more subtle and complete understanding of emergent processes in general.

Finally, one further benefit of providing a step-by-step account of the transition from non-life to life is that it can illuminate the concept of purpose or *telos*, and its origin from a previously purposeless universe. In the debate between science and fundamentalist religion that the world's citizens watch so attentively, the burden is on science to demonstrate how purposive processes can emerge in the absence of antecedent intelligence, carefully selected prior conditions, or intrinsically teleological components. Until it is possible to show at least in principle how teleological dynamics can emerge de novo, a shadow of doubt will remain about whether mechanistic causality and teleological causality are compatible, and whether consciousness, meaning, and value are ultimately ineffable. Bridging this threshold is the first step toward naturalizing humankind's undeniably sighted watchmakers. Though we will not attempt to address any of the grand mysteries of subjective experience and value, we believe that by tracking the emergence of the fledgling precursor to these intentional relations—function—we will have provided firm evidence that the naturalization of purpose is not an impossibility.

## The Thermodynamic Universe

A collection of interacting molecules (for example, a container of water) has no integration of parts, no for-the-whole contribution of one molecule to the rest, but, still, global properties emerge as these interactions produce a kind of vast regression toward the mean. Global features such as surface tension emerge in this way, and they are to some extent independent of many of the details of the molecules involved, since many substances can exhibit this phenomenon. Like the averaging of molecular movements producing temperature, surface tension is not a property of individual molecules or even of a few in interaction; it is a system-wide effect of a very large averaging process. Surface tension is a product of what are called van der Waals's forces: a weak energetic attraction between like molecules that keeps the space between them at a minimum (a little bit like the stickiness that can hold a statically charged balloon to the wall). The momentum of individual molecules is altered by the presence of nearby molecules in close interaction with each other, causing greater coherence between them than between them and molecules of air which are less tightly coupled.

Emergence in simple thermodynamic systems flows from the logic of the second law of thermodynamics, which, although based on the billiard ball-like interactions of molecules, is itself quite different in character because it is intrinsically distributional and statistical. It is a rule about probable and improbable patterns and how they are likely to follow each other in time. Although this rule is not so specific or absolute as are Newtonian laws of motion, it is all but guaranteed, in the same way that shuffling a deck of cards hundreds of thousands of times is still hugely unlikely to ever result in an arrangement in which each of the suits is separated and numerically ordered. The organizing effect exemplified by system properties such as surface tension occurs because the statistics of the ramifying and recirculating exchanges of energy eventually pits every difference of movement against every other, eventually leading toward thorough mutual cancellation, and thus uniformity. So, before life and before purpose, we can apply the concept of emergence in a minimal sense to these highly robust system-level tendencies. It is important to note, however, that these are the product not of new forces, but, rather, of population effects of the same forces. And, yet, the system-level tendencies have a new kind of causal efficacy that while based on the system's individual elements is primarily the result of the distributional characteristics of their repeated interactions. This is why both water and alcohol can behave in ways that are almost indistinguishable.

## Thermodynamics Plus Shape: Biased Molecular Interactions

In simple physical systems, molecules interact thermodynamically—colliding, rebounding, sometimes sticking. But it is not just their direction and momentum that matters. Shape matters. All of what makes chemistry different than billiard-ball interaction is a consequence of shape effects at some level and how this biases what is likely and unlikely to occur over and above the relentless evening out of the energetic shuffling process. At collision velocities and angles inappropriate to create stronger, electron exchanging covalent and ionic bonds, molecules usually just rebound. But because molecules in a solution also exhibit van der Waals's stickiness, in some orientations this mutual stickiness aided by complementary shapes can overcome the momentum that would otherwise cause them to bounce apart. The strength of this attraction, called hydrogen bonding, is comparatively weak and does not often reach the level to keep molecules together for long amid the constant jostling with neighbors. The strength of this stickiness, and thus the duration of time molecules tend to stay attached, is a function of the quantity of conforming surface area between them. (Thus, very large molecules with lots of surface area in contact can actually be very tightly bonded this way, as in the case of DNA.) The closer the fit between the shapes in contact between two molecules, the more likely they will stick, and the longer they will stick in exactly that orientation.

On the one hand, this differential stickiness is purposeless, devoid of all teleological impetus. It is just a consequence of the chance distributions of shapes and bonding predispositions in a collection of molecules. Overall, the stickiness is random, and mutually canceling, moving molecular interactions toward equilibrium. On the other hand, the contribution of shape that makes some molecules more likely to stick to each other, and more likely to be oriented in certain ways when they do, makes the whole process nonrandom in other ways.

Thermodynamic emergence drives systems toward equilibrium, in all attributes. Still, there is a very low but non-negligible potential for modest local reactions that bias molecular types away from an all-things-being-equal equilibrium. The effects of molecular shape are some of the most important of these biases. One major mechanism underlying this potential is catalysis, a result of shape-mediated molecular stickiness that affects rates of chemical reaction (that is, formation of ionic and covalent bonds, changing the structures of molecules). Catalysis occurs when one or more molecules mediate and potentiate specific reactions of other molecules but in which the biasing molecules are not permanently restructured in the process.

Most organic catalysts are proteins that increase the possibility that certain chemical reactions will occur by biasing the proximity and orientations of select molecules in ways favorable to a given chemical reaction between them. This is the result of the way the shape of the catalytic molecule temporarily captures other molecules with complementary shapes to it, briefly holding them in a specific orientation. This action may favor the captured molecule cleaving at a specific weakened point, or bringing two molecules into proximity with each other in orientations favorable to their forming a bond and fusing. The unaffected catalysts molecules retain their shape and therefore retain the ability to cause still other molecules to break apart or come together.

Catalysts have no purpose. Their biasing affect is merely a result of chance shape correspondences. But shape biases significantly contribute to skewing the thermodynamics of a molecular system away from billiard-ball randomness. A random distribution of molecules that happens to have strong catalysts present would spontaneously exhibit a system-wide behavior, a trend toward increased transformation of certain molecules to certain other molecular forms. This behavior is the net effect of many interactions between the elements. It is dependent on the energetic stickiness between molecules, and, hence, it is also a result of thermodynamic emergence—but not *just* thermodynamics. This is one reason chemistry must take more into account than physics. The relationships between the shapes of the molecules, their relative stickiness, and their electron sharing/exchanging potentials combines with thermodynamics to determine the resulting behavior. Chemical solutions, though still subject to shuffling effects, can produce a biased sorting and transformation of molecular types. So chemistry combines an evening-out effect with shape-charge-bias effects.

## From Thermodynamics to Morphodynamics

There are, however, special cases where the form effects don't tend toward an equilibrium, but, instead, compound to become even more prominent than the mutually canceling effect of thermodynamic shuffling. This happens in the special case when there is continuous thermodynamic instability, so that, within a part of a system, things never get a chance to even out. These are non-equilibrium conditions, and in these cases the biasing effects of shape can come to predominate. With new energy or materials continually entering and replenishing an original uneven distribution, interactions within this non-equilibrium context tend to generate compensating processes. Energy and new materials must be exported as quickly as they arrive, or else imbalances will build to the breaking point. Under these circumstances a different kind of evening-out process must occur: a balancing between input and output. Under these circumstances, mutually counteracting biases will still cancel, but complementary biasing effects will accumulate consequences and reinforce one another with respect to their combined contribution to regularizing this flow.

In non-equilibrium systems, as in the case of emergent features of thermodynamic processes discussed above, regularities emerge at higher-scales because of mutually canceling interactions of components. It's just that some effects do not cancel; they amplify. The biasing effects of shapes interacting with shapes can reinforce one another, if they are complementary. This is most easily seen in cases where diverse shapes and sizes of solid objects, e.g. pebbles, are incessantly buffeted, e.g. by ocean waves hitting the shore, and end up distributing themselves on the shore according to these features. The constant through-put of disturbing materials or energy samples and re-samples these otherwise subtle biasing effects, and compounds these with each other while it damps the rest. This pattern of dynamics, which is a special case of thermodynamic tendencies amplifying specific form tendencies, can be called morphodynamics.

## Autocatalysis: A Morphodynamic Chain Reaction

In a solution of many diverse kinds of molecules capable of catalytic effects, chances are fair that two or more catalysts will be mutually reinforcing in their biases. For example, one catalyst might transform raw ingredients into a molecule that can itself act as a catalyst. To risk a purpose-laden metaphor, this would be the equivalent of a production line that produces production line equipment. Though rare, it is also possible for a catalytic circle to form. To take an oversimplified example, imagine a catalyst, A, that catalyzes certain molecules, bonding them together in such a way that they become a second catalyst, B. Imagine, then, that catalyst B catalyzes certain other molecules, bonding them together in such a way that they become catalyst A. In this condition, known as autocatalysis (Prigogine and Stengers, 1984), the reciprocally reinforcing relationship between catalysts produces a kind of runaway effect. Starting with one of two catalytic molecules and abundant raw materials for both catalysts, the amounts of A and B would double with each catalytic cycle. This produces a compounding effect, because each cycle produces more catalysts, producing more cycles. Autocatalysis causes an accelerating chain reaction for as long as molecules are available to be catalyzed. Thus autocatalysis is a morphodynamic process determined by the way shape relationships self-amplify. But under normal circumstances substrates will be depleted very rapidly by runaway autocatalysis. So although autocatalytic sets diverge from initial conditions to rapidly bias concentrations of their components in some part of a solution, this is typically a very short-lived trend, eventually re-equilibrated.

Though it might be imagined that coincidentally reciprocal molecular shapes are highly improbable, work by Stuart Kauffman demonstrates that autocatalysis is more likely to arise spontaneously than one would generally suppose (Kauffman, 1986, 1993, 24). In an arbitrarily chosen solution of diversely shaped molecules in which there is a modest probability of some acting as catalysts for the formation of others, above a certain level of diversity of molecules the chances for closed circles of catalytic reactions grows rapidly, and eventually is a near certainty.

Autocatalytic sets are coherent sets in theory only, however. Unlike the analogy to a metaphoric factory production line, here, there is no dedicated linkage between the producers. Just as any single catalyst drifts about, interacting with molecules by chance, so, too, each of the catalysts in a catalytic set drifts without affinity, except by chance encounter. Although autocatalytic chain reactions have a kind of causal efficacy as a set, shifting a chemical soup out of equilibrium, they are merely molecules in local stochastic interaction. And despite the fact that each molecule of an autocatalytic set is, to our teleological way of thinking, part of a whole and able to produce more of its own components, this higher-order relation has no independent status. Individual catalysts encounter each other or diffuse randomly. Their interdependence is fleeting and serendipitous. The "set" itself is merely a descriptive attribute we use to explain the special dynamics that results, but which provides no independent constitutive contribution. Thus the set has neither individuality nor efficacy with respect to itself, and although its components can increase each-others' concentrations the "set" is not reproduced and cannot be in competition with other sets.

## Molecular Self-Assembly

Molecular self-assembly constitutes another class of molecular interactions that, like catalysts in an autocatalytic set, produce a runaway production of similar forms because of shape-fitting interactions. Self-assembly is a self-reinforcing pattern of molecular binding. In the same way that a catalyst and substrate molecule bind in a specific orientation, a single type of molecule can bind with other like molecules, forming an ordered structure, somewhat like a crystal. These structures could take various forms, depending on the symmetry of the molecule. Many molecules that bind into complexes produce clumplike or crystal-like structures, but some form regular polyhedral shells or tubes. The protein shells that encapsulate many viruses are well-known examples of self-assembled molecular polyhedrons and the microtubules that provide the virtual skeleton of eukaryotic cells are spirally assembled tubes. Self-assembly occurs spontaneously because molecules shaped so that they form regular arrays, when fit together, are at a lower energy state than when freely floating. And, as such structures grow, the number of facets in which new molecules can fit increases as well. If enough regular-fitting polygonal molecules are in the vicinity, self-assembly will result in formation of a hollow container. As such structures form, they will inevitably enclose other molecules in the vicinity, as though in a molecular capsule. This can lead to an interesting phenomenon.

It is possible that one of the catalysts or by-product of an autocatalytic cycle could also be a self-assembling molecule. In this special circumstance, self-assembling molecules would spontaneously form shells in proximity to molecules of the autocatalytic set of which they were by-products. In so doing, the shell is likely to enclose some or all of the molecules comprising the autocatalytic set. We would then have autocatalytic elements drifting within a shell that keeps them in proximity.

Deacon (in press) calls such self-enclosed autocatalytic sets "autocells." We should be careful to point out that they are not cells, like bacterial and eukaryotic cells, nor are they alive by any usual definition, yet they have interesting lifelike properties we will now discuss.

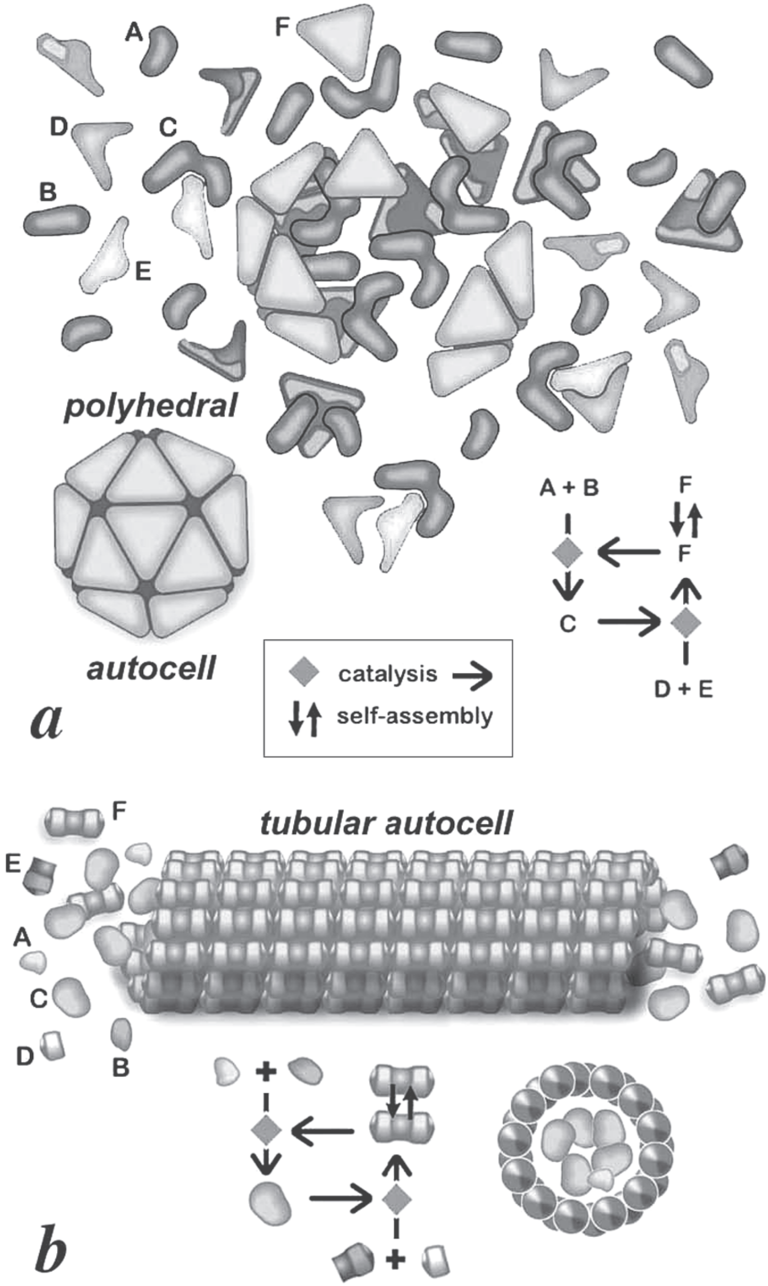


**Fig. 4.1** Two general classes of autocells are depicted as geometric constructions. An autocell produced by polyhedral containment is depicted in *a* and an autocell produced by spirally elongated tubular containment is depicted in *b*. Both are minimal autocells to the extent that each is constituted by only two catalysts (C and F in both). Catalysts are also depicted as synthesized from two substrate molecules in each case (A & B and D & E in both), though only in *a* is there any indication of the shape complementarities contributing to catalysis and self-assembly. Autocatalytic cycles are depicted with arrow diagrams for each (using letters in *a* and component shapes in *b*). From Deacon (2006)

## Autocell Functions

Surprisingly, autocells are sufficiently complex molecular systems to illustrate how elementary functional organization can emerge spontaneously from self-organizing processes. The key feature is not any single type of process in autocells, but rather the synergistic relationship between the two self-organizing processes that reciprocally depend upon one another's persistence. This feature does not depend on the continuous persistence of self-organizing processes, or of any component chemical reaction, only the *potential* of their persistence. Thus, paradoxically, one of the critical characteristics of autocells is that they are self-stopping. When a shell is complete, enclosing autocatalytic molecules, it limits catalysts' access to substrate molecules. Enclosure causes its catalytic processes to run down more rapidly than it would if the catalysts were free floating, so that catalysis inside the shell ceases altogether shortly after closure. Nonetheless, enclosure also keeps catalytic molecules from diffusing; they maintain proximity to one another despite their chemical inactivity. So, self-assembly temporarily limits catalytic activity and halts further growth but also limits molecular dissipation that could *permanently* undermine autocatalytic capacity.

Enclosure is inevitably a temporary condition. Molecular shells are buffeted about, as are individual molecules. As a result, they will occasionally break, spilling their contents, allowing their previously sequestered catalysts to again come in contact with the external milieu. If an autocell shell contains a full complement of catalysts from the autocatalytic set, and breaks in the presence of catalyzable molecules, the autocatalytic cycle can begin again, producing more catalysts and more shell molecules and again reconstituting a new shell that closes around whatever molecules happen to be present. Moreover, new autocells formed from the breakup of a parent autocell will form in the same way as their parent, and so will maintain continuity of structural characteristics over an extended period of time. In this way, the addition of the shell produced as a by-product of the autocatalysis creates the minimal condition for sustainable autocatalysis. By alternating between an enclosed dormant form and an open catalytic form, the overall configuration will be capable of both self-repair and self-replication, even though components come and go. An autocell is effectively a two-stroke engine that alternates between two reciprocal states—active and passive—to achieve a best-of-both-worlds configuration. An autocell is not responsive to its environment—responsiveness would have to evolve. Still the two-state nature of an autocell represents a necessary precursor condition to responsiveness, a life-like balancing act that natural selection could eventually shape. Thus, concomitant with co-dependency emerges another of life's primary requirements, an adaptable changeability that supports its continuity with consequences for the longevity of its form.

It is this systemic interdependence, or synergy, and not any component molecules or chemical reactions, that is the defining property of an autocell. In this way, autocellularity is not decomposable to any of its component molecules or reactions, even though they are necessary components. This special complementarity that exists between the two kinds of self-organizing processes in an autocell validates calling these processes *functions*; they are appropriately described as such precisely because of the way in which they indirectly aid their own persistence irrespective of specific material components. For example, we can now say that by virtue of self-assembly, an autocatalytic set functions to generate its own protection against diffusion; the shell protects the process that produces it. Similarly, we can say that container self-assembly functions to insure future container repair and replication by capturing the catalysts it needs. Autocatalytic sets by themselves do not endure, because they deplete resources and ultimately dissipate. For this reason, we would not use the term *function* to describe the reciprocal relationships between catalysts in the set. In contrast, within an autocell, these same relationships can be described as functional, precisely because they don't merely increase the probability of similar reactions (as do free-drifting catalysts of an autocatalytic set); they also play a role in ensuring that the *potential* to do so is more likely to persist as well. The functionality of component processes is defined with respect to this reflexivity whereby each contributes to the contextual conditions that make them more likely to persist, even despite their periodic cessation. Autocellular synergy thus illuminates a necessary condition of *telos* that we describe as "function."

There is nothing about an autocell that is greater than the sum of its parts, and, yet, there is nonetheless a new kind of causal efficacy exhibited that is irreducible to the precursor causal processes, treated in isolation. More precisely, although autocells are analyzable into component molecules and chemical reactions, autocellularity—and the special properties of self-reconstitution and self-replication it creates—cannot be reduced to these components alone. Although reaction energy, molecular interactions, and the thermodynamic and morphodynamic processes that result are necessary conditions for the production of autocells, once formed, autocells take on "a life of their own" as causal loci of a special type. Only where these conditions converge to produce the uniquely synergistic topology of causes that defines an autocell are these higher-order properties exhibited. This feature gives autocells a form of objective individuality that is quite concrete and distinctive, despite the fact that it is not identifiable with respect to any specific molecules or chemical reactions. It is individuality of a *potential* for a specific chemical dynamic, a particular structure, and most of all of specific systemic properties.

## The Birth of Evolvable Teleodynamics

We have seen how an autocell makes possible a prototypical self-reconstituting configuration of molecules worth regarding as an individual. Though the autocell lacks many necessary features for life, it is an individual precisely because this configuration constitutes a locus of causal consequences that are irreducible to any precursors. Because of this individuality and self-directed, self-reconstituting, self-reproducing dynamic the locus of potential that defines an autocell exhibits a primitive form of end-directedness; in other words, a minimal *telos* or *entelechy*. For this reason, although the process is both a reflection of thermodynamic and morphodynamic processes, we can describe this higher-order dynamic as teleodynamic.

Autocells have one more critical capacity that makes them of central interest to our discussion of the origins of *telos*: they can evolve. Shell molecules breaking apart and coming together would form multiple shells as easily as forming one alone. Multiple shells forming in and around an autocatalytic set would capture slightly varied samples of autocatalytic molecules. Many shells would be empty, many would contain incomplete complements of the necessary set for reinitiating autocatalysis when opened, and many would open in solutions devoid of catalyzable molecules. In these circumstances, dissociated components would likely dissipate without reforming shells. But where a full set of catalysts is enclosed and then broken open in the context of catalyzable substrates there is the potential for the vague equivalent of multiple "offspring" being generated. Breaking open by happenstance in the presence of catalyzable molecules, the contents of one autocell could reconstitute the original, or form several autocells.

Because of their periodic openness to the surroundings, given enough time and enough persistence, the autocatalytic set characterizing an autocell would likely come to interact with elements not in the original set. Some such interactions would undermine catalytic productivity. For example, a new catalyst entering the mixture might begin to transform other catalytic contributors, breaking them up even as their precursors produce them. In such cases, autocatalysis would significantly slow and decrease the effectiveness of the process of re-enclosure. Autocells thus handicapped would replicate more slowly and would fail to reconstitute more often than others.

It is also possible, however, that new catalytic relationships could accumulate without undermining the original autocatalytic set's productivity. Alternative catalysts or substrates might be present when an autocell opened that could be even more effective than the original precursors, or that provided an additional complementary catalytic route to autocatalysis, producing one of the autocatalytic set's component elements by other means. Having two ways to produce a catalytic element might accelerate the autocatalytic set's chain reaction. Various combinations of catalytic substitutions and partial duplications of cycles might also increase catalytic versatility, making the more complex autocatalytic set productive in environments that lack the raw ingredients for one or the other cycle. All such changes will result in alternative variant forms of an autocell lineage.

Biologists are coming to recognize how much of life's innovation comes about not just through random variation in genes but through homeosis, the chance duplication of components. Divergent modification of redundant components (typically, duplicated genes) can increase both versatility and specialization over the course of subsequent evolution, by virtue of the way it predisposes the evolution of complementary function. Hemoglobin provides a classic example: Multiple duplications of the ancestral globin gene evolved divergent complementary functions. In the same way, despite their simplicity, the inclusion of two or more slight variant forms of component autocell processes, could serve as the basis for autocell complexification in evolution.

Any of these transformations would amount to the equivalent of speciation of autocell lineages. In effect, two species of autocell—the one with the original structure and the one with an alternative structure—would be in competition with each other for those resources they both utilize. There would be differential replication rates and differential stability, and, thus, differential lineage propagation, due to the difference between their alternative ways of carrying out the corresponding functions. Though it is a leap from autocell evolution to the evolvability in life, this simple model provides a plausible hypothesis for the minimal conditions for evolvability, without needing to postulate the existence of information-bearing molecules like DNA. Indeed, this gives us a way to understand how molecular encoding of information in specialized template molecules could be a later evolutionary acquisition—one that differentiates out of this more primitive functionality. There is no need to imagine that information-bearing molecules like RNA are a necessary primitive given for the origin of life.

## Discussion

The origins of life have remained mysterious for so long that many assume it to be a recondite phenomenon. But we are aided in reconstructing this transition by virtue of the fact that conditions in a pre-life world would have necessarily limited the origin's complexity. The autocell scenario neither relies upon engineering or radically improbable coincidence. Nor does it imagine that life with the features of contemporary forms could arise in a single step. Life originated, by necessity from extremely simple beginnings and the transition from non-living to living was thus likely a many-stage evolutionary process.

In our scenario, we started not with evolution (for how could evolution arise by evolution?) but rather self-organization or as we have termed it, morphodynamics, the production of short-lived dissipative structures.

Next in sequence was Kant's necessary condition of reciprocal co-production:

> In such a natural product as this, every part is thought as owing its presence to the agency of all the remaining parts, and also as existing for the sake of the others and of the whole, that is as an instrument, or organ …Its parts must in their collective unity reciprocally produce one another alike as to form and combination, and thus by their own causality produce a whole, the conception of which, conversely … could in turn be the cause of the whole according to a principle, so that, consequently, the nexus of efficient causes might be no less estimated as an operation brought about by final causes.

By Kant's standards, we could say that an autocell is an organism though not a living one. Autocells lack many features we associate with life: They are exergonic, relying on the bonding energy intrinsic to catalysts and substrates rather than generating their own energy through work cycles. They have no replicator template—no RNA or DNA—and their forms do not differentially survive through replications so much as self-reconstitution. Indeed, they are not even responsive to their environment. Though they alter between two states—closed shell/inactive autocatalysis, and open shell/active autocatalysis, they open and close by chance alone, not in response to environmental conditions.

Still, as simple as autocells are, they nonetheless possess some of life's essential features in primitive barely recognizable form:

## Individuality

Autocells are robust to perturbation, as are all morphodynamic (self-organizing, dissipative) structures. Unlike other morphodynamic products however, autocells are also robust to disrupted energy flow. In their closed form autocells persist without energy throughput. As such, autocells maintain a systemic individuality in the face of both material turnover (as in all morphodynamic structures) and intermittent energy flow. Thus, with autocells we have the emergence of a primitive form of "self." The ability to persist without energy throughput is a necessary but perhaps not a sufficient condition for defining self-hood. The attributes described below also contribute to the reasonable application of the concept of self to autocells.

## Value, Purpose, End directedness and For-ness

In a lifeless universe there are no extant selves in the service of which things can be said to occur. With hindsight, one could argue that occurrences in a lifeless universe are in the service of the future living. Still, science is far from demonstrating that life was inevitable, so strictly speaking before there were entities to benefit from occurrences in the universe nothing was of value. There were no persistent forms to derive value.

The line at which value emerges is crossed with autocells. Of reciprocal co-production one could say that the container is good for the present (not future) autocatalytic set's perpetuation and the autocatalytic set is good for the present (not future) container's perpetuation, and further that occurrences in the autocell's environment are good for, or bad for present autocell lineages. There arises therefore a primitive form of value—of good and bad for an entity.

## Adaptation, Function, and Aboutness

Autocells oscillate between two states—closed and open. Possessing more than one state with regard to some contextual feature is a pre-requisite for evolvability. It provides behavior that can be modified through an evolutionary selective process. Variations between autocell lineages make such selection possible. It provides the requisite variation upon which selection can act.

We say that something that is good for an entity serves a function for that entity. The autocatalysis, the container and the relationship between them are good for the autocell's longevity. "Function" refers to a structure or process within a dynamical context that embodies the potential to promote the continued persistence of the dynamics that sustains this potential. As autocell lineages vary, stochastically acquired features could increase or decrease in functional value to the longevity of the autocells. Thus one could say that with autocells, primitive function and the evolution of function arises. An observer could describe a feature's function in two respects, the ways in which a feature was selectively retained in autocells and the ways in which the feature prepared the autocell for probable conditions in a stable environment in which past is to some extent prologue. With autocells we thus have a primitive form of evolution by adaptation, one that has no independent germ, one that is more Lamarckian than Darwinian but is nonetheless a product of blind variation with selective retention from which adaptive function emerges. Adaptive functions are elements of an entity that respond to and thus reveal something about the nature of the entity's environment. They are by definition in reference to, or "about," something other than the entity itself, something absent from the entity with which the entity fits. With the autocell's reciprocal co-production, the autocatalytic set as an entity persists because of the container—it is to some extent about the container. And likewise the container as an entity persists because of the autocatalytic set—it is likewise about them autocatalytic set. The synergy produced by this mutual aboutness gives rise to the autocell, which through evolvability acquires traits that are "about," features of the autocell's environment. Through adaptations, evolving autocells could be said to represent their environment, as a shoeprint could be said to represent a shoe. With autocells there is representation without a separate medium for representation, without either DNA or RNA.

## Conclusions

Bateson sought the connection between pleroma and creatura in two respects. He wondered how creatura interfaces with pleroma in cognition. That is, how we could ever know the *ding an sich*—a problem addressed in Cashman's paper. Bateson also wondered how creatura could emerge from pleroma; the ultimate problem of evolution, and the implication of the necessary dependency of creatura on pleroma. This is the question we have addressed in this article.

Our most ambitious claim is that autocells fill the missing link between non-life and life. Though we do not yet have an experimental proof of concept, nevertheless, the autocell model is testable and requires no special physical or chemical assumptions. We also cannot provide conclusive evidence demonstrating that life as we know it begins where autocells leave off. Though the conceptual thrust of this model does not depend on its relevance to the origins of life, only on the fact that it embodies the critical principles demonstrating that it can emerge from self-organizing processes alone. Still, autocells, as described, fill a significant gap in the mystery of how life could emerge from non-life, and elsewhere one of us (Deacon, 2006) has provided a detailed description of how autocells might eventually evolve into life.

Even if we cannot yet say that life on earth emerged from a prior autocell stage, this model demonstrates that there is an unbroken continuity from thermodynamics to evolvability, and that it is possible to show how life could emerge from non-life following exacting standards of scientific credibility and feasibility. Were Bateson alive today and witness to these further developments of the evolutionary, cybernetic, semiotic, and complexity theories that underlie the autocell model, he would likely have found reason to abandon his tentative gestures toward idealism. The core questions that motivated his life's work focused on the possibility of identifying the pattern which connects life to mind and, ultimately, pleroma to creatura. His eventual—perhaps reluctant—conclusion that such a connection might only be achievable by an act of faith, appears to have been premature.

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# Chapter 5
# Bateson's Method: Double Description. What is It? How Does It Work? What Do We Learn?

**Julie Hui, Tyrone Cashman, and Terrence Deacon**

**Abstract** Gregory Bateson introduced the concept of double description as a method of analysis critical to his challenge to bridge the connection between mind and evolution. First we examine three ideas crucial to double description: abduction, induction, and logical types. Abduction is employed to find potentially informative similar patterns. Induction makes use of the systematic comparison of abductions to shift attention from similarities and differences, to relationships of a higher logical type in which juxtaposition of similar differences generates higher-order percepts, concepts, and normative rules. Next we describe a number of recent findings from evolutionary developmental biology (evodevo) that exemplify a parallel logic behind Bateson's notion of a biological pattern which connects at multiple levels of biological form. The roles of gene duplication–differentiation and correlated body segment duplication–differentiation in evolution are shown to exemplify an evolutionary parallel to double description. We conclude that Bateson's notion of double description was a prescient insight concerning the commonalities between the creation of knowledge and the evolution of adaptive forms in biology. Both share a duplication–differentiation form-production logic that epitomizes what distinguishes creatura (both living and mental processes) from pleroma (simple material-energetic processes).

**Keywords** Abduction, double description, logical types, pattern which connects, EvoDevo

## Introduction

In his book *Mind and Nature*, Gregory Bateson presents a method of analysis that he believes is critical to sorting out some of the fundamental questions of biology. He argues that this method is largely unrecognized and underutilized, and yet it is

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essential for investigations within the realm of *creatura*, i.e. the living world in which information processes, not just material-energetic processes, are relevant. He describes his method as "double description". More than mere comparison, double description includes elements of both Charles Sanders Peirce's abduction and Bertrand Russell's logical types, although neither term is used in their original senses. The historical origins of this concept and its relationship to other analytical concepts such as these will not be explored here. The purpose of this paper is to examine what Bateson means by double description, how it works as an analytic tool in Bateson's hands, and what Bateson believes can be achieved by its careful application (where possible to determine). In particular, we hope to critically develop the logic of this analysis to the point where we can reconsider an exemplary challenge that Bateson poses at the beginning of *Mind and Nature* (which involves multiple levels of double description) in light of more recent developments in evolutionary and developmental biology. He asks:

> What pattern connects the crab to the lobster and the orchid to the primrose and all the four of them to me? And me to you? And all the six of us to the amoeba in one direction and to the back-ward schizophrenic in another? (Bateson, 1979: 8)

## Double Description

Bateson's methodology is introduced in chapter 3 of *Mind and Nature*, where he "[brings] to the reader's attention a number of cases in which two or more information sources come together to give information of a sort different from what was in either source separately." (Bateson, 1979: 21) One of his primary examples is that of binocular vision. As with all primates, humans can perceive a single object in front of us with both of our eyes due to our overlapping fields of view. We cannot, however, perceive distance ahead of us with only one eye since the image on the retina of each eye is only two-dimensional, on the left–right, up–down axes. It is only when the images of the two eyes are combined that the brain creates the additional sensation of depth in the forward direction. The information from our two retinas is fused to form a single image in our experience, but it is the differences in the original two images, as acknowledged and interpreted by our brains that generate depth perception. According to Bateson, "the two-eyed way of seeing is itself an act of comparison." (Bateson, 1979: 87) Acts of comparison involve taking account of both the similarities and the differences between the compared objects.

The neural logic of this process was just becoming understood by the time of Bateson's writing. Binocular fusion of the slightly disparate information arriving from our eyes is accomplished by processes taking place in the cerebral cortex. In the primary visual cortex of mammals like ourselves, monkeys, and cats inputs arriving from the two eyes are assembled into separate cortical strips called ocular dominance columns (Hubel and Wiesel, 1965; Hubel, Wiesel, and LeVay, 1977). Although information taken in from each eye is initially segregated, both eyes survey visual scenes that have extensive overlap and receive information from both the left and right sides of the visual field. This information remains segregated, but nerve fibers from each eye segregate so that half go to one side of the brain and the other half to the other. As a result, information from each eye about one side of the visual field is sent to the opposite hemisphere of the brain. In this way, inputs from both eyes conveying information about things on the right side of the field are separated from inputs about things on the left side of the field and analyzed in separate hemispheres. On each side the information from the two half-retinas converges in the visual cortex, forming a series of zebra-stripe like patterns, or ocular dominance columns, that interdigitate the maps from the two eyes so that information from a point in space as seen from my left eye will be adjacent to information from that same point in space as seen from my right eye (Steward, 2000). Light reflected from objects that are close will enter the two eyes at more divergent angles than objects that are more distant, and require more convergence of the eyes to fuse the images. Images from close objects will thus also be more different from each other as seen

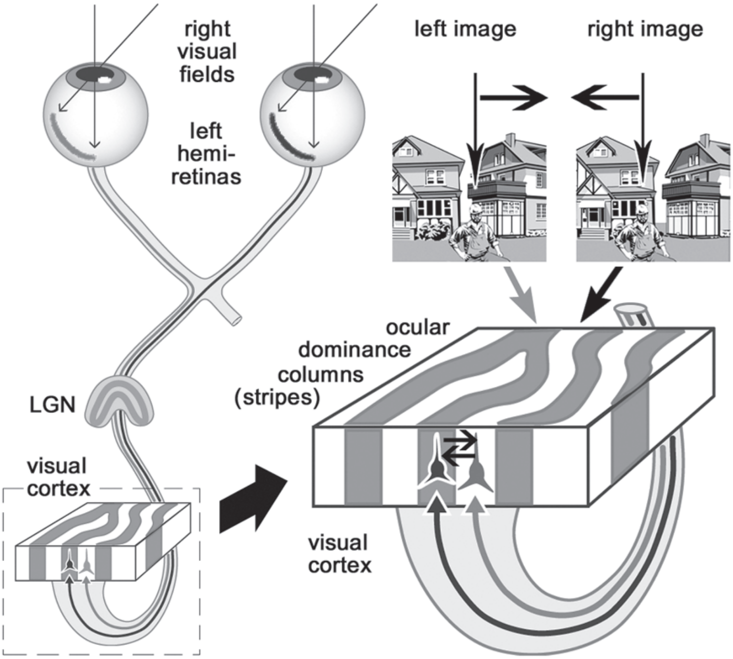


**Fig. 5.1** The logic of depth perception depends on light striking the two hemi-retinas opposite to the visual field they survey, and the signals being relayed through the lateral geniculate nucleus (of the thalamus) and ultimately to the contralateral visual cortex where signals from each common locus in the two visual images are systematically compared (as described in the text) in adjacent columns (stripes). The scenes presented to each eye are also depicted in order to exemplify foreground/background object position parallax (see arrows pointing to the man in the foreground) and indicate that this is encoded as an interaction dissonance between neurons in adjacent columns

by each eye. This means that neurons in adjacent columns receiving information from opposite eyes will differ more in their patterns of activity for close versus distant objects. Through a comparison of the firing disparity of neurons from opposite eyes surveying corresponding points in the visual field information about objects' relative distances is integrated into the unified visual experience. (Figure 5.1)

This is a slight simplification of the explanation of binocular vision, but it is sufficient to show correspondence between Bateson's understanding of depth perception, and other examples in which comparisons between similar phenomena yields information not evident in either phenomenon alone. Bateson's point is that the act of comparison in the case of binocular vision allows for the difference between the incoming information of our two retinas to make a difference in our visual experience. This act of comparison requires both a similarity in the images (due to the overlapping fields of view), and also some systemic difference between them that is extracted by the brain through the process of juxtaposing just slightly variant signals. "From this new sort of information, the seer adds an extra *dimension* of seeing." (Bateson, 1979: 70)

Despite beginning from this very concrete example of depth perception, in which information about a third spatial dimension is generated by comparison of two-dimensional images, he intends to use this logic more generally to describe a somewhat more metaphoric exposure of a previously hidden dimension, or depth, generated by comparisons of a special sort. He proposes that, "[in] principle, extra "depth" in some metaphoric sense is to be expected whenever the information for the two descriptions is differently collected or differently coded." (Bateson, 1979: 70) Comparing stereoscopic vision to a few other examples of double description will help us grapple with Bateson's understanding of this sort of "bonus" in information, or depth, that can be generated by double description.

For example, he compares the fusion of slightly disparate images to the fusion of two slightly different sound frequencies that produces an audible "beat" superimposed on the tone. "In the case of rhythmic patterns, the combination of two such patterns will generate a third. Therefore, it becomes possible to investigate an unfamiliar pattern by combining it with a known second pattern and inspecting the third pattern which they together generate." (Bateson, 1979: 79) This third pattern, in the case of two close sound frequencies, is a rhythmic beat that results from the way that the peaks and troughs of superimposed waveforms alternately reinforce and cancel as the slightly different frequencies shift in and out of phase alignment with respect to one another. The rise and fall in amplitude of the composite wave produces the "beat," and its occurrence is completely dependent upon the relationships between the two frequencies, but not either alone. So knowing the difference in frequencies, one can calculate the resulting beat. Such beats are most noticeable when the two interfering frequencies are quite close, because the resulting beat will be quite slow in comparison (since it takes much longer for the waveforms to shift 180° out of phase), but a beat is also a frequency and it may be more in the range of the other two if they are not highly similar and in this case heard as a sort of third, often dissonant, tone. More importantly, if you are given the rhythmic beat of amplitude and only one of the input sound frequencies you can calculate the missing input sound frequency. The relationship of these three frequencies allows you to predict any one of the three from the relationship between the other two. To put this in Bateson's terms: the double description provided by the juxtaposition of any two can provide information about the third.

Moiré phenomena offer a related spatial beat-like phenomenon, in which two line patterns can generate a third. If two sets of regularly spaced lines are superimposed such that one is slightly rotated with respect to the other, a third linear pattern is produced. Similar to the sound beat pattern, from this set of three patterns, any two, when superimposed, will produce the absent pattern. Again, the superimposed patterns must be highly similar for the difference pattern to be robustly noticed. More generally, both of these examples demonstrate that the relationship between two similar regularities or habits is also a regularity or habit. (Figure 5.2)

The generation of this new regularity is seen by Bateson to be an analogue to the generation of added dimensionality in stereoscopic vision. The regularities in the differences provide an extra dimension or an extra frequency beyond what was provided as input; a bonus. This, then, becomes a metaphor for what should result from useful double descriptions, and serves as a template for distinguishing double description from mere comparison. But whereas in these cases prior similarity in the regularities of the inputs are nearly inevitable or else assumed as given, for Bateson's method of double description to be a useful analytic tool for uncovering hidden patterns or pointing to unnoticed dimensions of relationships, the selection of inputs with respect to their similarities is a critical first step. This then begs the question of the logic or strategy for selecting potentially informative input phenomena leading to promising double descriptions. Though on this point Bateson is less than clear, he considers a largely overlooked form of inference as the key: abduction.

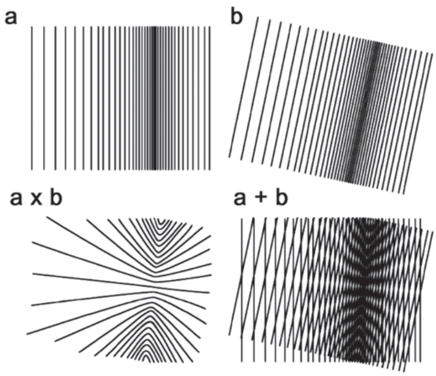


**Fig. 5.2** Moiré patterns (named for the effects of light passing through two delicate fabrics when superimposed) result from the analogue of an interference pattern produced when slightly misaligned linear patterns cause the positions of their overlap to stand out. The superimposition of patterns ***a*** and ***b*** shown as ***a*** + ***b*** produces a third pattern of curves shown as an interaction pattern ***a*** × ***b***

## Abduction

Abduction is a mode of logical inference that was first systematically described and explored by the late 19th century American philosopher Charles Sanders Peirce. Though still mostly ignored and misunderstood today, Peirce showed that abduction (his term) was a third inferential mode of reasoning in addition to the more traditionally recognized modes: deduction and induction. Continued historical neglect of this form of inference can probably be attributed to the fact that it appears to be merely an error of deductive inference; a logical fallacy. While Peirce would not have disagreed with its ultimate fallibility of inferential reliability, he nevertheless claimed that this form of inference is the foundation on which all other forms ultimately rest. This is because it is the inferential logic of categorization; of identifying similars.

As described above, similarity is an essential component of Bateson's double description. He appeals to abduction as a critical step in generating this further analytic operation based on an initial assessment of similarity. To investigate the relationship between abduction and double description, then, we need to spend some time distinguishing abduction from the other forms of inference. We can begin by exemplifying the familiar forms of deduction and induction and contrasting these with abduction using the classic forms of syllogistic (or sentential) logic (though these three can be generalized to more abstract and general logical forms).

To begin with, abductions and inductions both make predictions (table 5.1). In abductions, we use the similarity of predicates to attempt categorization of the subjects. In the case of induction, we use cases to generate a general rule. Neither abductions nor inductions generate conclusions with the logical necessity as formulated in deduction. However, abductions and inductions can be strengthened. In abductions, the iteration of the number of predicates strengthens the hypothesis that the subjects belong to the same category. Inductions are strengthened by iterating the numbers of cases. For instance, if a case about Aristotle is added to the inductive case above one is more confident about the general rule. On the other hand, deductions are only extended with further subject-predicate rules because the rules follow necessarily from one another. A point where Bateson appears to overlap with Peirce is in the use of abductions for making classifications, and the certainty about whether or not the classification holds true is through a strengthening of the abduction with further predicates. In essence, by showing that the similarities between two subjects is strong, we feel more confident that they are exemplars of a common type and

**Table 5.1**

| Abduction | Induction | Deduction |
|---|---|---|
| All men are mortal. | Socrates is a man. | All men are mortal. |
| Socrates is mortal. | Socrates is mortal. | Socrates is a man. |
| Socrates is a man. | All men are mortal. | Socrates is mortal. |

probably share other properties in common as well. This can be seen in Bateson's example of the similarity between natural relations and social organization:

> If I examine the social organization of an Australian tribe and the sketch of natural relations upon which the totemism is based, I can see these two bodies of knowledge as related abductively, as both falling under the same rules. In each case, it is assumed that certain formal characteristics of one component will be mirrored in the other. (Bateson, 1979: 143)

In this case, the abduction involves the categorization of the natural relations and the social organization based on similar rules. Bateson hints at the implication of further parallels in the final sentence of this quote. This implies that abductions need not require experiencing both inputs simultaneously, as might be suggested by the example of vision. It is only simultaneous in the sense that one can call the other to mind. In essence, abductions occur whenever there is a co-categorization based on similarity, and this can include situations as separated as the case of an anthropologist spending one field season studying the natural relations of a totemic system, and then in a subsequent field season noticing a correspondence with the kinship organization of the same group. If the kinship organization then brings to mind similar relationships found in the natural relations, or vice versa, then an abduction has occurred.

However, while Peirce uses abductive categorizations as the basis for inductions or deductions, Bateson seems to understand the term somewhat differently. "Every abduction may be seen as a double or multiple description of some object or event or sequence." (Bateson, 1979: 143) He proposes that abductions are not the basis for double description, as a Peircian might propose, but instead that double description is the basis for the abduction. This apparent circularity can be a bit confusing, but it follows from his notion of the primacy of relationship. He proposes that "[*relationships are*] *always a product of double description*." (Bateson, 1979: 132 – emphasis in the original). In this passage, he is arguing that the act of abduction requires putting two inputs or descriptions into relationship with one another in order to discover their similarities. This will become somewhat confusing, however, when we consider what else Bateson hopes to achieve by double descriptions: some guidance in formulating useful explanations.

Bateson appears interested only in a subset of all Peircian abductions: abductions that lead to something else: a larger systemic relationship. He includes this larger relationship as part of the abduction. In doing so, he inserts a hierarchical logic into the abduction. Confusion arises from this mixing of abductions with this ascent in the logical hierarchy of abstractions. We suggest that clearly separating these two features of double descriptions can clarify exactly what is involved, but at some cost to Bateson's more extended use of these concepts.

We will argue that the first step of a double description involves identifying potentially informative similar patterns through abduction, and then by virtue of their comparison discovering higher-order rules about their similarities and differences. While this can be seen as Peirce applied to Bateson, we believe that this clarification is necessary if double description is to be used as a scientific methodology. Although abductions may establish the ground for double description, they do not seem adequate for guaranteeing its usefulness. Bateson sees this usefulness in the capacity to provide metaphoric depth, but this is an aspect that requires a clear distinction between abduction and the hierarchical inference that the abduction can elicit. For Bateson, the key to the metaphoric depth comes from an idea he borrows from mathematics: logical types.

## Logical Types

The theory of logical types was developed at the turn of the 20th century by the British philosopher Bertrand Russell as a way of avoiding logical paradoxes in mathematics. These paradoxes, related to vicious circle reasoning, are derivatives of the Liar's Paradox. The most familiar form of the Liar's Paradox is, "I am a liar." If I am liar, then I am lying about being a liar and therefore am telling the truth; but if I am telling the truth, then I must be a liar. The paradox produces a never-ending alternation between truth and lie that is ultimately irresolvable. The undermining of hierarchic structure in the logic of this paradox can be better recognized if we slightly modify the sentence to read: "This sentence is false." In this case the subject of the sentence ("This sentence") refers to the whole sentence, but the negation in the sentence changes the reference implicit in the subject, and so on. The negation continually negates itself. Russell's remedy for avoiding such vicious circles requires distinguishing members of a class from the class as a whole and disallowing members of a class to refer to or presuppose the existence of the class. This exclusion was necessary to avoid the possibility of equivocation that could undermine his effort to derive mathematics from logic, which he undertook with Alfred North Whitehead, in *Principia Mathematica* (Russell and Whitehead, 1910), though this remedy was later shown to be inadequate. Nevertheless, the terminology identifies an important logical distinction. A hierarchical distinction is implicit because classes are always about conglomerates of members, making classes a higher order abstraction with respect to the members exemplifying it.

Over the course of his career, Bateson developed a wider use of the term 'logical type' from this mathematical–logical notion, and came to use it to great effectiveness throughout his writings to elucidate hierarchic relationships in many domains. In his conception of double description, Bateson argues that the metaphoric bonus obtained is inevitably of a higher logical type than the phenomena being compared. This application of a logical type to double description makes it more than simple abduction, in the Peircean sense. This logical type distinction is a second aspect of a double description. It requires using the abductively linked cases that were identified in the first step of this method to point to something in addition, which is at a higher logical type. The abduction allows the differences to make a difference (to use one of Bateson's favorite aphorisms). The differences between the two information sources form the basis for the treatment of the sources as two distinct cases of the same phenomenon exemplifying a general rule. In the Peircian categorization of inferential forms, described in the above section, inferring a rule from a comparison of cases is an induction. By definition, the rule is of a higher logical type than the cases which exemplify it. It is the shift of emphasis from similarities to differences that marks the transition from abduction to induction. Bateson does not, however, call this step an induction, but collapses both inferential steps into his notion of abduction. But maintaining this distinction both clarifies the relationship between Peircean abduction and double description and explains why this latter process generates a higher logical type result. It involves using an abduction to bring attention to a potentially instructive induction.

Invoking this framework of working from abductions to inductions can help to clarify some of Bateson's more confusing examples. Consider again his argument that the perception of binocular vision is an example of a shift in logical types, in which "the *difference* between the information provided by the one retina and that provided by the other is itself information of a *different logical type*." (Bateson, 1979: 70; emphasis in the original) Perceiving depth depends on registering a systematic difference in signals from the two eyes, but this cannot be recognized until the signals are juxtaposed and aligned with respect to their similarities.

What does it mean for this systematic difference to provide information of a different logical type? To be brought into relationship is to be categorized as cases belonging to the same class by abduction, and once the similarity is established the information sources can be systematically compared, exposing their differences. But without systematic comparison these patterns of differences will remain unnoticed, as will any higher-order rule accounting for the process that generated this pattern. It seems that for any double description to count as useful it must result in something of a higher logical type by making an induction possible. Presumably, if a double description does not render some further regularity of differences apparent, there may be something wrong with our categorization (the abductive step).

Bateson's example of binocular vision is a minimalistic variant of this logic. The overlapping fields of vision represent an innately evolved (and therefore reliable) abduction, that effectively "categorizes" the inputs from the two eyes as cases of the same class. The difference in patterns of neuronal firing are thus systematically compared when they converge in the cerebral cortex. From this comparison the distribution of differences across the visual field can be discovered to exemplify a general rule, which itself can be encoded in systematic neural firing patterns elsewhere in the brain. Although depth is not itself a rule, it is only experienced because a rule or regularity was discovered in the comparison. This new pattern of difference signals contributes to the experience of depth, and is itself potentially susceptible of further double descriptions. For example, it can potentially produce ever more abstract double descriptions with respect to other coupled processes (e.g. it can provide information about the amount of force that needs to go into a leap in order to reach the other side of some ditch in the path of running). Bateson's emphasis on depth as a product of the double description is merely a short-cut for talking about the regularity generated in the double description upon which it depends. Depth as a metaphor, does however provide a sense of what this hierarchic inference feels like, as an experience.

We can now return to the question that began this paper and Bateson's *Mind and Nature*. Understanding how an abductive juxtaposition creates the possibility of hierarchic ascent (or induction) in Bateson's logic of double description, helps to give meaning to his special use of the word 'connection' as exemplified in his homology comparisons.

> 1. The parts of any member of *Creatura* are to be compared with other parts of the same individual to give first-order connections. 2. Crabs are to be compared with lobsters or men with horses to find similar relations between parts (i.e., to give second-order connections). 3. The *comparison* between crabs and lobsters is to be compared with the comparison between man and horse to provide third-order connections. (MN, 11)

Here Bateson proposes that first-order connections are relationships of structures within one organism, in which parts share some structural resemblance to one another. The 'similar but different' aspect of sequentially modified body parts defines a series of double descriptions in which the relationships between parts and their systematic differences point to a theme and variations, that is modified in linear series. In the crab and lobster there is a gradient of similarity, e.g. between legs, where parts that are more similar tend to be located closer to one another than parts that are vastly different. We perform an abduction by noting the similarities between parts of an organism. For instance, leg segments in a crab are topologically similar to one another; that is they all share a rule about how a leg is structured from the same number of jointed segments. Each comparison between legs suggests a general rule about leg architecture with respect to which each is a slight variation. But how each leg differs is also dependent on where in the series the leg is located. The comparison of the bilateral and serial patterns of the leg-theme variations arranged along the crab's body suggests that a higher logical type of pattern characterizes the crab as a whole. So even within Bateson's "first-order connections" two nested levels of double descriptions are brought to bear. While Bateson categorizes these nested levels as one, in order to distinguish the first-order connections as internal, our distinction shows that both levels nevertheless follow a logic of theme and variations.

In second-order connections, we now look between classes of individuals (e.g. two distantly related crustacean species). Here, the results of first-order double descriptions become the basis for a second-order abduction. One can ask: what can we gain from noting similar serial patterns of part-to-part relations in two different species where we also find a systematic pattern of differences between their serial patterns? Bateson notes that these forms of shared characteristics are due to a shared common ancestry. Crabs and lobsters have similar appendages, laid out in a similar topological fashion, partially because of their linked phylogenetic history. They diverged from a common form, but the pattern of this divergence also carries information about what else influenced their divergence, i.e. what they differently adapted to.

Unfortunately, Bateson can be read in several ways on this point. Crabs and lobsters have similar appendages laid out in a similar topological fashion. In one sense, he might be suggesting the existence of a sort of *ur*-form that is neither crab nor lobster, but that both are partially expressing in their adult forms. Such a conception of biological forms was characteristic of much pre-Darwinian evolutionary thought, such as the morphological theories of Wolfgang von Goethe, Geoffroy Saint Hillaire, and Richard Owen. But Bateson's recognition of the role of common ancestry suggests that he is not interested in some type of idealized form, but rather in the logic of the generative process itself. He is interested in how the system of shared traits between crabs and lobsters, and their differences, informs us about the shared and divergent phylogenetic histories of these lineages, provides hypotheses about the traits of their common ancestor, hints at their adaptive differences, and possibly provides insight into the logic of their segmental morphology. However, Bateson indicates that these important biological insights are only part of what he thinks his analysis can lead to. This is because he notes that a third-order double description is also possible by using our double description of a crab and lobster, with a similarly derived double description of a horse and man (or an orchid and primrose) potentially telling us something about the theme and variations logic itself (Figures 5.3 and 5.4).

At this level of third-order connections we can ask: what can we learn about the overarching process producing theme and linear variation, of which genetic change and adaptation are exemplars? With each level of connection, we are forced to ask ourselves how the patterns and relationships that we see are more

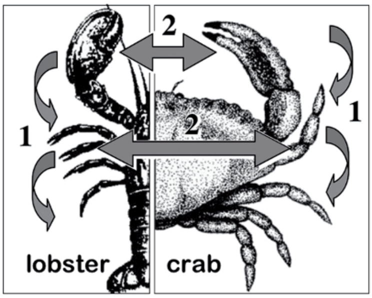


**Fig. 5.3** Comparison of the limb morphology of a crab and a lobster indicating first-order and second-order comparisons — serial- and phylogenetic-homologies — with curving arrows (1) and horizontal arrows (2), respectively

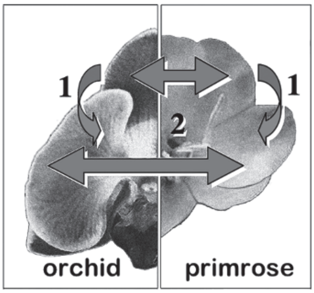


**Fig. 5.4** Comparison of the petal morphology of an orchid and a primrose indicating first- and second-order comparisons (homologies) as in Figure 5.3, comparing crab and lobster

universally applicable and further generalized. Bateson is pointing us towards a general logic of form production that can generate highly complex and organized systems such as organisms.

## The Pattern Which Connects

If we now re-examine the challenge that opens *Mind and Nature*, which was cited at the beginning of this paper, we find that each of the questions are posed as double or multiple descriptions. Although it perhaps betrays Bateson's acknowledged attraction to neoPlatonic conceptions of biological form, when placed in the context of his interest in identifying a "necessary unity" between mental processes and evolutionary processes it suggests that he is ultimately interested in understanding the commonalities of the formative processes behind these examples. Although the biological mechanisms underlying these regular and symmetrical segmental body patterns was unknown in Bateson's time, subsequent advances in molecular and developmental biology have uncovered many of the details of these processes. In hindsight, we can fill in much of the detail that Bateson believed held the key to forging this unity. In this way, we can take a final step that Bateson could only gesture toward: identifying the ur-logic of the pattern which connects.

We can begin with the first-order double description as exemplified by the cases of serial homology Bateson describes. Molecular-developmental biologists during the 1980s and 1990s discovered that such repetitions of body segments were under the control of a special subclass of genes that control genes (often described as regulatory genes). The products of these genes are transcription factors: proteins that control the expression of other genes by binding to sequences of the DNA chain just before an exon (a region that contains a sequence coding for a protein's structure) and thereby initiates, inhibits, or otherwise modulates its transcription into mRNA necessary for protein synthesis. The homologies Bateson points to in the crab–lobster comparison are consequences of the evolution of a subset of transcription factors produced by the set of homeotic genes Hox 1 to 9. These are responsible for segmentation and differentiation patterns of the body from the posterior head through the abdomen in arthropods and vertebrates (Gerhart and Kirschner, 1997). It is thought that the complex of Hox genes evolved over time through a series of duplications of a single ancestral Hox gene. Oftentimes in this process the duplicated gene is inserted into the genome next to the original. But because Hox genes control the expression of large suites of genes that produce the integrated structure of a single body segment, Hox gene duplication results in the serial duplication of a whole body segment. While the immediate result is two nearly identical segments, the two genes eventually accumulate differences over time due to mutations that slightly change the structures of each, and thus their products' binding to the control regions of target genes. This slightly alters the expression patterns of the different target genes, in turn slightly altering corresponding aspects of segment structure. For example, the anterior legs of crabs have diverged to exhibit pincers,

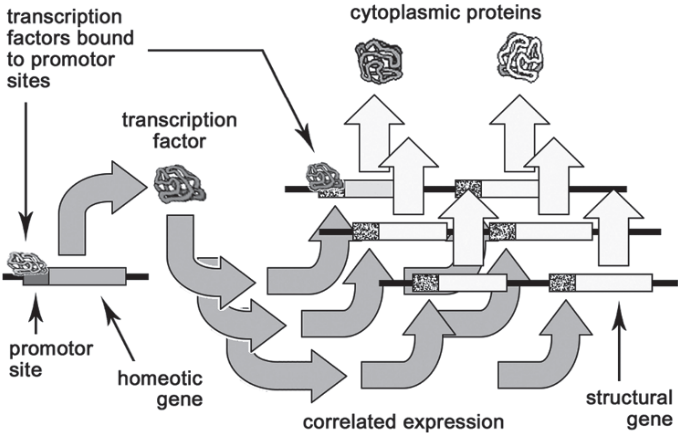


**Fig. 5.5** The logic of homeotic gene control. Structural genes and control sites (e.g. promoter sites) are schematically depicted as boxes strung along a chromosome (a line). Two kinds of protein products (transcription factors and cytoplasmic proteins) are also depicted as products derived from these genes. The binding of transcription factors (such as those produced by homeobox Hox genes) to a promotor site activates the transcription of a structural gene. The power of homeotic genes to organize complex segmentally repeated body structures is due to the fact that each can serve to promote the transcription of perhaps hundreds of genes in specific combinations at specific points in development

as opposed to simple pointed tips. This difference evolved as an adaptation for feeding and fighting instead of walking, and in this way reflects two different ways that the logic of leg design can be modified with respect to extrinsic constraints of crab ecology. In this way, leg duplication with slight serially varying differences was produced by an evolutionary duplication and differentiation of homeotic genes.

Bateson next compares the overall serial pattern of segments in the crab to the homologous patterns in the lobster to generate a second-order double description. This pattern is likewise correlated with a higher-order expression of the duplication–differentiation logic. A corresponding set of Hox genes is found in both groups (Figure 5.5). However, in the two lineages each component gene-segment relationship is slightly different, while features of the linear logic of the whole complex is also subtly different. The Hox complex has differentiated over time in the separate lineages. This new pattern which connects the crab and the lobster, based on the conserved similarities of their Hox complexes, allows us to use the differences in the complexes to make inferences about the factors that created the differences: i.e. their different adaptational contexts. The adaptation of crabs to environments where they are primarily walking, for example, resulted in wider bodies with tails that are curved under their bodies. The adaptation of lobsters to an environment that included the need to swim probably resulted, in an elongated body and tail. So the pattern of similarities and differences that evolved in the Hox complexes of these two crustacean lineages, corresponds to a higher-order pattern of similarity and difference; the synergies and specialization of segments that correspond to similarities and differences in the environments to which each have become adapted. This reflects a phylogenetic history in which previously very similar body forms derived from a common ancestor become progressively different.

But if we now consider the even higher-order relationship that connects the crab–lobster comparison with the orchid–primrose comparison we can no longer appeal to common ancestry and conserved Hox genes to explain why both comparisons involve the logic of theme and variations of body structures. This is because Hox genes are not involved in plant segmentation. Nevertheless, this common logic exposed by double description suggests that here too there may be a similar solution to the production of form, even though it must have evolved independently within two unrelated kingdoms. Although vascular plants, like orchids and primroses, do not share Hox genes with complex animals, they do have a series of transcription factor genes that work analogously to the Hox complex. So there is a pattern which connects the genetic trick shared by the crab and the lobster to the genetic trick shared by the orchid and primrose, even though they involve unrelated genes, different kinds of segmental strategies, and adaptations to vastly different modes of life. It is a duplication and differentiation logic of form production and adaptation whereby the interrelationships between similar but different forms results in the emergence of higher-order functional relationships. This third-order pattern is of a higher logical type than any particular relationships between genes, between body structures, between organisms, or even between homologous complexes in unrelated lineages. This general logic of duplication and differentiation is effectively a unifying pattern underlying the generation of biological form in organisms with respect to environmental constraints, irrespective of how it is implemented.

## Conclusions

Double description, as a method, is about a process of classifying the world and using that act of classification to learn something about both the justification for the classification and its generation. In some sense, double description looks past superficial similarities and differences to consider the underlying processes evidenced by the system. Bateson presents this method, which we experience metaphorically every moment we experience depth perception, and offers a deeper usage. He claims that this is something that he has learned from 50 years of science. (MN, 87) It is the foundation stone of knowledge generation and he pursues this methodology with a larger goal in mind, implicit in the title of his book *Mind and Nature: A Necessary Unity*.

This larger goal is seen in the double description between the method and the biological pattern which connects. The method of double description is based on a post hoc examination of a system to determine underlying rules. But the logic of double description, through the mixture of abduction and induction, is also for him the fundamental tool for the generation of knowledge (mind). We have now also followed Bateson's intuition that the logic of the evolutionary generation of biological form is connected to this as well. Exploring the genetic evolution behind the levels of homology and analogy of form between organisms as phylogenetically distant as crabs and orchids, we have uncovered a formative logic that itself exhibits an abstract similarity to the logic of double description. Because it is this logic itself that is being compared, it offers the basis for a yet higher-order double description that may indeed complete Bateson's enterprise.

The similarity between the generation of knowledge and biological form lies in the differentiation and duplication logic. The reliance of abduction upon duplicated similarities is abstractly analogous to the generated duplication found in the evolutionary logic. Similarly, the reliance of induction upon patterns of differences in similar cases is abstractly analogous to differentiation in evolution. Juxtaposing the similarities of these logics allows us to treat them as exemplars of a further process by way of their similarities and differences. In the case of knowledge generation, the similarities and differences explored in the phenomena we encounter become the basis for the discovery of the deeper formative processes that lie behind them. In the case of evolution, duplication of similar units of genetics, appendages, lineages, etc., provides the basis for adaptive differentiation to evolve with respect to an environment. This suggests that in both processes there is a higher order duplication–differentiation pattern at work. It is this abstract formative logic which forms the foundation from which correspondences, in the form of meanings or adaptations, can be built. And this process is common to both mind and nature.

So when Bateson enlarges his comparison to take into account amoebas and schizophrenics, he is pointing to this higher-order process linking mind and nature which all evolvable systems and mind exemplify. The amoeba perhaps represents one end of the spectrum of biological evolution and the schizophrenic represents another; the logic of knowledge creation and the systems of communication in which this process is of differentiation with respect to something not there—an environment adapted to or a phenomenon in the world represented in mind—is embedded. This higher-order process, while connecting all of *creatura*, also marks a distinction between *creatura* and mere material-energetic processes where cause-and-effect is direct and unmediated by information. It is only within the realm of information systems that differences (differentiation) can produce other differences with respect to something beyond either—an environment for an organism or the outside world to which subjective experience points—and yet which can thereby become a necessary constituent, exemplifying a necessary unity.

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# Chapter 6
# Gregory Bateson's Relevance to Current Molecular Biology

**Luis Emilio Bruni**

**Abstract** Among other things, Gregory Bateson is considered a pioneer in the study of communication in living systems and evolution. His contribution to cybernetics was very special because for him communication was a characteristic property of the living world. But his formulation of information as differences sensed by living systems did not hinder him from using the rest of the conceptual tool-box from cybernetics like, e.g., the notions of feedback, digital and analogical codes, and even information as improbability or restraints, which in his view emphasised the importance of the context in a developmental pathway. Being a central figure in the development of cybernetic theory he collaborated with a range of researchers from the life sciences who were innovating their own disciplines by introducing cybernetic concepts in their particular fields and disciplines. In the light of this, it should not come as a surprise today to realize how the general ideas that he was postulating for the study of communication systems in biology fit so well with the astonishing findings of current molecular biology, for example in the field of cellular signal transduction networks. I guess this is the case due to the fruitfulness of his abductive approach, being as he was concerned with advancing the search for fundamental principles in communication processes in living systems at different hierarchical levels. In this paper I point out some passages to illustrate Bateson's coherent approach to context-dependent information, hierarchical contexts and analog/digital communication, which I think molecular biologists could find of great inspiration. In particular I highlight ten "Batesonean ideas" that may prove to be of great relevance to the field of cellular signal transduction.

**Keywords** Communication, molecular biology, signal transduction, cybernetics, digital–analogical consensus

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## Was Gregory Bateson a Biologist?

I don't know whether it would be harder to sell the idea that "Gregory Bateson was a biologist" to an anthropologist, to a Batesonean scholar or to a trained biologist. Transdisciplinary researchers are confronted with the awkward situation that the peers from the original discipline from which they come do not accept them anymore as members of their guild, just as the peers from the new disciplines to which they are approximating do not accept them either.

Bateson contributed actively to at least half a dozen scientific fields including biology, ecology, ethology, psychology, anthropology and psychiatry, ending up however belonging to no academic discipline. As expressed by Levy and Rappaport (1982) "he was not essentially a scholar, a critic of other's writings, so much as a natural scientist" and "if the subjects of his research seem disparate, the list of topics over which he ranged seems even more so: biological evolution, adaptation, ecology, art, arms races, social organization, communication, cultural transmission, learning, play, fantasy, films, character and personality, and, more generally, the nature and pathologies of thinking and epistemology, of culture, and of a great class of integrative processes which he eventually called "mind" (Levy and Rappaport, 1982).

At the base of Bateson's transdisciplinarity was his particular use of abduction, which to him was the way of reasoning in which a recognized similarity between two realms proposes the possibility of further similarities. He constantly drew analogies from one kind of system to another where the red thread of his research was the study of communication in complex cybernetic systems. In particular he was interested in pathologies in communication, independently of whether the system in question was an organism, a social group, a family, an ecosystem or a cell. In fact, "…he dealt with these phenomena in terms of a coherent and increasingly integrated set of highly abstract concepts influenced mostly by theories of communication and by cybernetics" (Levy and Rappaport, 1982). Consequently, he is considered a pioneer in the study of communication in living systems and evolution, and a co-founder of cybernetics. His contribution to this field was very special among "the Cybernetic Group" (Heims, 1991) because for him communication was a characteristic property of the living world (one of the premises of current biosemiotics).

Let me summarize very shortly some aspects of his career that place him very close to biology. He received his bachelor's degree in natural sciences (and his master's in anthropology), and "… although he wished to escape from zoology because his interest in it was "purely intellectual and not heartfelt" (as he wrote his parents in 1925), his anthropological concerns were rooted in the natural biological sciences, not only as a result of his undergraduate training but from the intense informal education he got during his childhood and adolescence from his father [William Bateson] and his father's circle" (Levy and Rappaport, 1982), quite an influential figure in the history of biology and one of the founders of modern genetics.

In biology his main contributions were to biological evolution, adaptation, ecology and particularly to ethology having conducted important studies on porpoises' behavior and other marine species. His interest in behavioral morphology (inherited from his father interest in biological morphology), which for him involved structures of meaning and communication, "led him from his early career to be distrustful of simple reductionistic models of cause and effect, which seemed to leave out too much and to distort understanding" (Levy and Rappaport, 1982).

Being a central figure in the development of cybernetic theory he collaborated with a range of researchers from the life sciences who were innovating their own disciplines by introducing cybernetic concepts in fields like embryology, neurophysiology, ecology, genetics and evolution. Nowadays it is very hard to avoid cybernetic language in most of the biological subdisciplines. Historians of biology have recognized the influence of cybernetics in the genesis of molecular biology. The importance of these concepts was such that contemporary historians and philosophers of biology contend that the notion of "information" has allowed us to mark the limits between molecular biology and biochemistry (Segal, 1998). It may be a curious anecdotic fact that it was Warren Weaver, an information theory scientist close to the "Cybernetic Group", who in 1938 coined the term "molecular biology" (in his yearly report as the head of the "Natural Sciences Division" of the Rockefeller Foundation). As a cyberneticist Bateson was very close to these developments.

In the light of this, it should not come as a surprise today to realize how the general ideas that Bateson was postulating for the study of communication systems in biology fit so well with the astonishing findings of current molecular biology, for example in the field of cellular signal transduction networks. Once again he would be illustrating the fruitfulness of abduction, being as he was concerned with advancing the search for fundamental principles in communication processes in living systems at different hierarchical levels:

> 'Explanation' is the mapping of data onto fundamentals, but the ultimate goal of science is the increase of fundamental knowledge … Many investigators … seem to believe that scientific advance is predominantly inductive, and should be inductive … they believe that progress is made by the study of the "raw" data, leading to new heuristic concepts. The heuristic concepts are then to be regarded as "working hypotheses" and tested against more data. Gradually, it is hoped, the heuristic concepts will be corrected and improved until at last they are worthy of a place in the list of fundamentals. About fifty years of work in which thousands of clever men have had their share have, in fact, produced a rich crop of several hundred heuristic concepts, but, alas, scarcely a single principle worthy of a place in the list of fundamentals
>
> (Bateson, 1972: xix).

The fact that the enormous quantity of data pouring out of the new genomic disciplines – and particularly from the growing field of signal transduction networks and informational pathways in cellular systems – may very well find a meaningful and fruitful mapping in Gregory Bateson's approach to information, hierarchical contexts and analog/digital communication, may eventually prove that the general ideas he was postulating for the study of communication systems in biology may have the value of fundamentals applicable at all levels of the biological hierarchy.

In this paper I will point out some passages from Bateson's work, which I think molecular biologists could find of great inspiration. In particular I will highlight ten Batesonean ideas that may prove to be of great relevance to the field of cellular signal transduction independently of whether we consider somatic or neural cells, prokaryotes or eukaryotes, unicellular or pluricellular organisms.

## Reductionism in Biology

It is widely accepted that biology, and in particular empirical biology, operates within a framework of reductionism, although for the most part practitioners may be unaware of what this does really mean. According to Nagel (1998: 3) the reductionist idea claims basically that "all of the complex and varied and apparently disparate things and processes that we observe in the world can be explained in terms of universal principles that govern the common ultimate constituents out of which, in many different combinations, those diverse phenomena are really composed".

In science in general, and in biology in particular, the common ultimate constituents are material and therefore the universal explicative principles are those of physics, which in turn are based on a material-mechanical conception of causality. This "express-link" between reductionism, physicalism and mechanicism is not always explicitly acknowledged.

Positivism added a new dimension to the express-link between reductionism and material-mechanical causation: the quest for an exhaustive science, the idea of an asymptotic approximation to total knowledge. In biology, the ideal we asymptotically endeavor to reach can be imagined as a huge mosaic with countless empty holes that, as science advances, are going to be filled in. From the reductionist point of view this mosaic is a huge taxonomy of constitutive species from which structures and functions can be derived with the help of some established physical laws, i.e., the inductive strategy. The principle of analysing complex things into simpler more basic constituents has lead to the view that living processes can be explained (only) in terms of the material composition and physicochemical activities of living things (Nurse, 1998: 93).

The reductionist approach adheres to a methodology that recently, with the genome programs, has been renamed "discovery science". Most of the work is concerned with discovering the different molecular components, and there is hope that very soon we will come to know who all the actors are in biology. Knowing the structure will often provide the answer to other questions (Henderson, 1998: 37). If we start with the structure of biological macromolecules, we are interested in the size of the molecules, their behaviour in terms of aggregation or self-assembly, the secondary structure and atomic structure of the various molecular components. Once we know what all the components are and what they might do, we can then start looking for explanations and levels of answers. Once you have a structure and know the function you can make hypothesis without doing any more experiments (Henderson, 1998:37).

The reductionist ideal in relation to the highest hierarchical levels of emergence, as for example the human "mental process", is still believed to be the most promising strategy as exemplified by the following statement:

> New neuroanatomical components that one had no idea about are being described simply by looking at where specific proteins are distributed in the brain. My guess is [M. Raffs'] that the reductionist approach, even where it is just a fishing expedition, will lead to real understanding in unpredictable ways, and that the molecular and cellular basis of memory, learning and other higher brain function could well emerge bit by bit, until the mystery

> gradually disappears, just as has been happening in developmental biology (M. Raff, in the discussion of a symposium paper by W. G. Quinn, 1998: 124).

Many of Bateson's contributions to the epistemology of biology provide insightful tips to conceptualise and address biological problems in non-reductionistic terms. In particular, Bateson proposes that besides considering the material-energetic aspects we should also take into account the communication aspects of living systems, which in his view imply a different (although complementary) kind of causality.

Bateson was not opposing reductionism in science (or in biology) but rather pointed its limits and searched for a complementary alternative. This can be appreciated in the basic "definition" of reductionism that he offers in his glossary:

> *Reductionism*. It is the task of every scientist to find the simplest, most economical, and (usually) most elegant explanation that will cover the known data. Beyond this, reductionism becomes a vice if it is accompanied by and overly strong insistence that the simplest explanation is the only explanation. The data may have to be understood within some larger gestalt (Bateson, 1979: 252).

1st Idea

The data may have to be understood within some larger gestalt.

## Limits to Material Reductionism and Lineal Causality

A good example of the reluctance often encountered in biology to consider something besides the linear (material) "cause and effect", which undoubtedly is at the base of the successful empirical strategy of "knock-outs"[1] (whether genes, species

[1] The knock out strategy in biology has been very frequent in genetic research. It consists in disrupting the function of a gene by induced mutations in order to assess what would be the function or the role of the disrupted gene. The assumption of the strategy is that there is an unequivocal linear relation between the knocked gene and its expected effect. With new gene technologies and mapping techniques, which permit non-random mutation of selected genes, the "knockouts" have become more precise. However the problem of how to interpret the resulting phenotypic changes prevails, especially when applied to "behavioral phenotypes".

More generally, the same strategy of eliminating a component from a complex system in order to asses its role in the functioning of the system as a whole, has been transferred to other fields of biology as for example in the study of multitrophic systems. Here one species of a community is knocked out (eliminated or incapacitated) in the experimental set-up in order to assess the role of that species in the system.

The knockout strategy in biology is of course in the tradition of the old scientific principle of assessing one variable at a time, the rest remaining equal. But one of the problems with this strategy is that most knockouts (genes or species) can be only achieved under highly controlled experimental conditions. This means that all the contextual parameters in the field cannot be correlated with the knocked component. There can be many factors under natural conditions that affect or are affected by the knocked components. This is a common source of discrepancy between experimental settings and natural conditions.

or other factors in the experimental set-up), is given by ethologist Patrick Bateson (1998: 169):

> When told about all the things required to generate an observed piece of behaviour, many neuroscientists react with irritation at what seems to them to be a blatant piece of obscurantism. 'What is really driving the system?' they will demand. The implication is that if, in an experiment, a factor was varied and produced an effect, then surely that was the cause.
>
> To assume that a given cell or a given condition is doing all the work may be good practice when setting up analytical experiments. However, any strong claim that one event is normally sufficient for the occurrence of another event will meet with frank incredulity from most ethologists."

The feedback concept, introduced by the cyberneticists in the 1940s, brought to science not only new terminology but also a logical principle, or more precisely, a kind of causality, namely, circular causality. This notion became of central importance in the biologists' conceptual toolbox. This does not mean that the notion of feedback was not intuitively accessible to students and laymen before cybernetics. All we can say is that it was not previously explicitly conceptualised in the western scientific world of the post-Newtonian age of modernity. Might there perhaps be other overshadowed notions of causality?

It is precisely the impressive results of molecular biology that have devaluated the role of linear causality in biological systems. The overwhelming omnipresence of "cross-talk", "redundancy", "pleitropy", "epistasis", "polygenes", "cryptic variants" (e.g. the "jukebox" effect in development),[2] for example, has posed serious challenges to the logical foundations of biology. Based on this experience, it is easy to foresee that a further challenge to those foundations will become evident when biologists learn to recognise (as it is happening already) the existence of informational processes

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[2] All these terms describe phenomena that pose difficulties to lineal causal explanations in genetics and molecular cell biology. The term "cross-talk" comes from information theory where generally refers to the unwanted interference between two signals, which ideally should be independent. In biology the term is being used in slightly different senses at different hierarchical levels. The most common usage is at the intra cellular level, where signal transduction pathways rather than being discrete and separate units "cross talk" with each other posing a great challenge to molecular biologists. (In Bruni (2003, 2006) I proposed a model for conceptualising cross talk in molecular cell biology.)

"Redundancy" is also used at different levels in biology. Both in engineering and biology, the term refers to the duplication of critical components of a system with the purpose of increasing reliability of the system. An error or a failure in one component may then be compensated by another component that is said to be "functionally redundant". For example, gene redundancy refers to the existence of many copies of the same gene in a genome. In cellular signal transduction networks many components are "functionally redundant" in order to buffer the effects of perturbations in neighboring nodes and related pathways. There are also redundant and compensatory connections at higher levels such as the vascular and circulatory systems.

"Pleitropy" in few words means the participation of a single gene in several distinct and seemingly unrelated processes or phenotypic effects. On the contrary a "polygene" refers to a group of nonallelic genes that together influence a phenotypic trait. In relation to this, "epistasis" refers to the interaction between two or more genes in the production of a single phenotype, or when a mutation in one gene disables the expression of another (nonallelic) gene.

(implicit in, e.g. signal transduction, non-trophic interactions, etc.) and of emergent properties and processes in a historical and hierarchical perspective. The concatenation of emergent and hierarchical levels will require different logics to think about causality, not just renaming well-established terms and concepts.

Of the limits that material-mechanical reductionism may present in the study of living systems two of the most important are:

1. The impossibility of considering causal links embedded in hierarchical emergent systems, agents or processes – particularly of the "informational" kind
2. The tendency to exclude the context.

"We have learned from the paradigm of the freely falling body – and from many similar paradigms in many other sciences – to approach scientific problems in a peculiar way: the problems are to be simplified by ignoring – or postponing consideration of – the possibility that the larger context may influence the smaller." (Bateson, 1972: 245–246)

"The hierarchy of contexts within contexts is universal for the communicational (or "emic") aspect of phenomena and drives the scientist always to seek for explanation in the ever larger units. It may (perhaps) be true in physics that the explanation of the macroscopic is to be sought in the microscopic. The opposite is usually true in cybernetics: without context, there is no communication." (Bateson, 1972: 402)

> 2nd Idea
>
> Information is always contextual, and context is always hierarchical.

## Biology: The "Science of Sensing" and the "Integrative Agenda"

A cross-disciplinary look of current biological scientific literature reveals that at all hierarchical levels there is:

1. An increasing importance being ascribed to "context".
   The importance of context is becoming a recognised challenge to all empirical endeavours, and many multiple knockout strategies will have to be rethought accordingly.

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Lastly, the term "cryptic variants" has been used at both the genetic and the cellular-metabolic level. Cryptic genetic variation is defined as genetic variation that "normally" does not contribute to the normal range of phenotypes observed in a population, but that is available to modify a phenotype when an unusual developmental demand arises due to particular environmental conditions, i.e., the existence of potentialities that become manifested only under especial circumstances. At the cellular level, cryptic variants may exists as expressed cellular components, e.g. signaling pathways, that remain "silent" until their action is required, i.e., as redundant components in case of emergency.

2. Consideration of communication systems and information.
   I take as a given the powerful trend that sees biology as the "science of sensing", e.g., from the central role of signal transduction in all cellular and inter-cellular activities to phenomena such as quorum sensing in prokaryotes; from semiochemicals and info-molecules between con-specifics to non-trophic interactions in multitrophic systems; from gene technology to biosensing and biocontrol.
3. A general call for the integration of molecular biology with developmental, physiological and ecological approaches.
   The "integrative agenda" has become a priority and regulation at all levels has become essential. "The unravelling of [the] genetic code, of molecular structure, of subcellular mechanisms, has been so breathtakingly rapid in creating a mountain of detailed information that integrative work has barely had time to define the problems let alone tackle them on the scale required. Nevertheless, the integrationist agenda is being defined" (Noble, 1998: 56). Such agenda depends on the consideration of the "flow" of information within organisms (the genetic, epigenetic and physiological levels) and between organisms of the same or different species, i.e., the ecological level of functionally integrated multitrophic and multisemiotic systems (i.e., considering also non-trophic interactions).

We have accumulated vast quantities of empirical data that characterise the material-energetic exchanges in living matter at all hierarchical levels of biology. Now biologists have arrived to a point in which they need to characterise informational processes in all branches and hierarchical levels of empirical biology. Such characterisation will be central in the progress of the integrative agenda that passes through molecular-genetic, epigenetic, physiological, organismic and ecological levels (Bruni, 2003, 2006).

With the rapid development of molecular techniques, there is in all branches of biology a sort of interaction with molecular biology. While on the one hand the integration of molecular, physiological and ecological approaches is more than necessary, there is yet the risk of importing some of the ambiguities of the "informational talk" from molecular biology to other hierarchical levels. In relation to this we may also find a tendency to reduce physiological and ecological complexity to its molecular "components": the massive characterisation of signal-transduction networks and the elicitors and components of the cascades that determine complex genetic reactions in response to variable environmental cues. The understated goal would be that of mapping an ecosystem in terms of molecular kinetics.

Nevertheless, the field of signal transduction networks seems to be one of the first conceptual links between hierarchical levels. Signal transduction has opened the doors to the integration of molecular techniques with embryologic, developmental, physiological and ecological approaches. It has also re-dimensioned the centrality of DNA as the sole source of biological information. Whereas DNA was the dominant and central element in the conceptual and experimental framework of biology, today its place is being taken by signal transduction. Once we recognise that sensing is one of the necessary properties of life, we cannot do without considering the *hierarchical* formal processes of mapping, translation, transformation, transmission and interpretation of context-dependent information. We need to consider the role and the position of signal transduction networks in the larger semiotic networks in which they function (Bruni, 2003, 2006).

After 50 years of "informational talk" we find an entangled set of concepts and terms such as, genetic information, gene expression, information transfer, recognition, signalling factors, quorum sensing, signal transduction, analogues, replicons, functional mimicry, decoding, cross-talk, non-trophic interactions, etc. All these terms imply an understanding of causality, which has had difficulties in conforming to the view of nature established in classical physics and dynamics because the "information" implied in biological processes is context-dependent and entails systems with the capability to sense and sort out elemental differences as well as complex patterns of differences, i.e., entails a semiotic process.

> In the natural world, communication is rarely either purely digital or purely analogic. Often discrete digital pips are combined together to make analogic pictures … and sometimes … there is a continuous gradation from the ostensive through the iconic to the purely digital. At the digital end of this scale all the theorems of information theory have their full force, but at the ostensive and analogic end they are meaningless (Bateson, 1972: 291).

3rd Idea

In the natural world, communication is rarely either purely digital or purely analogic.

## Material Information?

The debate on the concept of "biological information" has so far proceeded in an inductive manner, different concepts having been developed autonomously at specific levels and applications. When it was thought that the information "problem" was solved and put aside with the cracking of the "genetic code", biologists began talking again about cracking other "codes". In this spontaneous inductive strategy (within the "spontaneous semiotics" in the life sciences described by Emmeche, 1999: 274), different types of "information" keep emerging, which may not have a clear conceptual link with previous concepts of biological information. So the need for unifying concepts prevails together with the lack of proper interfaces to couple the different "codes" that are being inductively "cracked" and defined at the different emergent levels of the hierarchy. This is where Bateson's coherent approach to context-dependent information, hierarchical contexts and analog/digital communication becomes a fundamental.

After deciphering what came to be known as the "genetic code", new problems challenged the "information" concept. In 1962 for instance, the Austrian-American biochemist Erwin Chargaff noticed that if there was no continuous 'chain of information' from the lowest level to the highest, there was no justification in claiming that 'DNA is the repository of biological information (Sarkar, 1996: 199). Although this argument was raised to rebut the usefulness of the notion of "biological information", in reality it only, and very strongly, rebuts the exclusivity of DNA as biological information (or more precisely as the physical support for information). The argument also poses a very interesting and central challenge to contemporary biology: how can we conceive the "continuous chain of information from the lowest level to the highest" and perhaps from the highest to the lowest?

Through the path of "biological information" we arrive to the "genomics age" where genomes organisation, expression and interaction are the central issue. Whereas the 1990s have been characterised by genome projects that have called for massive data processing solutions, the next step will be to understand the results.

There is a huge sector in contemporary biology that advocates for interdisciplinary approaches in order to unravel complex biological codes. It is said that after having studied individual proteins and genes in isolation throughout the last four decades, the future lies in the study of the genes and proteins of organisms in the context of their informational pathways or networks. However, very often the nature of this interdisciplinarity reflects the ambiguous epistemological status of the concept of "biological information" on which these approaches are based.

Let us take as example "systems biology", the influential approach advanced among others by Leroy Hood (one of the first scientists to advocate for the Human Genome Project and credited for having played a lead role in inventing automated DNA sequencers in the mid-1980s). In Hood's view, "systems biology" is interested in analysing whole systems of genes and proteins. Its central and most highlighted slogans are that "biology is an information science" and that "biotechnology is the industrial use of biological information" (Pongor and Landsman, 1999; Smaglik, 2000). There are however several epistemological flaws in the way the notion of "biological information" is treated in this approach. One of the most evident is to confuse "scientific information", data for the researcher, with "biological information", differences sensed by organisms.

In a *Nature* interview (Smaglik, 2000) Hood defines "biological information" in a variety of ways that constantly interchange the different kinds of information involved in biological processes with the different kinds of data that a researcher must gather in order to characterise a system (which is also information, but of a different logical type). He explains that "systems biology" uses tools for capturing information from all the different biological levels – DNA information, RNA information, protein information, protein interaction information, pathways and so forth, and this information has to be afterwards integrated. The ultimate objective is to write mathematical models that are capable of predicting something about the structure of the biological system under evaluation as well as predicting something about its properties, given particular kinds of stimuli or perturbations. In this sense information means simply data.

There are three fundamental types of biological information in this framework:

1. First we have the one-dimensional language of DNA, with its four-letter alphabet. Here the fundamental units of information are the individual genes, most of which encode the second type of biological information: proteins.
2. Proteins are strings of letters derived from a 20-character alphabet. Proteins are synthesised as linear strings and the order of protein letters in each protein string direct how the string folds to generate three-dimensional molecular machines (although there is experimental evidence of the involvement of "other" proteins in protein folding that seems to conflict with this universal hypothesis, see for example Eder and Fersht, 1995). The hundreds of thousands different protein machines catalyse the chemistry of life and give organisms shape and form.
3. The third type of information arises from biological pathways and networks – groups of genes or proteins that work together to execute particular biological functions. These biological networks give rise to systems or emergent properties such as memory, consciousness and the ability to learn. "Systems biology" requires that all of the gene or protein elements in a particular informational pathway be studied simultaneously to follow the informational flows – if we are ever to understand the system's properties.

What is wrong with this concept, or concepts, of "biological information"? The first two types of information are two kinds of physical entities, DNA strips and proteins, and as physical entities they are not more informative than lipids, ions, water, whole organisms, cars or sculptures. The third kind of information seems to be of a different logical type: particular informational pathways formed (structurally?) by the first two kinds of "information", groups of genes and proteins "which have to be studied simultaneously to follow the informational flows – if we are ever to understand the systems properties". So the third kind of information is the informational pathway itself in which information flows and which is structurally (i.e., physically) constituted by other two kinds of (material) information. What is it that flows? Can the informational pathway itself be information to someone different than the researcher?

So far no informational processes and communication within and among living beings have really been considered in order to add something to the characterisation of the system under this model.

As things get more complex there is always the hope for developing better computer algorithms and more powerful hardware. But in reality, the Laplacean algorithms that should correlate these massive data sets have to deal exclusively with the kinetics of molecular interactions. Seeing biology as an informational science in this framework means seeing biology as a computational and data-management science. Hood asserts that the idea that "biology *is* information" is a wonderfully integrating concept that theoretically should permit us to view biology, from molecules to ecologies, as an integrated whole. One can agree on that, but are these contradictory concepts of information really suitable for such a necessary integrating role? Or are they inadvertently a disguise that hinders a true integration and simply redefines the reductionist strategy in a massive quantitative search for exhaustivity?

4th Idea

The problem of "localisation" of information and regulation.
"It is flatly obvious that no variable of zero dimensions can truly be located. 'Information' and 'form' resemble contrast, frequency, symmetry, correspondence, congruence, conformity, and the like [e.g. "specificity"] in being of zero dimensions and, therefore, are not to be located"

(Bateson, 1972: 408)

## Systems of Correspondences – Systems of Ideas in Circuit

While we can consider genetic heredity as a vertical (diachronic) communication system between generations of organisms of a same species, on the other hand genomes and the organisms carrying them are also engaged in developmental and ecological communication (Bruni, 2002, 2003). The genetic match (specificity) between participant species of a given network is more evident in cases of symbiosis where genetic determinants in one organism have a functional role in the regulation of specific developmental pathways in an organism of a different species. But the channels of communication, both in evolution and development (there is no way we can separate these two processes), are ramified into pathways and networks that would not be traditionally considered symbiotic in nature although the principles of mutual determination, specificity and functional integrity are there.

At the present stage of evolution we have to deal with coevolutionary systems, which present emergent properties. What are evolving today (and since a long time ago now) are not single entities but entire complexes of sophisticated networks at all levels. What is informed by the genome are integrated systems of functional domains, which constitute elemental units for a great diversity of emerging codes. The different functional domains in a single protein allow its interaction in and with different directions of the network and with different actors of the system. Each functional domain represents a correspondence with other domains distributed in the products that are coded in the genome, as well as correspondences with products coded in or by the environment, including organisms of the same or different species (Bruni, 2003, 2006).

These correspondences at the level of functional domains are what are actually coded in the genome, i.e., networks of correspondences which are used to constitute metabolic codes;[3] not complete complex phenotypes. What are coded in the genome

[3] In 1975 biochemist and molecular biologist Gordon M. Tomkins claimed that "Since a particular environmental condition is correlated with a corresponding intracellular symbol, the relationship between the extra- and intracellular events may be considered as a 'metabolic code' in which a specific symbol represents a unique state of the environment." (Tomkins, 1975: 761).

are the elemental units of specificity, which are used and arranged modularly in the distributed network, as well as the "recipes" for successful structural elements. Part of the arrangement may be implicit in the complex architecture of the genome. But the model for integrating circuits is an analogue that must be implicit in the embryonic signalling system of the dividing new cell or the fertilised egg – what could be called the *embryonic signalome* (Bruni, 2003). The analogical "know-how" to ensemble and differentiate systems of correspondences must be inherited in such embryonic signalome. Once cells start dividing, the new cells get the library and the whole system of interpretation.

The combinatorial possibilities of domains constitute complex codes with different infrastructural organisation and mechanisms but which share common logical principles. In this view, DNA is more like a library of distributed architectures of integrated systems of corresponding (specific) sequences: the emergent digital units of the DNA code. The sequences or domains – be that binding sites, integrating repetitive motifs, protein domains, regulatory sequences, etc. – are used modularly within systems of correspondences and specificities that reach beyond the organism into its niche.

In the communicational world the dichotomy between inside and outside the cell, the organism or whatever unit, is meaningless and irrelevant. The contexts, be that inside or outside the unit under study, and which includes all sorts of cues, "have communicational reality only insofar as they are effective as messages, i.e., insofar as they are represented or reflected (correctly or with distortion) in *multiple* parts of the communicational system which we are studying; and this system is not the physical individual [or cell] but a wide network of pathways of messages. Some of these pathways *happen* to be located outside the physical individual [or cell], others inside; but the characteristics of the *system* are in no way dependent upon any boundary lines which we may superpose upon the communicational map" (Bateson, 1972: 251).

Thus we have pheromones, signals released by one organism that can be picked up by the signal transduction networks of other organisms of the same species, thus informing behaviour or gene expression in the latter. This kind of communication can be encountered from bacteria (e.g., quorum sensing) to eukaryotes. Then we have inter-species and inter-kingdom signals, like for example when a species of bacteria in the guts of a herbivore emits an elicitor that plants' cells are able to recognise prompting the plant to respond by emitting another signal-molecule that attracts the herbivores' predators (Baldwin et al., 2001). Lastly we have intracellular and, in the case of multicellular organisms, intercellular signals, i.e., signals within organisms. These last networks are mainly the subject matter of signal transduction. What distinguishes cellular biochemistry from chemistry outside the living cell is that cellular events are subject to biological regulation by *signal transduction networks*, which insure a match between a complex set of contextual cues and the appropriate cellular response.

All these signal molecules, now referred to as "info-chemicals" or "semiochemicals", are in complex interactions within what Tomkins (1975) called metabolic codes, and participate in networks that extend beyond the boundaries of the organisms. The extra- and intracellular events are intrinsically linked by systems of correspondences. Genome communication is not limited to the evolutionary process. Inter-species genome communication influences development in the ecological space. Signals from organisms of one species determine genetic responses in organisms of different species.

At ecosystem level, biodiversity is the library for the ecological systems of correspondences, which are involved in the development and organisation of ecosystems. If we destroy the information, i.e., if we interrupt networks, we destroy the regeneration capacity of the ecosystem. Conversely, if we disable ecosystem-function, the information loses its sense; there will be no context for its interpretation. These two metasystems of correspondences, the genome and biodiversity, are in correspondence with each other. So besides a taxonomy of species, we should be developing a taxonomy of circuits.

It is not the unit of selection that we should be worrying about, but the unit of survival. The minimal unit of survival is not the gene, nor the breeding individual, the family line, the population, the sub-species or some similar homogeneous set of conspecifics. The minimal unit of survival is the *organism plus its environment* (Bateson, 1972, 1979), including organisms of the same or different species and the communication networks that they constitute.

What evolves and develops in the living world are systems of correspondences.

5th Idea

"It is the *context* which evolves." (Bateson, 1972: 155)
What survives are "systems of ideas in circuit" (Bateson, 1972: 461).

## From Genome Sequences to Higher Hierarchical Levels

Besides the massive identification of genes and their functions, in order to follow the reductionist strategy, we also need an equally massive characterization and classification of regulatory elements of genes, protein regulators, signal-transduction components and the elicitors of the cascades that determine complex genetic reactions in response to variable environmental cues. The passage from genome sequences to higher hierarchical levels would require the generation and correlation of data about: the regulation and interactions of genes and gene products within cells, the interactions and communications between cells, and the biological responses and susceptibilities of cells and organisms to biotic and abiotic environmental cues. In sum we would need to go from a focus on one pathway at a time to the integration of multiple pathways. To additively reintegrate all the reduced parameters we need computer power and more sophisticated algorithms capable of correlating the multidimensional data pouring from expression arrays that may include more than 20,000 genes assayed in different cell or tissue types, different genotypic states, different physiological states, different developmental states (considered at different times), after different sets of cues, perturbations or stimuli. Here the central assumption is that biology "happens" from the DNA sequence, through the structure and function of proteins, through the interactions of DNA and proteins in simple pairs and as parts of complex networks involving the hundreds or thousands of genes and proteins that control complex biological responses. As mentioned above, in this bottom-to-top research strategy "biological information" is allegedly called to play an important role.

According to Nurse (1998: 98) it will be an immense if not impossible task to adequately describe cellular phenomena in terms of a precise description of all the molecular interactions involved. There is already an information overload in cellular and molecular biology with many molecules identified but with the underlying processes much less understood. From different directions we can perceive how the concept of biological information is changing from its widely accepted and reductive meaning of DNA-based-genetic-information, to address new emergent levels in which the "context" becomes a priority. As mentioned before, there is need for unifying concepts that can couple the different "codes" that are being inductively "cracked" and defined at the different emergent levels of the hierarchy.

## An Integrative Concept of "Biological Information"

The concept of context-dependent information in biological systems developed by Gregory Bateson (1972, 1979) departs from any paradoxical physicalist account of information (i.e., it considers as true that information is information not matter nor energy, and thus that certain materials such as DNA or any of the so-called "informational" molecules are not *per se* information). It also departs from the purely probabilistic accounts of the mathematical theory of information formulated by the cyberneticists, although instead of excluding these accounts it rather overlaps with them.

In Bateson's definition the smallest unit of information is a difference or distinction, or news of a difference. So information means a difference that makes a difference to a system capable of picking it up and reacting to it, i.e., for there to be a "difference" – news of a distinction – there has to be a biological system that senses it. Otherwise they would not be differences, they would be just impacts (Bateson, 1972, 1979).

"Such a difference, as it travels and undergoes successive transformation in a circuit, is an elementary idea." (Bateson, 1972: 315). An "idea" can be a complex aggregate of differences or distinctions. It can be formed by the smallest units of informational processes, i.e., news of a single difference (Bateson, 1979: 250), as, e.g., the binding of a single signal-molecule to its membrane-receptor. More elaborate ideas (or in semiotic language, signs) can be formed by complex aggregates of elementary differences (which constitute more complex differences). This implies the emergence of codes: “Every effective difference denotes a demarcation, a line of classification, and all classification is hierarchic … differences are themselves to be differentiated and classified” (Bateson, 1972: 457). But also complex aggregates of differences are to be differentiated and classified. That is, they have to be recognised as *patterns*.

This is why informational description in biological systems is always hierarchic:

> … there is that hierarchy of differences which biologists call ‘levels.’ I mean such differences as that between a cell and a tissue, between tissue and organ, organ and organism and society. These are the hierarchies of units or *Gestalten*, in which each subunit is a part of the unit of the next larger scope. And always in biology, this difference or relationship … is such that certain differences in that part have informational effect upon the larger unit, and vice versa” (Bateson, 1972: 458).

As it can be noticed, in this perspective biological information is not restricted only to DNA and amino acid sequences. It is an emergent process based on sensed differences and complex aggregates of differences. There is no information without interpretation (i.e., pattern recognition), and herein the importance of the context.

This way of understanding information gives place to the following distinction between causal links:

1. On the one hand we have the world of non-living billiard balls and galaxies – the material world – characterised by the kinds of regularities described in the physical sciences, where forces and impacts are the “causes” of events (Bateson, 1972, 1979; Bateson and Bateson, 1989: 211). This is what Bateson identified as the “pleroma” (which corresponds to the Percian description of “dyadic action”).
2. On the other hand we have the world of the living – where *distinctions* are drawn and a *difference* can be a cause – all processes in which the analog of cause is information or a difference, i.e., the entire biological and social realm, the world of communication, necessarily embodied in material forms subject to physical laws of causation as well as the distinctive processes of life (Bateson, 1972 1979; Bateson and Bateson, 1989: 207). This is what Bateson identified as the “creatura” (which corresponds to the Percian description of “triadic action”).

The two kinds of action are irreducible, but inseparable and superimposed. “… information does not belong to the sphere of matter and energy, but to the subjective and non-dimensional sphere of structure, pattern and form … At the most fundamental level the distinction between life and non-life is dependent on this ability: the response to differences … Nothing in the world of living systems makes sense unless we include in our explanations this peculiar ability to respond to selected differences in the surroundings” (Hoffmeyer and Emmeche, 1991: 123).

6th Idea

"A 'bit' of information is definable as a difference which makes a difference. Such a difference, as it travels and undergoes successive transformations in a circuit, is an elementary idea" (1972: 315).
More elaborate "ideas" can be formed by complex aggregates of differences. Biological information belongs to an emerging process based on sensed differences and complex aggregates of differences.

## The Problem of Delimiting a Semiotic Network

Now that we have a concept of biological information relevant to different hierarchical levels, what do we need to keep in mind in order to delimit a semiotic network?

Semiosis or communication processes are multidimensional, i.e., innumerable semiotic processes occur at the same time in multiple directions and emergent levels. Some of them may intersect; others may not (Santaella, 1999: 516). Semiotic networks can be temporally and spatially separated and still be in communication. Or they can be causally linked although they belong to (or can be identified at) different levels of the biological hierarchy. Therefore it is not an easy task to delimit a semiotic network. In Bateson's work there are already some criteria that differentiate semiotic kinds of networks from more physical kinds of chain-reactions.

As Bateson pointed out, in the hard sciences effects are in general caused by rather concrete conditions or events – impacts, forces, and so forth. But once you enter the world of communication, organisation, regulation, controls, etc., you leave behind that whole world in which effects are brought about by forces, impacts and energy exchanges. You enter a world in which "effects" are brought about by *differences*. As he shows, the whole energy relation is different (Bateson, 1972: 452).

First, we have an economics of energy and materials (bioenergetics) within a single cell, an organ, a coral reef or a tropical rainforest. Second, we have an "economics of information" within these entities. According to Bateson (1972: 460) these two pictures do not fit together very well precisely because the units are differently bounded in the two sorts of ecologies. In bioenergetics it is natural and appropriate to think of units bounded at the cell membrane, or at the skin; or of units composed of sets of conspecific individuals. These boundaries are then the frontiers at which measurements can be made to determine the additive–subtractive budget of matter–energy for the given unit. In contrast, in informational physiology and ecology, the semiotic aspects deal with the budgeting of pathways, codes and of probability. The resulting budgets are fractionating (not subtractive).

The world of information and differences is not limited to the imaginary "Gauss' surface" that we may draw in order to enclose our selected system, not even when we are talking about a higher organism, whose informational pathways extend much beyond its skin.

"*The boundaries must enclose, not cut, the relevant pathways"*, which protrude with messages and other pathways beyond the boundaries in which we have enclosed our relative unit (Bateson, 1972: 460). Bateson further claims that in light of this, the very meaning of "survival" becomes different when we stop talking about the survival of something bounded by a membrane and start to think of the survival of "the system of ideas in circuit"(Bateson, 1972: 461), i.e., the survival of semiotic networks. This points to the difficulties that may arise when we attempt to separate the systems of correspondences that link the communication processes inside cells and organisms (endosemiosis) from communication processes outside cells and organisms (exosemiosis) or when we fail to pay attention to the diachronic–synchronic continuity of the system. Maybe such separation is theoretically possible when dealing with bioenergetics (although I doubt it), but it is certainly impossible when dealing with semiotic networks. Because of the richness of details that may constitute the context of a given system, its characterisation may appear sometimes as an impossible task, but instead of concentrating on the totality of pathways and restraints at a certain level we can concentrate on the hierarchical nature of pattern-formation and contexts when choosing the imaginary borders of the network under study.

Linear "cause and effect" explanations can be said to be "positive": "We say that billiard ball B moved in such and such direction because billiard ball A hit it at such and such an angle". On the other hand cybernetic explanation is always "negative", i.e.: it considers "what alternative possibilities could conceivably have occurred and then ask why many of the alternatives were not followed" (Bateson, 1972: 399). In a cybernetic system the course of events is said to be subject to *restraints*: factors, which determine inequality of probability. Without restraints, the pathways of change would be governed only by equality of probability (Bateson, 1972: 399). Restraints of many different kinds may combine to determine uniquely a given pathway or sequence of events. In biological systems these restraints, or determinants, include cues, i.e., sources of information, which will guide the system in its "selection" or in its development. From the point of view of the cybernetic observer, these pieces of information are restraints in the sense that they increase the probability of a given manifestation or event to happen, or a given pathway to take course (Bateson, 1972: 400). From the semiotic point of view these pieces of information are differences that make a difference to an emergent interpretant within a hierarchical structural–functional system. Cybernetics deals with the probabilities of pathways while semiotics deals with the *choices* of pathways that the system makes based on the global interpretation of such restraints and probabilities in relation to its internal coherence. In this sense living systems are said to be stochastic. The restraints – including sources of information – lay out the probabilities of the pathways among which the informed system, based on its global interpretation will tend. So in biological systems restraints do not fully determine the outcomes of events; they increase the probabilities of certain pathways over others. A specific complex configuration of cues guides the system in its development at every instant, in a continuous way.

In semiotic networks (and also in cybernetic circuits, as originally stated by Bateson), formal processes of mapping, translation, or transformation can be imputed to every step of a given sequence of phenomena. These *mappings* or transformations may be very complex, e.g., where the output of some system is regarded as a total transform of the input; or they may be very simple, e.g., where the output is a digital transform of the input (Bateson, 1972: 401). For example, cellular signal transduction does not function with a single signal. The process consists in translating the analogical concentration of signals (sensed by the compound effect of a number of "digital" signal-receptor bindings) into an analogue concentration of single transforms that reflect the analogical information of the concentration present at the input. The elementary unit of information, *a difference that makes a difference*, is able to make a difference because the pathways along which it travels and is continually transformed are themselves provided with energy. The pathways are ready to be triggered. We may even say that the question is already implicit in them (Bateson, 1972: 453).

In a selected or identified network there is a contrast between most of the pathways of information inside the "system" in which it is manifested and most of the pathways outside of it. For example let's take a mammalian cell's signal transduction pathway of the kind that uses "relay systems" to transduce the signal from the cell-surface receptors to the nucleus, with the resulting alteration of transcriptional activity. The first part of the journey, the arrival of the signal molecule to the vicinity of the receptor, that which will produce the first difference, is energised from "behind", by some source outside the system, and, if it comes from the environment like, e.g. an odorant, it can be said to be energised in the ordinary hard-science way. If instead the signal is generated by another living system the network could then be extended in that direction. But once the difference is transduced inside the system, this type of travel is replaced by travel which is energised at every step by the metabolic energy latent in the protoplasm which *receives* the difference, recreates or transforms it, and passes it on (Bateson, 1972: 453). (However, exceptions may occur on both sides of the line, i. e.: some external chains of events may be energised by relays, and some chains of events internal to the system may be energised from "behind", depending on our delimitation of the network. However, as a general rule we can say that the coding and transmission of differences outside the system is somehow different from the coding and transmission inside.) (Bateson, 1972: 454).

This is exactly the case of signal-transduction networks. If one strikes the head of a nail with a hammer, an impulse is transmitted to its point. But it would be incorrect to say that what travels from the receptor to the nucleus in a cellular process is an "impulse". It would be more correctly called "news of a difference" (Bateson, 1972: 454).

> … 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, 1972: 455).

7th Idea

The elementary unit of information, *a difference that makes a dfference* [e.g., the binding of a single molecule], is able to make a difference because the pathways along which it travels and is continually transformed are themselves provided with energy.

## From the Binding of a Single Molecule to Complex "Locks-and-Keys"

Let us take for example the most widely characterised endocrine systems, which involve water-soluble hormones with cell-surface receptors. Normally these systems work as follows: a signal (a hormone) emitted by a remote cell makes contact with the surface receptor of the "target" cell. This produces a conformational change (and dimerisation or oligomerisation of the receptor) that permits the activation of a cascade of events and components in which the "difference" created by the binding of the hormone to the surface receptor is "transduced" through different possible mechanisms. The different *intermediate* steps may include a modular arrangement of ready-to be- activated components that give rise to identifiable codes which are implemented through different infrastructure but which share some logical principles, interfaces and cross-talking pathways (for a description of the common logic of such codes see Bruni, 2003, 2006).

The cascades of patterns of second messengers and of protein interactions and modifications is what then relays the signal – sometimes amplifying or diversifying it – to the nucleus where it is finally "translated" into a cellular response. The interpretation key for each signal is embedded in the larger message that its concentration conveys. One single molecule will not be enough to transduce the necessary concentration threshold for the "last" signalling event of the cascade to happen, i.e., the transcription of particular mRNAs that will work as signs in further semiotic networks, from translation and so on. Actually, what is conveyed is news of differences in concentrations.

The whole code of signal transduction is based on signs consisting in complex patterns of concentrations of different signal types and the subsequent modulations of concentrations in all the intermediary steps. In Bateson's terminology, the transform of a difference (caused for example by the binding of a single signal-molecule) traveling in a circuit is an elementary idea. The concentration of transforms is a less elementary idea, and still less elementary is the difference created by cocktails of concentrations of transforms of diverse signals acting simultaneously.

Sensed differences are closely related to the very common notion of biological specificity. However, there are new kinds of specificities at much higher levels than the basic stereochemical specificities between two binding molecules. Actually, these basic stereochemical specificities combine to give rise to more complex specificities. This emerging process is related to, and is probably at the base of, the increasing semiotic freedom exhibited by complex organisms, i.e., the extent of logical (or causal) independence that some processes may acquire with respect to the physical dynamics of the substrate that underlies such processes.

There are basic types of specificities which give rise to new and more complex types of specificities:

– The specificity of each DNA sequence for its complementary strand, determined by the specificity of DNA base pairs
– The specificity of the relation between DNA and protein, what has been called "genetic information", understood as the specification of a protein sequence, i.e. the linear amino acid residue sequence of a protein from a DNA sequence as a process of "translation", i.e. the triplet-amino acid specificity

There are more complex types of specificities:

– Gene-enzyme specificity
– Enzyme-substrate
– Antibody-antigen
– Signal molecule-receptor
– Activation complex-DNA, and so on

The simultaneous and complex "activation" of an indeterminate number of these "lock and key" mechanisms mediate the emergence of new informational contexts and new and more complex "lock and key" mechanisms and specificities like for example:

– "Cocktail" of signals-cellular response
– Host-symbiont
– Organism-niche

Differences are sensed, transformed and conveyed across hierarchical levels, forming therefore higher order differences. Specificities at different levels become analogical messages out of the complex interaction of many lower-level specificities. These complex specificities establish "systems of correspondences", "systems of ideas in circuit".

For example, a particular complex "lock-and-key" is created by which a complex configuration of concentration thresholds of signals-receptors-complexes and transforms of signals-receptors-complexes link a specific contextual demand to a specific cellular response. These complex lock-and-keys are higher order specificities. They are built on, but not limited to, the more basic individual stereochemical specificities between two molecules (I have referred to this process as "digital–analogical consensus" (Bruni, 2003, 2006)).

The importance of considering semiotic contexts hierarchically is that sometimes at a given level what may look as an "either–or" choice of function or manifestation may be determined by the compound effect of a larger analogical message, a bulk of information that has a causal link to the lower level. For example, whether a pathogen protein acts as a virulence or as an avirulence factor is determined by a larger gestalt above, or beyond, the specificity of the molecular binding between the resistance determinant and the avirulence protein. This is related to the "1st idea" mentioned above, which expresses that "the data may have to be understood within some larger gestalt." This case is an example of the importance of looking at a larger context since the occurrence of many other simultaneous factors (a larger gestalt) may be what determines when the same protein emitted by a potential pathogen functions as a virulence factor on its "victim" (as a "weapon"), or when it functions as an avirulence factor (a "warning") that allows the potential "victim" to start a defence response on time (Nimchuk et al., 2001: 288).

Complex specificities and "lock and key mechanisms" create immense combinatorial semiotic possibilities for regulating and fine-tuning complex, detailed and decentralised responses to equally complex, detailed and decentralised stimuli.

## Where is Regulation?

We tend to see the process of signal transduction as beginning with the extracellular signal and ending with the transcription of a gene. But the hormone is not the beginning and mRNA is not the end of the semiotic network, they are just transient signs that take the process into new developments which will produce new sets of interconnected informational pathways in an endless progression until the system ceases to be a living-semiotic system within a network, that is, when its whereabouts will be determined exclusively by physical dynamics and there will be no more room for sensing, constructing and interpreting signs out of concentrations of signal-molecules. Information comes out of a context into a context. It does not matter whether that context is inside or outside the cell, the organism or the niche. This is why at the level of signal transduction it would be more appropriate to talk about mediation (as some authors do) rather than regulation, being the regulatory properties always found at higher hierarchical levels of integration.

It does not seem correct to claim that a given ion, molecule or protein complex is "the" regulatory element of a given process as it is usually stated in textbooks. There is no signal transduction network, which is regulated by such a single element, and there is no signal transduction pathway that stands on its own. Any "second messenger" is no less a regulator than the primary or the final signal. Primary signals come from and go to different directions and networks, all of which offer further possibilities for regulation. There is either no final signal because the process is continuous and signal pathways do not end. Signals are only transformed within larger circuits of branching and interconnecting chains of causation. These chains of causation are "closed" or integrated in the sense that causal interconnection can be traced around the circuit and back through whatever position was arbitrarily chosen as the starting point of the description (Bateson, 1972: 404). Because such complex networks are not exclusively determined by mass-energy restrictions, a random event – such as the building up of a given extracellular signal's concentration in the periphery of a cell – will produce a non-random response to such an event (Bateson, 1972: 405).

What differentiates a signal from an "impact" is its triadic nature, i.e.,"… differences are not intelligible in the absence of a purpose" (Hoffmeyer and Emmeche, 1991: 126). Rather than an "impulse", a signal transmits "news of a difference" or a "transform of a difference".

8th Idea

A non-random response to a difference or to a complex aggregate of differences is not deterministic in the physical sense because the system that reacts to the random event has a repertoire of responses of which it will select the optimal one based on a global assessment of the context.

## Global and Hierarchical Regulation

There are many sources for complexity in integrated signal networks. It is the interactions of different signaling pathways that permit the fine-tuning of cellular activities required to carry out complex developmental and physiological processes (Lodish et al., 2000: 894).

Lodish et al. (2000: 886) assert that "The coordinate regulation of stimulatory and inhibitory pathways provides an efficient mechanism for operating switches and is a common phenomenon in regulatory biology". From a mechanist point of view this leads to a paradox: does the coordinate regulation provide an efficient mechanism or does an efficient mechanism provide coordinate regulation?

A hormone or a neurotransmitter does not control anything; it rather cooperates with something. We can say that it is a limiting or a cooperative factor, but not properly a regulator. Regulation is a continuous process and anywhere you enter the circuit you will find a sort of "local regulator" or a checkpoint, which in turn is regulated and controlled by further ramifications of the semiotic network. In other words, all the pathways involved in such "control" or "regulation" processes are themselves opportunities for further regulation and control.

In his article "Cybernetic Explanation", Bateson (1972: 401) claims that a tactic in the construction of cybernetic explanations is the use of "mapping" or rigorous metaphor. Formal explanations or representations of communicational phenomena in one system or process can be applied to a different system or process within "the world of communication". In this abductive strategy some explanations at the level of cognitive processes could find relevance at the level of cellular communication. In this line of thought, Bateson argues that "… from the cybernetic point of view, a word in a sentence, or a letter within the word, or the anatomy of some part within an organism, or the role of a species in a ecosystem, or the behavior of a member within a family – these are all to be (negatively) explained by an analysis of restraints" (Bateson, 1972: 400). We could easily add to this list "the role of a signal in a signal network".

In the same article Bateson elaborates on the nature of “negative” explanation in cybernetics by using a linguistic example on how to avoid error in spelling and grammar, by recognition of patterns and retrieval of information from our memory: “…***choices are not at all at the same level***. I may have to avoid error in my choice of the word “many” in a given context, discarding the alternatives, “few,” “several,” “frequent,” etc. But if I can achieve this **higher level choice** on a negative base, it follows that the word “many” and its **alternatives** somehow must be conceivable to me – **must exist as distinguishable and possibly labelled or coded patterns** in my neural processes. If they do, in some sense, exist, then it follows that, **after making the higher level choice of what word to use, I shall not necessarily be faced with alternatives at the lower level**” (Bateson, 1972: 405, my emphasis). I claim that this idea can be generalised to regulatory biology.

Bearing in mind the universality of the hierarchical nature of contexts within contexts in the communicational aspects of phenomena, which should drive the scientist always to seek for explanation in the ever-larger units, we can reformulate some of the ideas highlighted above in order to infer in which way regulation in biological systems hardly ever depends on a single “informational molecule” or a single signalling pathway. We should think about the hierarchical nature of regulation and in which way it tends to be integrated at the highest possible level.

9th Idea

Selection of responses,‘choices’, can be achieved at different levels. If a response can be selected at a rather higher level of integration, the alternative responses must exist as possible and ‘distinguishable’ coded patterns in the system.

If alternatives do exist and can be selected at higher levels of integration than, for example, the single signal network, it may not be necessary to face selection at lower levels which are already included in the selection of the higher level. This is why regulation should not be considered exclusively a local event, but also a compound effect more properly describable at a level closer to the context of the system under consideration. Contrary to our genetic determinism (and now our signal determinism), choices at higher hierarchical levels, determined by sensing larger aggregates of differences, will have larger restrictive or regulating effects upon the whole hierarchy by influencing a larger set of circuits and networks which inform about larger portions of the context as opposed to a single signal-pathway mediating or contributing to the expression of a single gene, which in turn may contribute to a phenotype.

It seems as if every time a signal-regulatory network is elucidated it is always discovered that there is further regulatory complexity. There is always integration of different regulatory mechanisms and signals depending upon many different cues like for example nutritional status, environmental stress, surface viscosity, cell density and many others, in order to elicit a complex phenotype. Not to mention the regulation of interconnected pathways like for instance those that originate the precursors from which the signal-generator produces the signal-molecule, or those that modulate the number and/or activity of functional receptors on the surface of cells decreasing or increasing the sensitivity of the cell. Therefore it is becoming customary to speak about global and primary regulatory controls.

> … we know that no part of such an internally interactive system can have unilateral control over the remainder or over any other part. The mental [or in our case, the regulatory] characteristics are inherent or immanent in the ensemble as a *whole*.
>
> Even in very simple self-corrective systems, this holistic character is evident (Bateson, 1972: 315)
>
> The stability of the system (i.e., whether it will act self-correctively or oscillate or go into runaway) depends upon the relation between the operational product of all the transformations of difference around the circuit and upon this characteristic time. (Bateson, 1972: 316)

10th Idea

Hierarchical sensing of differences and complex aggregates of differences lead to global regulation and homeostasis.

## Conclusions

When we are exploring how differences are sensed, transformed and conveyed across hierarchical levels, forming therefore higher order differences, we are mostly concerned about regularities in the formal and logical aspects of such processes rather than in the regularity of the physical structures that underpin them. The material means implicated in the formal process can be bewilderingly diverse. Since biology has focused mostly on the diversity of structures, rather than on the formal logics behind biological-informational processes, induction has necessarily been the norm, presenting biology as a science with very few deductive principles, generalisations or rules, and focused rather on specific, local and apparently idiosyncratic cases, putting us in front of a jungle of proteins where it is sometimes difficult to see the forest from the trees.

Data is not what biology is lacking. There is an enormous production of data in the new "genomic", "proteomic" and "metabolomic" approaches. This is particularly true for the growing field of signal transduction networks and informational pathways in cellular systems and organisms. These massive data sets may very well find a meaningful and fruitful mapping in Gregory Bateson's approach to information, hierarchical contexts and analog/digital communication. For example, in Bruni (2003, 2006), I have developed a framework based on triadic causality and on the interplay between digital and analogical codes in living systems adapted from Bateson's framework and from biosemiotics in order to re-interpret current molecular cell biology data about cellular signal transduction networks, taking into consideration the hierarchical embeddeness of such networks in contexts and meta-contexts. In particular, there I outline a way to look at how elementary differences build up and are sensed up and down the biological hierarchy, and how can biological systems categorise, distinguish and obtain relevant information out of otherwise ubiquitous differences and signals. The idea is to address some important questions in signal transduction such as how specificity is determined, how ubiquitous signals or messengers convey specific information, how undesired cross-talk is avoided and how redundancy integrates the system. Based on Bateson's framework I coined the term "digital–analogical consensus" in order to characterised such processes, in particular I have taken as an example what deserves to be called the Calcium code. Sign-processes in biological systems involve hierarchical sensing and transduction of complex "logical products" that become crystallised in codes that bind specific complex configurations (which mirror the context) to specific responses.

There is a new and exciting epistemological path open in biology, which is seriously considering the evolution of signal networks as one of the most important processes in living systems. These new efforts to tackle biological complexity will lead to modeling, mapping and monitoring systems based on the sign-networks operative at all hierarchical levels. We can of course aim to characterise exhaustively the material components and mechanisms of entire signalomes. For economical reasons we can also envision a strategy that relies on the identification and hierarchical organisation of crucial semiotic patterns which can then guide our quest for infrastructural details to fill in the relevant gaps in the sphere of the systems of interest. Conversely, what can guide our choices for the meaningful patterns at higher levels is our understanding about transduction of information across emergent levels and our knowledge about the rules of redundancy in the system, i.e., coding instances. We can aim to identify "overall structural motifs" of patterns and then concentrate on the local patterns that influence the meta-patterns most critically.

These characterisations cannot include the totality of the exhaustive mosaic of "all the actors" but will have to rely on the identification of "indicator patterns" that can guide the observer when characterising a semiotic network.

> A pattern, in fact, is definable as an aggregate of events or objects which will permit in such degree such guesses when the entire aggregate is not available for inspection (Bateson, 1972: 407).

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# Chapter 7
# Process Ecology: *Creatura* at Large in an Open Universe

**Robert E. Ulanowicz**

**Abstract** Gregory Bateson maintained that access to the Sacred was being impeded by contemporary scientific attitudes. He urged that, in order to avoid a bad end, society must adopt an ecological vision. The conventional perspective can be described as the legacy of a Newtonian metaphysic, which consists of five postulates about how to view nature. Consideration of some aspects of ecosystem dynamics reveals, however, that they violate each of the five assumptions. In order that science may progress in its treatment of living systems, it thus becomes imperative that a new ecological set of assumptions supplant the former foundations. Nature is thus seen as open, contingent, historical, organic and granular. That these attributes allow more ready access to the Sacred is seen when one considers how they either obviate or mitigate former controversies such as free will, the origin of life, the possibility for Divine intervention and theodicy.

**Keywords** Autocatalysis, *creatura*, determinism, divine intervention, free will, newtonian metaphysics, origin of life, process ecology, radical chance, theodicy

## Introduction: An Occidental Pathway?

Should conventional scientific attitudes impede our approach to an "epistemology of the Sacred", the late Gregory Bateson would urge us to adopt in its place an "ecology of the mind". A deep and powerful idea! In reviewing Bateson's work, I have been amazed time and again by how prescient he was in so many ways. And yet, if one were to ask most ecologists to comment on Bateson's challenge to conventional science, the likely response would be a blank stare. Perhaps such ignorance would not have been a surprise to Bateson, who noted how the cybernetic nature of individuals and society induces them to be self-corrective against any disturbances to their

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J. Hoffmeyer (ed.), *A Legacy for Living Systems: Gregory Bateson as Precursor to Biosemiotics*

worldview (Bateson 1972, p. 429).[1] Still, I am left to wonder whether Bateson's own eclectic vision didn't sometimes work against him. For example, he showed little reluctance to invoking sources from Gnosticism or Alchemy, but such allusions away from metaphysical naturalism often burden one's credibility among the bench ecologist – not to mention among those who set the trends for what is legitimate in science. I am reminded here of the overt disdain that most professional ecologists express for the concept of Gaia, due in large measure to the transcendental intimations evident in Lovelock's (1979) original formulation. And so with great and due respect to Bateson's genius, I will entertain the proposition that a more direct critique, posited within the Occidental framework that Bateson largely eschewed, might possibly have elicited a wider-ranging and longer-lasting response.

I note how Bateson hardly has been alone in invoking ecology to distinguish views that do not conform to conventional science. One encounters, for example, books on "the ecology of computational systems," (Huberman 1988) and entire institutes that are devoted to the "ecological study of perception and action" (Gibson 1979). Some have even accused ecosystem science of resting upon overtly theological underpinnings (Sagoff 1997). The latter allegation is hardly surprising, when one considers how Arne Naess (1988) purports that "deep ecology" affects one's life and perception of the natural world in a profound and ineffable way. Profound? Yes, and Bateson makes a good case for how language alone cannot convey all knowledge, but, as I hope to make apparent presently, maybe ecology need not be as ineffable as either he or Naess have contended.

I, therefore, entertain the proposition that the ways by which ecology affords *creatura* an escape from the mechanical shackles of mainstream science can be outlined in terms of a relatively straightforward metaphysics. For, in scrutinizing the assumptions that have sustained science over the last three or so centuries, one could conclude that, not only have they impeded access to the Sacred for many, but they have also blocked the road to full consideration of some very important natural phenomena as well. To heed Occam's Razor is all well and good, but to indulge in an exaggerated minimalism does a major disservice to our understanding of the natural world (Ulanowicz 1995a).

I will begin my parallel to Bateson's development by creating a "strawman" metaphysics that characterizes the consensus of scientific attitudes at the apogee of Newtonian science very early in the 19th century. I acknowledge that this framework has eroded considerably through the appearance of Thermodynamics, Darwinism, Relativity and Quantum Theories, but, depending on the particular field of endeavor, I would argue that various elements of the original structure remain solidly in place throughout almost all of contemporary science. I will then attempt to demonstrate how the phenomena particular to ecosystem behavior can violate each and every point of these conventional foundations. In a spirit of Postmodern Constructivism (Griffin 1996), I will try to outline a countervailing "ecological metaphysic", that poses far fewer barriers to the Sacred. In closing,

[1] All subsequent citations of Bateson 1972 will be denoted simply by the page number on which the material appears.

I will touch upon a few particular implications of this new metaphysic for some abiding issues in philosophy and theology, such as free will, the possibility of divine intervention, the origin of life and theodicy.

## Barriers to the Sacred

Although books on the Scientific Method are legion, summaries of the fundamental assumptions which underlie the scientific endeavor are comparatively few. One such synopsis is by Depew and Weber (1994), who enumerated four fundamental postulates about nature according to which Newtonian investigations were pursued:

1. Newtonian systems are causally *closed*. Only mechanical or material causes are legitimate. Other forms of action are proscribed from consideration, especially any reference to Aristotle's "final", or top-down causality, which Thomas Aquinas later identified with God. The publication of Newton's *Principia*, after all, had been quite decisive in showing how the movements of the planets could be accurately described and predicted without any reference whatsoever to supernatural agencies.[2]
2. Newtonian systems are *atomistic*. They are strongly decomposable into stable least units, which can be built up and taken apart again. This property is ineluctably bound up with the notion of reductionism, whereby only those agencies at the smallest scales are of any importance. Whence, Carl Sagan, in wrapping up his television show on biological evolution that highlighted such megafauna as dinosaurs saw no inconsistency whatsoever in declaring, "These are some of the things that *molecules* do!" Another tacit implication of atomism is that in breaking any system apart nothing of essence is thereby lost. Thus, when atomism is combined with closure, the outcome is akin to the dictum of Lucretius (1st century BCE), "There are atoms, and there is the void." – nothing more!
3. Newtonian systems are *reversible*. Laws governing behavior work the same in both temporal directions. This is a consequence of the symmetry of time in all Newtonian laws. Although the obvious irreversibility of biological phenomena might give one pause, it should be pointed out how Aemalie Noether (1983) demonstrated that symmetry in time and the notion of conservation (of material and energy) are inextricably linked, and virtually all scientific endeavors rely on some assumption about conservation. One should note as well that in a reversible, conservative world nothing essentially new can possibly arise.

[2] Eddington's original warning read, "If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations – then so much the worse for Maxwell's equations. If it is found to be contradicted by observation, well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give you no hope; there is nothing for it but to collapse in deepest humiliation".

4. Newtonian systems are deterministic. Given precise initial conditions, the future (and past) states of a system can be specified with arbitrary precision. So enamored of their own successes were the mechanists of the early 19th century that Pierre Laplace (1996) was able to exult in the unlimited horizons of the emerging mechanical worldview. Any "demon" or angel, he proclaimed, that possessed a precise knowledge of the positions and momenta of all particles in the universe at any single instant could invoke Newtonian-like dynamics to predict all future events and/or hindcast all of history.

In addition, I have elsewhere (Ulanowicz 1999) suggested a fifth article of faith, namely that

5. Physical laws are *universal*. They apply everywhere, at all times and scales. The keyword here is "everywhere". In combination with determinism, universality says that nothing occurs other than what is elicited by a fundamental physical law. Or, as Philip Hefner (2000), former director of the Zygon Center for Religion and Science, once wistfully expressed his doubts by saying that God just doesn't have enough "wiggle-room" to act in the world.

As I mentioned earlier, nobody fully accedes to all five postulates. Almost every scientist, however, clings to one or more of the tenets. Thus it is that closure is strictly applied to the neo-Darwinian scenario of evolution. The theory is scrupulous in making reference to only material and mechanical causes (Dawkins 1976, Dennett 1995). Atomism (reductionism) still dominates biology – witness the preponderance of molecular biology today. A substantial fraction of scientists even continue to deny the reality of chance in the world. "If only the depth and precision of one's observation were not so limited", they maintain, "one could in principle predict what now appear to be random behaviors." So it is not surprising that for many, science appears as an ostensible refuge from having to confront questions of faith.

As Bateson might underscore here, these postulates all pertain to the *pleroma* in nature (p. 481). They are set up to describe the world in terms of eternal and unchanging fundamental *objects*. Change at higher levels is thereby only illusory or epiphenomenal. And so we confront the first major question, "How can things change?"

## The Aleatoric in Nature

Bateson (p. 427) was fond of pointing to Lamarck as the first to interject change into biology, and the evolutionary theorist would immediately (and correctly) interject that Wallace and Darwin introduced both change and history with their description of evolution. Later Mendel demonstrated how change could be discrete, as opposed to gradual. This is all well and good, but it needs to be emphasized how, at the beginning of the 20th century, none of these individuals enjoyed widespread approbation among scientific circles; primarily because their narratives evoked too much discord with the Eleatic view of Newtonians that the universe is essentially unchanging. Evolutionary theory began to gain ground only in the 1930s, after Fisher and Wright had borrowed the probabilistic approach of Boltzmann and Gibbs to show that the genie of chance could be pushed back into the bottle. Although there might be small departures from the grand continuum, these deviations were simple and regular in nature and could be predicted in the aggregate using probability theory.

This reconciliation by Fisher and Wright, commonly call the "Grand Synthesis", conveniently ignored the potentially radical nature of some events in a complex world. Actually, consideration of radical chance came well before the advent of what we today call "Complexity Theory", Walter Elsasser (1969) elaborated it about the same time that Bateson was actively preaching the Ecology of Mind (although in my brief survey of Bateson I encountered no evidence that he was aware of Elsasser).

In brief, Elsasser argued for the existence of unique events – events that occur once and never again. He began by introducing the concept of an "enormous number" – numbers so large that they defy physical reality. In order to approximate the threshold of enormous numbers, he attempted to estimate an upper limit on the number of simple events that possibly could have occurred since the Big Bang. Elsasser reckoned the number of simple particles in the known universe to be about $10^{85}$, give or take a few orders of magnitude. He then noted as how the number of nanoseconds that have transpired since the beginning of the universe is about $10^{25}$. Hence, his rough estimate of the upper limit on the number of conceivable events that could have occurred in the physical world is about $10^{110}$. Any number of possibilities much larger than this value simply loses any meaning as regards physical reality.

Bateson's eschewal of the Big Bang notwithstanding, anyone familiar with combinatorics immediately will realize that it doesn't take very many identifiable elements or processes before the number of possible configurations among them becomes enormous. One doesn't need Avagadro's Number of particles ($10^{23}$) to produce combinations in excess of $10^{110}$ – a system with merely 80 or so distinguishable components will suffice. In probabilistic terms, any event randomly comprised of more than 80 separate elements is almost certain never to have occurred earlier in the history of the universe. Such a constellation is unique once and for all time. It follows, then, that in ecosystems with hundreds or thousands of distinguishable organisms, one must reckon not just with the occasional unique event, but with legions of them. Unique, singular events are occurring all the time, everywhere!

In the face of this reality, any consideration of determinism as a universal characteristic seems absurd. All hope of probabilistic prediction fails, because probability theory cannot deal with singular events. In order to define a probability for an event, it must re-occur a sufficient number of times. Suddenly, the entire ground has shifted. The dominant question no longer is how can things change, but rather how can any pattern persist in the face of such radical indeterminacy?

## A Cybernetic World

This shift in leading question throws us back into Bateson's home territory – that of cybernetics, for now one must ask what elicits and sustains order in the midst of a world full of noise? In formulating a response, we note Bateson's opinion (p. 404) that a causal circuit generates non-random response to random stimuli. I, therefore, wish to concentrate on a particular form of causal circuit – that of autocatalysis. My definition of autocatalysis is any manifestation of a positive feedback loop whereby the direct effect of every link on its downstream neighbor is positive. Without loss of generality, let us focus our attention on a serial, circular conjunction of three processes A, B, and C (Figure 7.1) Any increase in A is likely to induce a corresponding increase in B, which in turn elicits an increase in C, and whence back to A.

A didactic example of autocatalysis in ecology is the community that forms around the aquatic macrophyte, *Utricularia* (Ulanowicz 1995b). All members of the genus *Utricularia* are carnivorous plants. Small bladders, called utricles, are scattered along its feather-like stems and leaves (Figure 7.2a). Each utricle has a few hair-like triggers at its terminal end, which, when touched by a feeding zooplankter, opens the end of the bladder, and the animal is sucked into the utricle by a negative osmotic pressure that the plant had maintained inside the bladder. In nature the surface of *Utricularia* plants is always host to a film of algal growth known as periphyton. This periphyton serves in turn as food for any number of species of small zooplankton. The autocatalytic cycle is closed when the *Utricularia* captures and absorbs many of the zooplankton (Figure 7.2b).

In chemistry, where reactants are simple and fixed, autocatalysis behaves just like any other mechanism. As soon as one must contend with organic macromolecules and their ability to undergo small, incremental alterations, however, the game alters considerably. Whenever the effect of any catalyst on the downstream element is fraught with contingencies (rather than being deterministic and obligatory), a number of decidedly non-mechanical behaviors can arise (Ulanowicz 1997). For the sake of brevity, I will discuss only a few:

Perhaps most importantly, autocatalysis is capable of exerting selection pressure upon its ever-changing, malleable constituents. To see this, one considers a small spontaneous change in process B. If that change either makes B more sensitive to A or a more effective catalyst of C, then the transition will receive enhanced stimulus from A. Conversely, if the change in B either makes it either less sensitive to the effects of A or a weaker catalyst of C, then that perturbation will likely receive

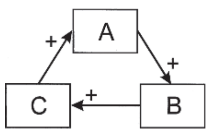


**Fig. 7.1** A simple example of autocatalysis

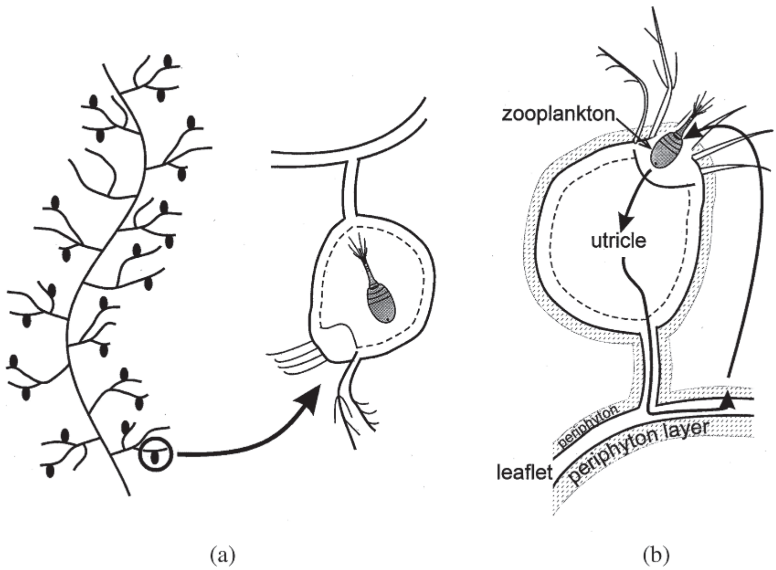


**Fig. 7. 2** (a) *Utricularia*, a carnivorous plant. (b) The cycle of rewards in the *Utricularia* system

diminished support from A. That is to say that there is a preferred direction inherent in autocatalysis – that of increasing autocatalytic participation. This preferred direction can be interpreted as a breaking of symmetry, and such asymmetry violates the assumption of reversibility. Furthermore, as elements increasingly engage in autocatalysis, or mutually adapt to the cycle, they lose the capability of acting on their own. They may even become unable to persist in isolation, or if they do, it would be with behavior radically different from what they exhibited as part of the autocatalytic scheme. That is, the full cycle manifests an organic nature that belies the assumption of Atomism.

To see how another very important attribute of living systems can arise, one notes in particular that any change in B is likely to involve a change in the amounts of material and energy that are required to sustain process B. As a corollary to selection pressure we immediately recognize the tendency to reward and support any changes that serve to bring ever more resources into B. Because this circumstance pertains to any and all members of the feedback loop, any autocatalytic cycle becomes the epi-center of a *centripetal* pattern of flows towards which as many resources as possible will converge (Figure 7.3). In a way of speaking, an autocatalytic loop *defines its own selfhood* by virtue of being the focus of centripetal flows. It is what Bateson refers to as the unit of evolutionary survival that he identifies with “mind” (p. 483).

Bateson (p. 402) noted a proclivity in cybernetic systems to exert top-down influence, and the selection pressure inherent in autocatalysis acts in exactly this

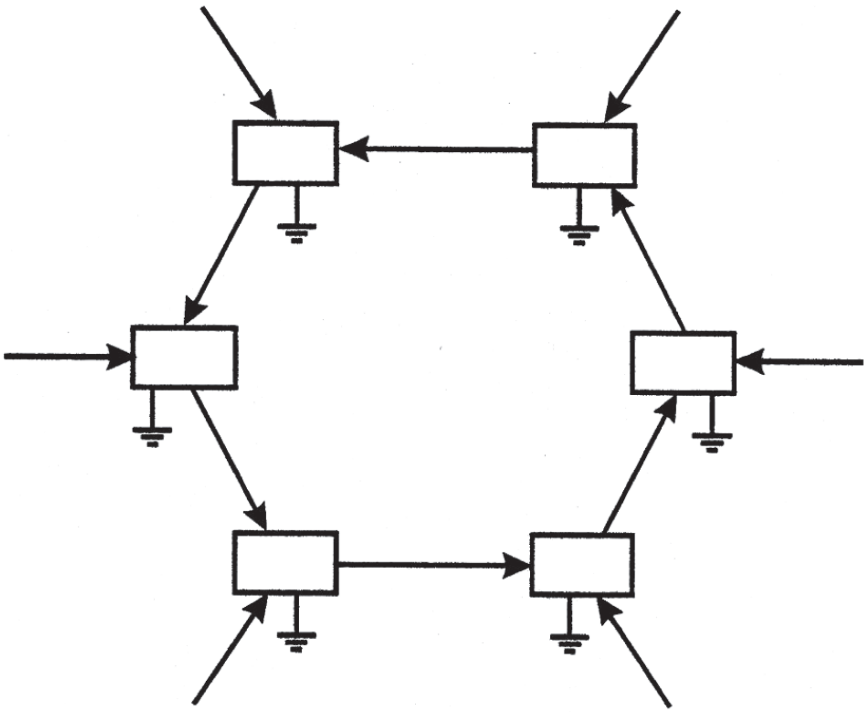

**Fig. 7.3** Centripetal action as engendered by autocatalysis

fashion. It is an agency proper to the macroscopic ensemble that actively orders its constituent elements. When viewed at the level of the entire loop, centripetality appears as an agency originating *at* the focal level. Both of these modes of action violate the rule of causal closure, which allows only mechanical actions at smaller levels to ramify *up* the hierarchy of scales.

A common consequence of centripetality is that whenever two or more autocatalytic loops exist within the same system and draw from the same pool of finite resources, *competition* among the foci usually ensues.[3] In particular, whenever two loops share pathway segments in common, the result of this competition is likely to be the exclusion or radical diminution of one of the non-overlapping sections. For example, should a new element D happen to appear and to connect with A and C in parallel to their connections with B, then if D is more sensitive to A and/or a better catalyst of C, the ensuing dynamics should favor D over B to the extent that B will either fade into the background or disappear altogether (Figure 7.4). That is, the

[3] The focus here upon competition is to demonstrate how centripetality can order dynamical structures. One must always bear in mind that such competition does not act in exclusion of mutuality, which constitutes the very foundation of centripetality.

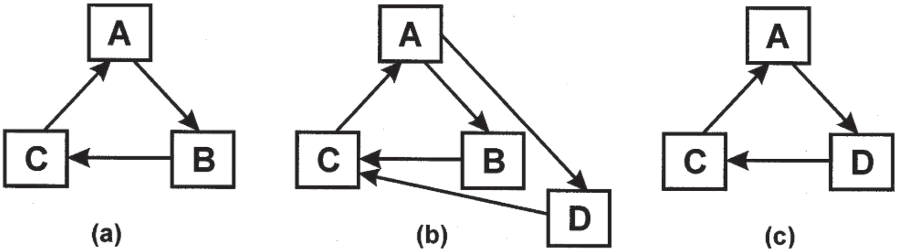


**Fig. 7.4** The selection of new element D to replace B

selection pressure and centripetality generated by complex autocatalysis (a configuration of processes) is capable of influencing the replacement of elements.

In the conventional view, agency is considered to originate only with objects, but we now perceive yet another inversion of affairs. A *configuration of processes* strongly influences which objects remain and which pass from the scene. I would suggest that such configurations are at the crux of Bateson's "*creatura*". Processes participate in the creation of their own elements, a fact which also underscores Whitehead's (1978) emphasis on process over objects and laws.

Bateson posits as how creatural description is always hierarchical (p. 457), and so it is worthwhile to note how autocatalytic selection sometimes acts to stabilize and regularize behaviors across the hierarchy of scales. Unlike the rigidity of Newtonian universality, the effects of a chance event anywhere in the realm of "process ecology" rarely will propagate up and down the hierarchy without attenuation. The consequences of noise at one level are usually mitigated by autocatalytic selection at higher levels and by energetic culling at lower levels. Nature as a whole takes on "habits" (Hoffmeyer 1993) and exhibits regularities, but the universality and uniformity of all Newtonian laws are replaced by a *granularity* of the real world. That is, models of events at any one scale can explain matters at another scale only in inverse proportion to the remoteness between them. Obversely, the domain within which irregularities and perturbations can damage a system remains circumscribed. Under the more flexible scenario of process ecology chance does not necessarily unravel a system.

Finally, it should be pointed out that the overall autocatalytic configuration will tend to persist, even as constituents *and associated mechanisms* come and go under its aegis.

## A Transactional Ecology

In the years following Bateson's participation in the series of Macy Conferences, those in the discipline of information theory made strides in extending Claude Shannon's measure of information to apply to Bayesian or conditional probabilities

(Rutledge et al. 1976). As a result, it is now possible to identify Shannon-like indices capable of decomposing the overall complexity of a configuration (or network) of processes into separate components that represent organized or coherent structure on the one hand and disorganized flexibility, on the other. As a result we now have the capability to quantify Bateson's "economy of flexibility" (p. 349ff) in terms of two measurable and complementary terms called the network ascendancy and overhead, respectively (Ulanowicz 1980).

Those cybernetic tendencies that reinforce autocatalytic performance and thereby create order contribute quantitatively towards an increasing system ascendency (Ulanowicz 1986). It is tempting to think that an ever-higher ascendency would always benefit an ecosystem. It appears, however, that systems can acquire a surfeit of order and constraint to the point of growing "brittle" (Holling 1986). Too low a proportion of overhead represents a deficiency of flexibility in the system that would otherwise allow it to adapt to novel challenges. In Bateson's terminology, the system comes to lack a "defense in depth" (p. 351), and such brittle systems become candidates for collapse (p. 495).

In keeping with the complex nature of the biological world, changes in ecosystem structure do not appear to move toward a single goal (p. 500). Not only do ecosystems appear to respond to a multiplicity of "orientor" functions (Mueller & Leupelt 1998), but a major division of trends into order-enhancing or ascendant directions as opposed to entropic or diversifying dispersions becomes visible. The interplay between the contributions to ascendency and overhead resembles nothing other than a classical dialectic (although a "transactional exchange" might describe the situation with fewer distracting connotations). Contributions to either side of this transaction tend to subtract from its complement, and vice versa. Over the longer term (at a higher level), however, only systems that retain appropriate amounts of *both* attributes can persist (Ulanowicz 1986, 1997).

## An Ecological Metaphysic

The astute reader may have noticed that I have offered at least one reason why each of the five Newtonian postulates does not pertain to the realm of ecosystem development. In order to make further progress in understanding the realm of *creatura*, it becomes necessary to formulate an ecological counterpoint to each of the five Newtonian postulates (Ulanowicz 1999):

1. Ecosystems are not closed but *open* to the influence of non-mechanical agency.
2. Ecosystems are *contingent* in nature.
3. The realm of ecology is *granular*, rather than uniform and universal.
4. Ecosystems, like other biotic systems, are not reversible but *historical*.
5. Ecosystems are not easily decomposed; they are *organic* in composition and behavior.

## Fading Issues

As Bateson proposed, not only does an ecological vision help us to perceive reality more clearly than the procrustean Newtonianism it supplants, it also places far fewer barriers to encountering the Sacred. Perhaps the Newtonian impediments should not be too surprising, seeing as how they had precipitated during a time of secular–clerical strife. But those conflicts are now behind us (at least in the Western World), and so we should now reconsider a few of the issues that until rather recently have been regarded as conflicts between science and theism (Ulanowicz 2004):

Take, for example, the controversy surrounding free-will. In a deterministic Newtonian world there simply is no place whatsoever for free-will. To paraphrase the Newtonianist Sagan, thinking is just one of the things that *molecules* do, and molecules do not swerve from their lawful course. But the world of ecology is an open theatre, replete everywhere with legions of singular events. Nor is it any longer necessary to confine the search for free will to the vicissitudes of quantum phenomena (Penrose 1994). Contingencies can arise anywhere among the many layers of patterns that separate the firing of neurons from conscious thought, and the top-down influences of mind cannot be discounted (Juarrero 1999).

Then there is the matter of prayer, so central to the religions of the Book. While most believers acknowledge that the highest form of prayer should concern attitude rather than supplication, the latter retains its place among all such denominations. But why pray, if the Deity cannot interfere with its ordained laws? Such was the conundrum for the Deists, who sprang up in the wake of Newton. As Philip Hefner once opined, God just doesn't have the "wiggle room" to answer entreaties. The ecological world, however, is a far more supple place. Singular events are occurring everywhere, all the time. Most amount to nothing in the long run; a few damage the system and elicit a response; a miniscule few take the configuration into new and more effective (autocatalytically speaking) modes of operation and become incorporated into the history of the system. As mentioned, the fabric of causality is porous at all levels, and one cannot exclude a priori the possibility that a Deity might execute a coordinated action across several levels that need not propagate to the rest of the universe. God is not to be iced-out of the natural world, nor need small miracles defy rationality.

These last few statements most certainly will be rejected summarily by some as just another "God of the Gaps" argument. For those critics, I have special words: First, I would emphasize the sheer ubiquity of singular events in this complex world. One is not pointing to just rare and occasional gaps through which a God can tinker with nature. The entire fabric is *full* of holes. Secondly, as John Polkinghorne has noted, there are gaps and there are gaps (Davis 1998). It is rational to *believe* in the universality of scientific law, both those derived in the past and those yet to be formulated. It is contrary to that belief, however, to deny that limits to our knowledge, such as the natural ones posed by, say, the Heisenberg Principle, cannot exist. The gaps which I have described are of this latter nature, and one ignores them at peril to one's own rational integrity. With all due apologies to Arthur Eddington (1930) and the late Karl Popper (1990), I would dare to say to those who cannot accommodate causal openness:

> If someone points out to you that your pet theory of evolution is in disagreement with Fisher's equations, then so much the worse for Fisher's equations. And if your theory contradicts the facts, well, sometimes these experimentalists make mistakes. But if your theory cannot accommodate gaps in the causal structure of living systems, I can give you no hope; there is nothing for it but to fall grievously short of providing you full knowledge of how living systems evolve.

Evolutionary theory sidesteps circumstances leading to the origin of life, although there is no paucity of theories concerning life's beginnings. Given the emphasis in conventional science, however, upon attaching agency solely to objects, the focus of most of these theories is upon those structural elements that could lead to life. That is, most infer that once the right chemical structures appear, they will immediately spring to life, somewhat akin to Ezekiel's dry bones taking on flesh and dancing. Process ecology bids us instead to entertain a more consistent scenario.

Howard Odum (1971), for example, proposed that *proto-ecological* systems had to already be in existence before proto-*organisms* could arise. His scenario was that at least two opposing (agonistic) reactions (like oxidation–reduction) (Fiscus 2001) had to be physically separated and their reactants be actively transported across a spatial domain that consisted of one region where a source of energy dominates and another where the residuals of that energy (entropy) can be conveyed out of the system. Such a cyclical configuration of processes, via scenarios involving selection like those just discussed, could readily engender more complicated but smaller cyclical configurations (proto-organisms). Unlike the warm soup hypothesis, such transition poses no enigma. In irreversible thermodynamics processes are assumed to engender (and couple with) other processes all the time. Large cyclical motions spawn smaller ones as the normal matter of course, as when large-scale turbulent eddies shed smaller ones (Ulanowicz 2002). Corliss (1992) has suggested that an Odum-like scenario might have played out in proximity to archaen thermal springs – an idea that recently has found new enthusiasts in Harold Morowitz and Robert Hazen (Cody et al. 2001). Thus, process ecology, with its notion that objects can be created by configurations of processes, provides a far more consistent narrative of the origin of life.

One barrier to the Sacred that did not originate with the Newtonian worldview is the problem of evil in the world, or theodicy, as the theologians call it. To be sure, this vexing issue does not simply disappear from the ecological vision, but it does take on a different form. Bateson, for example, was prescient in recognizing the necessity of noise in the creative process (p. 410). Unfortunately, few have come to share his insight, and most prefer instead to concentrate on the necessity of the right "machinery" to carry out creative acts. But all the machinery in the world will not result in creative change, absent some form of participation by the aleatoric. Efficiency and performance may be necessary for creativity, but they are insufficient to guarantee it. For this reason a healthy ecosystem must always retain a modicum of inefficient, incoherent and disorganized repertoires that could be implemented in the face of novel perturbation to generate an effective response to the threat (Ulanowicz 1990). Any system that is so finely honed in its performance so as to exclude too much such insurance is doomed to extinction. Similarly, a society that seeks to purge itself of all petty evil will collapse. Just like weeds among the wheat, some tolerance for minor evils must be allowed in order for society to progress. The problem of theodicy, therefore, is no longer why any evil exists (ontology), but becomes rather a question of magnitude – why are *excessive* evils allowed to persist?

## Conclusion: New and Renewed Dialogs

I would like to close by supporting Bateson's approbation of a Buberian I–Thou relationship between humanity and the living world (p. 446). Bateson prefigured by at least a decade Ilya Prigogine's (and Stengers 1984) call for a new dialogue between "man and nature". Indeed, the metaphor of a dialog is an encouraging replacement for the timeworn notion that competition and struggle between humankind and the rest of the universe constitute a necessary state of affairs. Speaking as a conventional theist, I would like to venture even further and suggest that the ecological vision does not proscribe a renewed hope in a continuing exchange between humanity and the Divine, as has been described over the centuries by the religions of the Book. Perhaps ironically, by delving ever deeper into the natural world, both scientists and theists are discovering that ostensible conflicts between them are beginning to pale (which is not to say that they will ever completely disappear). Nevertheless, the inevitable but necessary decay of order into the void that has made a "cosmology of despair" (Haught 2003) so fashionable among academics is now being countered in the ecological vision by the cybernetic pull towards more organized living configurations, so that a growing number of scientists no longer need abandon rationality in order to begin to entertain a countervailing "cosmology of hope".

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# Chapter 8
# Connections in Action – Bridging Implicit and Explicit Domains

**Theresa S.S. Schilhab and Christian Gerlach**

**Abstract** Implicit and explicit learning and knowledge processes differ with respect to acquisition as well as expression of knowledge. For instance implicit knowledge improves correlative to extended practise, is normally unknown to the subject and is closed to verbal reports.

On the contrary, explicit knowledge works proportionately well on single exposures to stimuli, is accessible to awareness and is preferentially recoverable as propositional, rational statements, conceptualisations and the like.

Standard view is that implicit and explicit learning are separately engaged as they attend to different tasks and seem to occupy distinct neural regions. Here, we report on results obtained in functional imaging studies, which suggest a revision of this view.

The results imply a positive effect of extended naturalistic practise on processes responsible for categorising items in an object recognition task – knowledge traditionally thought of as explicit. The results therefore provide evidence of how implicit learning might influence explicit knowledge at the neural level.

**Keywords** Implicit and explicit cognition, action knowledge, categorization, manipulability

## Introduction

In this paper we address issues closely related to what Bateson refers to in 'Mind and Nature' (1979) as empirical epistemology.

By way of results obtained in functional imaging studies we substantiate the claim that unconscious perception seem to result in conscious products. The fact that conscious ideas are under the direct influence of unconscious processes should come as no surprise since it aligns with the ubiquitous complexity of nature. It is

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also disagreeing with the dominant lineal cause and effect thinking in traditional science and, as Bateson has already stated, in fact repudiates the idea of science's ontological priority on the basis of objective experience. Therefore, the possibility of substantial connections between the non-conscious (implicit) and the conscious (explicit) collides with conventional positions within the neuropsychological field, as well as presuppositions about neutral experiences that still thrive in many scientific communities.

However, the split between implicit and explicit learning, knowledge and memory is more or less accepted. For instance, neuroscientific research seems to suggest different neural underpinnings of implicit and explicit learning, memory and knowledge (see, Squire and Zola-Morgan, 1988; Rugg, Mark et al., 1998; Critchley, Daly et al., 2000). And neuropsychological research has revealed different characteristics and qualities of implicit and explicit processes with respect to acquisition as well as expression of knowledge (e.g. Kirsner, Speelman et al., 1998; Speelman and Maybery, 1998; e.g. Stadler and Frensch, 1998). For instance explicit learning is coupled to awareness and intent, is often verbally expressible as propositions (Wackerhausen, 1997) and can be volunteered on command.

Contrariwise, implicit learning comes about incidentally. Being susceptible to subliminal signals (e.g. Underwood, 1996; MacLeod, 1998) and contingencies between stimuli that are either too complex or too vague to bring about attention (e.g. Reber, 1992, 1993), it is beyond conscious control of the learner. The resulting knowledge takes the form of nonverbal behavioural changes.

Characterisations of the implicit and explicit are highly incongruent and the standard stance seems to be the co-existence of in fact very different learning capacities, each fulfilling unique and separate parts in learning, knowledge and memory. Evolutionary interpretations accommodate this view (Reber, 1992, 1993). Here implicit processes are thought of as the 'original' mode of cognition and explicit processes as the more advanced cognitive overlay (Gibson and Ingold, 1993; Noble and Davidson, 1996).

To some degree the standard view acknowledges the difference between theoretical and practical descriptions of the implicit and explicit. Most positions agree that in practice, when solving tasks in everyday life, both modes are more or less engaged. For instance, to ride a bike successfully involves among other things to make it balance and roll, avoid obstacles in the road and adjust to variable weather conditions. While the act of balancing and rolling might be obtained by implicit skill knowledge, attention to obstacles and weather conditions most probably rely also on attention and explicit knowledge about appropriate steering, when the road is wet by rain or critically damaged. Still, in this understanding the implicit and explicit co-exist and have no common ground of interaction whatsoever. (Though departure from a rigid division between explicit and implicit learning, memory and knowledge is sustained by some studies, see for instance Wynne, 1998; Bayley and Squire, 2002.)

Recent functional imaging studies focussing on the organization of a subset of explicit knowledge – conceptual knowledge – in the brain now seem to hamper the rigid understanding of two isolated learning capacities (Gerlach, Law et al., 2002a, 2002b). And they force us to rethink the connection between conceptual and motorically acquired knowledge. Apparently, the studies suggest that accidental handling of objects facilitates the conceptual knowledge of objects.

In this paper we reinterpret and analyse the results into the context of the implicit and explicit and instigate the Connections in Action hypothesis (CIA-hypothesis) that neural connections between the implicit and explicit exist. For one thing the CIA-hypothesis implies that the absolute segregation of implicit and explicit processes is wrong. There is no hard and fast boundary between implicit and explicit cognition. For another, the CIA-hypothesis implies that tangible physical interaction with items somehow improves our conception of them.

## Connections in Action – the CIA-Hypothesis

In a study on conceptual knowledge by Gerlach et al. (2000) subjects were asked to categorize drawings of natural objects or anthropogenic artefacts (such as animals, plants, tools, etc.) as either 'natural' or 'man-made' whilst concurrent activation of cortical regions was recorded. The study revealed that categorization of man-made objects activates the left ventral premotor cortex (PMv) to a greater extent than natural objects do.

A distinct feature of most man-made objects is that they are assigned some kind of function, understanding of which entails appreciation of action in some way. For instance a cup is for drinking; a tie for knotting (around the neck) and a chair for sitting. On the other hand it makes no sense to search for the function of self contained natural objects.

Moreover, PMv is thought to be the human homologue of monkey F5 area, which is involved in goal-directed actions such as grasping and manipulation of objects (Grafton, Fadiga et al., 1997; Rizzolatti and Fadiga, 1998). Therefore the results by Gerlach et al. (2000) seem to suggest that comprehension of man-made objects in categorization entails 'motor-based knowledge of object utilization' (action knowledge) (Martin, Wiggs et al., 1996; Chao and Martin, 2000; Gerlach, Law et al., 2002a, p. 1230).

In light of the paradigmatic distinction between implicit and explicit knowledge the finding is remarkable. Action knowledge is thought to comprise representations of complex actions that mediate object utilization and is entirely different from semantic knowledge comprising information of object functions and inter-object associations (such as is it a natural or man-made object?) (Raymer and Ochipa, 1997; Gerlach, Law et al., 2002a, 2002b). Action knowledge is likely to result from extended unattended practise, is normally unknown to the subject and closed to verbal reports. As such, action knowledge can be conceived of as a type of implicit knowledge. In comparison, explicit knowledge works well on single exposures to stimuli, is accessible to awareness and is preferentially recoverable as propositional, rational statements and conceptualisations.

Despite the obvious differences between conceptual and motor knowledge, the results seem to imply that action knowledge of man-made objects (acquired by accidentally manipulating the objects) is involved in the conceptual task of categorising.

Obviously, one thought-provoking suggestion which we want to introduce by the name the Connections in Action hypothesis – (CIA hypothesis), arises. As neural processes normally dedicated to implicit knowledge might be part of the neural underpinnings of explicit knowledge, it seems to suggest that unattended real life interactions with objects, such as direct handling actually add to our conceptualisation of them. In other words, at least in some tasks conceptual judgements depends not exclusively on explicitly but also on implicitly acquired knowledge.

If corroborated, the CIA-hypothesis stirs the traditional distinction between the implicit and explicit, as well as ideas of the primitive and original cognition subordinate to more advanced and explicit capacities and seems important to discussions on learning potential and appropriate learning facilities (Schilhab, 2007).

Now, how do we corroborate the CIA-hypothesis? Obviously, we are facing a number of serious objections and in the following we will divide our discussion into three general sections to defend the hypothesis: (1) The interpretation of the PMv activation; (2) The question of manipulability, and, (3) Effects on conceptual task solving.

## The Interpretation of PMv Activation

First, the interpretation of PMv activation is not straight forward. How can we be certain that the PMv activation actually reflects direct involvement of action knowledge in conceptualization? For instance, is it not possible that PMv activation is caused simply by watching drawings of manipulable items (defined as any object you handle) that induce anticipatory motor responses? Such effects are well known from studies of mirror neurons (Gallese, Keysers et al., 2004; Van Schie, Mars et al., 2004) in which the sight of manipulation by third parties also activate motor neurons normally involved in the execution of first person motor activities. Now, that kind of activation would not as such come into conflict with the CIA-hypothesis, since mirror neurons are known to have both visual and motor properties as they respond to both visual and motor stimuli. Even if PMv activation during exposure to manipulable items reflects previous visual experience such activation is likely to result *also* from first-person motor activity. On the other hand, the problem is that if PMv activation stems from mirror neurons discharging, we can not say for certain, that motor knowledge acquired by first-person manipulation is part of the neural correlate of conceptual knowledge, since the PMv response might be caused exclusively by the visual properties of mirror neurons. To summarise, PMv activity could in principle emerge as a result of previous *watching* of others engaging in manipulation of items and not as a result of previous *manipulation* of items.

Speaking against this interpretation was the additional finding by Gerlach et al. (2000) that activation in the PMv was significantly higher during the categorization of manmade objects than during shape judgments of the very same items. Should the

PMv activation simply reflect the visual properties of mirror neurons or a motor priming effect, we would have expected the PMv to be activated to similar degrees during the conceptual (categorization) task and the shape judgement task (object decision) which it clearly was not. This interpretation is further substantiated by a related study in which subjects were asked merely to *name* items (Gerlach, Law et al., 2002b). Again, PMv activation was insignificant. Thus, the anticipatory motor responses interpretation seems to be at variance with studies on object decision and object naming.

## The Question of Manipulability

Another question along the same lines is whether the results actually warrant that manipulability and real-life interaction is responsible for the PMv activation. In the reported data, PMv activation was exclusively linked to man-made items. But if manipulability was to explain the activation, surely categorisation of natural *manipulable* objects should show the same effect.

Put differently, if the CIA-hypothesis holds, objects categorically belonging to 'natural kinds' such as fruit and vegetables, which we manipulate and interact with on a daily basis, should also invoke so called action knowledge. To test this, Gerlach et al. (2002a) asked subjects to categorise natural and man-made objects that could be either manipulable or non-manipulable objects to study the activation of PMv.

Amazingly, PMv lit up during categorisation of manipulable objects, irrespective of whether they were natural or manmade, corroborating the hypothesis that manipulability in itself could be responsible for the activation of PMv (see Figure 8.1).

The results are the more convincing as natural objects contrary to artefacts, are primarily pooled by shape characteristics (Gerlach, Law et al., 2000), which are processed in the ventral parts of the occipito-temporal regions, making it most probable that activation of the PMv is due to manipulability.

It is also unlikely that the PMv activation in the studies by Gerlach et al. (2000, 2002a) reflects that the manipulable objects just happened to be more familiar than the non-manipulable objects: all stimuli were matched both with respect to name agreement, visual complexity and familiarity (Snodgrass and Vanderwart, 1980).

So far, tapping conceptual knowledge seems to rest on action knowledge under at least some circumstances. In the next section we dig further into possible effects of such neuronal activity on solving of conceptual tasks.

## Effects on Conceptual Task Solving

Apparently, action knowledge obtained by real interaction with items adds to conceptual knowledge, but what evidence is there of its importance to the semantic act of comprehension? Is it not plausible that action knowledge might be triggered

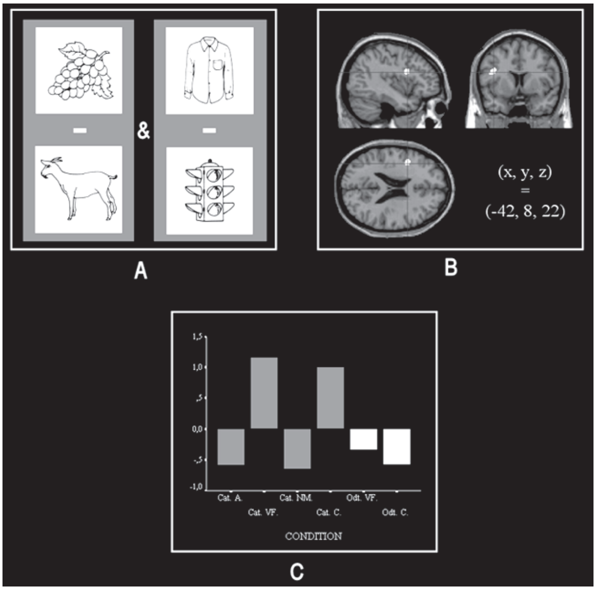


**Fig. 8.1** (A) Examples of the stimuli used in the four categorization tasks with animals, vegetables/fruit, articles of clothing, and non-manipulable objects respectively. (B) Three sections showing the activation associated with categorization of both fruit/vegetables and articles of clothing relative to categorization of animals and non-manipulable man-made objects and to object decisions on vegetables/ fruit and articles of clothing. (C) This plot shows the effect size associated with each task in the left PMv where Cat. = categorization, Odt. = object decision, A. = animals, VF = vegetables/fruit, NM = non-manipulable man-made objects, and C. = articles of clothing. Values have been mean centered so that the y axis shows the relative effect sizes (increases or decreases from the mean)

in tasks concerning conceptual knowledge, but in itself is irrelevant to perform the task successfully? After all, functional imaging of normal subjects can 'only' reveal the regions contributing to performance in a given task, but cannot reveal which of these regions are critical. Such knowledge can only come from lesion studies or imaging studies with patients (Price and Friston, 1999; Price, Mummery et al., 1999).

Obviously, action knowledge is not normally crucial to the mean act of comprehension. For instance, patients suffering from apraxia (a motor disorder in which volitional or voluntary movement is impaired without muscle weakness), caused by lesions of the left frontal and parietal cortex, are still able to access the functional meaning of manipulable objects, suggesting that object comprehension is not contingent on access to action knowledge (Buxbaum, Schwartz et al., 1997; Heilman, Maher et al., 1997; Moreaud, Charnallet et al., 1998; Buxbaum, Veramonti et al., 2000; Buxbaum, 2001; Buxbaum and Saffran, 2002; Rosci, Chiesa et al., 2003).

On the other hand results on connections between action and conceptualisation at the neural level are supported elsewhere. According to Hauk et al. (2004) words frequently encountered in the context of body movements such as 'kick'? may produce meaning related activation in the context of body movements. Also Pulvermuller et al. (2001) and Hauk et al. (2004) shows that action words referring to movement of different parts of the face, arm or leg activate the motor cortex similarly to the activation pattern observed for actual movements of the relevant body parts.

A plausible hypothesis, to account for the data, would be that action knowledge, instead of being of pivotal importance, somehow contributes to the processing by forming part of the cell assembly sustaining conceptual knowledge. But the question remains; to what effect? One likely effect, that would also make biological sense, is a reduction of response times in solving the conceptualisation task. Hands on experience would ease the conceptual problem solving by reduction in reaction time and thereby give the organisms an evolutionary advantage. While this has not yet been tested directly some evidence for the suggestion that action knowledge contributes to the cell assembly sustaining conceptual knowledge comes from patients with category-specific disorders for artefacts; a disorder characterized by impaired comprehension of artefacts concurrently with relatively spared comprehension of natural objects. These patients typically suffer from lesions affecting left frontoparietal structures – regions normally associated with motor function (Gainotti, 2002). This relationship between motor function and comprehension of artefacts is clearly in agreement with the suggestion that action knowledge contributes to comprehension.

However, in line with what we have argued so far, we do not want to make the claim that impaired action knowledge with necessity leads to impaired comprehension of artefacts. Rather, we would make the claim that patients with category-specific disorders for artefacts suffer from a general semantic impairment (affecting the comprehension of both natural objects and artefacts) which becomes exacerbated for artefacts following additional damage to regions important for action knowledge (the frontoparietal regions). This suggestion accords with the observation that these patients generally are impaired on semantic tasks, although more so for artefacts.

Further, and more direct, evidence for our proposition comes from a study by Humphreys and Riddoch (1999) who examined the role of action knowledge in vocabulary learning in a child with a learning deficit. They had the child acquire the names of tools under two conditions: (i) when the tools were presented along with contextual information consistent with where the object would be found, and (ii) when the tools were presented along with a gestured action. Subsequent testing revealed significantly better name learning when the tools were presented with their action than with their context.

## Discussion

To summarize; the interpretation of results by Gerlach et al. (2002a), which we named the CIA-hypothesis, implies that non-symbolic, implicit knowledge might be involved in solving tasks normally thought to rely solely on explicit knowledge.

More specifically, it seems to entail that manipulation of objects all else being equal will improve our abilities of comprehension by sustaining our categorisation abilities.

Somehow, the finding is controversial as it infringes against the common understanding that categorization is essentially conceptual. If manipulation and bodily interaction has a relevant impact on categorisation the rigid segregation of 'knowing how' and 'knowing that' in all its aspects is heading for a fall. It simply dismantles the elevated position of explicit cognition and forces us to reconceptualize ideas about thinking organisms.

To biologists the interrelation between actual handling (implicit knowledge) and conceptualisation (explicit knowledge) might come as no surprise.

To segregate implicit from explicit knowledge is to segregate body from brain. And it makes no biological sense whatsoever.

We meet our environment by the surface of the body. In fact in the beginning were the body and then the brain (Dennett 1996). Our senses (and their location in the body) have evolved and evolved susceptibility to environmental features over time in close arms race to fit what might be of interest to organisms. In evolutionary terms senses can not be thought apart from the environment they were shaped by. Intertwined development is carved in the delicate constitution of the body. From the lowest molecular level of co-operative second messenger cascades to idiosyncratic features of sense organs. Every subtle cellular mechanism consists of elements that can be traced back to tricks that have worked since the beginning of life (this does not exclude that elements that add nothing or are slightly counterproductive to cumulative reproductive success are tolerated within the system). The sophistication is formidable and might escape disentanglement.

In that understanding, the body is indispensable because it literally carries with it examples of processes that makes evolutionary sense that are also worked into brain (for the irreducibility of the body in cognition, see also Schilhab and Gerlach, in press).

In the present context it makes sense that neural configurations already adapted to sustain motor activity might also sustain conceptual tasks.

From the organismic point of view the categorisation into motor knowledge and conceptual knowledge might indeed seem arbitrary. The segregation of these knowledge types belongs to the third person point of view in which qualitative differences are obvious. But it does not warrant neural segregation of implicit and explicit processes.

In every respect the body and its brain is an imprint of evolutionary progress and time. Therefore, what can in fact be processed by the brain is uniquely determined by the history of the body as the resonator of evolutionary trial and errors, with successes and near-successes being the driving force.

From the CIA-hypothesis we should gain that organisms, in this case humans, simply by physical configuration have multiple strategies when they learn. In some cases man is better off staking his body as well as his mind, when aiming to learn something, whether concepts or skills.

To what extent and under which circumstances awaits further research.

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# Chapter 9
# Bateson: Biology with Meaning

**Brian Goodwin**

**Abstract** Nature and culture have been sharply separated in modern thought. A major reason for this is the belief that language and meaning apply to humans and culture, but not to the evolution of species generally. However, recent studies in post-genomic biology on the structure of proteomes, on genetic and metabolic networks, are leading to a new perspective on the nature of the processes involved in reading and expressing the information in the genome. These are beginning to be recognised as having the network properties of a language, so that a reading of the genetic text by an organism is a process that makes meaning of the text through the self-construction of the organism. The members of a species are then participants in a culture with a language. They make meaning of their inherited texts by generating a form (a distinctive morphology and behaviour pattern) that is dependent on both genetic text and external context. This understanding of development and evolution arises from experimental observation and mathematical modelling, and leads to an extended conceptual context for understanding living processes. Biology is finally catching up with Bateson's (1979) view of organisms and natural creativity, which was that nature and culture are one, a necessary unity, not two.

**Keywords** Meaning, form, evolution, language, natural creativity, Gregory Bateson

## Information and the Genome

The molecular biology revolution of the 20th century was driven by the realisation that the hereditary polymers of organisms, their DNA and RNA, carry information that is used to make the molecular components of cells whose finely discriminating interactions can also be understood as forms of information. Instead of chemical machines, organisms became information machines, like computers, only more complex since they self-replicate. The genome projects were a logical extension of this perspective, based on the premise that since we know how to read the genetic

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code we can make sense of all aspects of organisms by reading the information in their genomes. This led to a period of dramatic technological and analytical development in biology as genetic databases were revealed and the details of molecular information-processing unfolded.

However, natural processes have an uncanny way of escaping from well-designed research nets intended to catch and reveal their essential natures. We need only recall the astonishment and bewilderment of the physics community in the early years of the 20th century at the revelations of quantum mechanics as the constituents of atoms disappeared into a cloud of energetic entanglements that remain mysteriously holistic despite mathematical descriptions of their behaviour. Living processes can likewise be expected to lead us on to some quite unexpected revelations.

Something rather similar to the quantum mechanical revelation is now happening to the genes, which seemed to have been caught in the genome information net only to escape into deeper subtlety. One of the early shocks of the genome project was that the perceived morphological and behavioural complexity of higher organisms is not reflected in the number of genes in their DNA, measured in terms of coding sequences for proteins. Humans, mice, Drosophila and higher plants don't differ nearly as much as had been believed: the expectation of something like 100,000 genes for humans has been scaled down to about 33,000, while the tiny plant, Arabidpsis, may have as many as 27,000. In fact, the protein-coding sequences account for somewhat less than 2% of the human genome, while 97–98% of its transcriptional readout is estimated to be non-coding RNA. Inevitably the focus now shifts from number of protein-coding sequences to how they are translated and how their products interact during development so as to make organisms of distinct morphology and behaviour.

The view that is emerging is that organisms have much more sophisticated ways of reading and editing their DNA than was previously believed, so that what was believed to be a single coding sequence is in fact many. For example, in the hair cells of the inner ear of the chick there is a gene that can be translated into 576 different proteins, each one altering the tuning of cells to sound frequencies (Black, 1998). The single sequence of bases in the DNA that contains the information for making these proteins is read in many different ways by alternative splicing, the different versions of the protein being produced in hair cells in different positions of the inner ear, in systematic spatial order. In the fruit fly, it has been estimated that the number of different messages that could arise from a single 'gene' sequence is 38,016! Furthermore, the non-coding regions of the DNA, originally described as 'junk', turn out to be major players in the selection, modification, and editing of the DNA during development and throughout the life of the organism.

## The Changing Story of the Gene

Reflecting on such questions in her thoughtful book, 'The Century of the Gene', Evelyn Fox Keller (2000) observed: "What is most impressive to me is not so much the ways in which the genome project has fulfilled our expectations but the ways in which it has transformed them. Contrary to all expectations, instead of lending support to the familiar notions of genetic determinism that have acquired so powerful a grip on the popular imagination, these successes pose critical challenges to such notions. Today, the prominence of genes in both the general media and the scientific press suggests that in this new science of genomics, twentieth century genetics has achieved its apotheosis. Yet, the very successes that have so stirred our imagination have also radically undermined their core driving concept, the concept of the gene. As the human genome project nears the realisation of its goals, biologists have begun to recognise that those goals represent not an end but the beginning of a new era in biology".

Keller goes on to suggest that a major lesson from the genome project could be a qualitative shift in attitude on the part of the scientific community. "It is a rare and wonderful moment when success teaches us humility, and this, I argue, is precisely the moment at which we find ourselves at the end of the twentieth century. Indeed, of all the benefits that genomics has bequeathed to us, this humility may ultimately prove to have been its greatest contribution. For almost fifty years, we lulled ourselves into believing that, in discovering the molecular basis of genetic information, we had found the 'secret of life'; we were confident that if we could only decode the message in DNA's sequence of nucleatides, we would understand the "program" that makes an organism what it is. And we marveled at how simple the answer seemed to be. But now, in the call for a functional genomics, we can read at least a tacit acknowledgement of how large the gap between genetic 'information' and biological meaning really is".

## Biology, Meaning, and Language

What kind of agent is a living organism that it can read the information in its genome and make meaning of it in its life? Organisms survive and flourish in particular habitats by taking discriminating actions appropriate to circumstance, actions that matter to them for their well-being and the perpetuation of their kind. Discriminating and mattering are the components of meaning as expressed in language (cf. Caws, 1988). Meaning is a high-level concept not normally used in biology, though Bateson (1979) used it in the sense of organisms telling us their stories. He said: "'context' is linked to another undefined notion called 'meaning'. Without context, words and actions have no meaning at all. This is true not only of human communication in words but also of all communication whatsoever, of all mental process, of all mind, including that which tells the anemone how to grow and the amoeba what it should do next" (p. 14).

To say that organisms take discriminating actions that matter to them in their development and for their survival is common sense. How does this translate into molecular activities within cells? One significant aspect of post-genomic biology is the recognition that the sophisticated patterns of molecular interactions whereby genetic information is read and instructions are executed is through complex networks. Genomes and proteomes are now being modelled as self-referential networks, a description that beckons in a new direction. As stated by Jeong et al. (2001) in connection with their study of the structure of the protein interaction network in yeast: "Proteins are traditionally identified on the basis of their individual actions as catalysts, signalling molecules, or building blocks in cells and microorganisms. But our post-genomic view is expanding the protein's role into an element in a network of protein–protein interactions as well, in which it has a contextual or cellular function within functional macromolecules".

These networks have generic properties that identify them as self-organised systems defined by power laws. If we ask what is the probability that a particular protein in the network interacts with k other proteins, the answer is $P(k) = ak^{-\alpha}$ where a and $\alpha$ are constants (Jeong et al., 2001). It has been known for many years that such relationships are also characteristic of written texts. If we rank-order the frequencies of words in any text and calculate the frequency of the rth most frequent word, then we find that it is $f(r) = br^{-\beta}$ where again b and $\beta$ are constants (Zipf's law). Organisms appear to be using forms of language in their discriminating functional activities, which have meaning in relation to their goals. Here meaning depends on the embodied or tacit knowledge and information used by organisms, forms of knowledge now recognised by cognitive scientists as primary also in human culture (Varela et al., 1997; see also Maturana and Varela, 1987, 1998).

Power laws describe the property of self-similarity in networks: a part of the network looks like and has the same connectivity structure as a larger or smaller part, and as the whole. Such structures are also described as fractals. Fractal structures are widely encountered in biological morphology, as in the branching patterns of trees, the venation patterns of leaves, and the structure of respiratory or circulatory systems. Here the principle can be connected with efficient flow of fluids, compressible or incompressible, throughout the living system, as demonstrated by West et al. (1997).

Another domain of fractal order in connectivity patterns is in metabolic networks, often taken to be the very essence of biological process. Morowitz (1992) proposed that the pattern of interactions of metabolites in organisms reflects the natural interactive order of chemicals, an hypothesis confirmed by Fell and Wagner (2000), Wagner and Fell (2001) in a study of bacterial metabolism. These networks have evolved their complexity through gradual addition of components to core reaction pathways. It appears that they have self-organising properties that are naturally fractal and are not a result of natural selection. The agency that is expressed in organisms through their sophisticated contextual networks of molecular interactions is robust and evolutionarily adaptable, but not designed simply for survival. There seems to be a deeper principle at work that has survival and adaptability as a consequence, not a primary, imposed design feature. Natural selection seems to be the fine tuner, not the initial generator of the organisational principles of living organisms, which reflect principles of order that extend beyond the living state to its physical and chemical substratum.

## Nature and Culture

I mentioned Zipf's law for the probablility distribution of words in written texts, rank-ordered according to their frequency, which exhibits a fractal, self-similar power-law pattern. The same law holds for the frequency of cities with n inhabitants, which behaves according to the relation

$$f(n) \propto n^{-\alpha}$$

A similar relationship holds for the frequency of cities with area a, with the consequence that cities grow with a fractal, self-similar pattern. Language and cities are usually associated with culture, not nature, but the relationships being revealed between the pattern of living networks and cultural networks suggests that these are deeply related in their generative dynamics. Furthermore, Ferrer i Cancho and Solé (2001, 2003) have shown that human languages can be seen as the result of a phase transition arising from a tension between the demands of a speaker and a receiver of verbal communication in human culture, resulting in Zipf's law for word frequencies. The self-similar, self-referential properties of genetic, protein, and metabolic networks can now be seen as proto-languages whereby organisms make sense of their inheritance and their environmental contexts by generating forms (organisms of specific morphology and behaviour) that express embodied meaning in coherent wholes.

We can now see that organisms are telling us the meaning of their inherited texts by telling us their story in embodied form, which is the organism itself as an actor within the great cosmic story of evolution. In consequence, the distinction made by humans between nature and culture is somewhat arbitrary, as both may be understood to be the result of similar generative dynamic processes that underlie the emergence of form, whether in evolution or in art or craft. This was anticipated by Bateson, as is evident in the following passage from Mind and Nature (p. 12): "Now I want to show you that whatever the word 'story' means …, the fact of thinking in terms of stories does not isolate human beings as something separate from the starfish and the sea anemones, the coconut palms and the primroses. Rather, if the world be connected, if I am at all fundamentally right in what I am saying, then *thinking in terms of stories* must be shared by all mind or minds whether ours or those of redwood forests and sea anemones.

Context and relevance must be characteristic not only of all so-called behaviour (those stories which are projected out into 'action'), but also of all those internal stories, the sequences of the building up of the sea anemone. Its embryology must be somehow made of the stuff of stories. And behind that, again, the evolutionary process through millions of generations whereby the sea anemone, like you and me, came to be – that process, too, must be of the stuff of stories. There must be relevance in every step of phylogeny and among the steps".

Here was an anticipation of the fusion of nature and culture that is now proceeding through biological semiotics and hermeneutics (Sebeok and Umiker-Sebeok, 1992; Hoffmeyer, 1998; Markos, 2002). Physical, biological and cultural evolution are undergoing unification into a coherent whole in terms of new general principles whereby all natural processes generate wholes of distinctive quality. This unifying insight is perhaps the most significant result of the complexity revolution that has swept through physics, biology, and the humanities in the past 20 years. What may be emerging here is the formulation of a new principle of creativity in natural/cultural processes that manifests as the generation of coherent wholes. We are familiar with this in culture since all our creative activities including science, literature, art and craft take the shape of stories and forms that seek coherence and wholeness as their signature. Nature can now be seen to do likewise. The result is that the nature/culture boundary, long cherished by humans as that which distinguishes humanity from mere animals or mechanical nature, erodes. Evolution emerges as a process whose intrinsic tendency is to generate coherent wholes with meaning.

## Meaning, Beauty and Archetypes

Bateson saw clearly that the biological realm needed descriptive and explanatory principles that go well beyond those of the analytical and the quantitative. “I hold to the presupposition that our loss of the sense of aesthetic unity was, quite simply, an epistemological mistake. I believe that that mistake may be more serious than all the minor insanities that characterise those older epistemologies which agreed upon the fundamental unity.”(p. 17)

“In other words, logic and quantity turn out to be inappropriate devices for describing organisms and their interactions and internal organisation. The particular nature of this inappropriateness will be exhibited in due course, but for the moment, the reader is asked to accept as true the assertion that, as of 1979, there is no conventional way of explaining or even describing the phenomena of biological organisation and human interaction” (p. 19).

Bateson extended these thoughts into the realm of the sacred, using a phrase from Shakespeare’s The Tempest. “Prospero says, ‘We are such things as dreams are made on,’ and surely he is right. But I sometimes think that dreams are only fragments of that stuff. It is as if the stuff of which we are made were totally transparent and therefore imperceptible and as if the only appearances of which we can be aware are cracks and planes of fracture in that transparent matrix. Dreams and percepts and stories are perhaps cracks and irregularities in the uniform and timeless matrix. Was this what Plotinus meant by an ‘invisible and unchanging beauty which pervades all things?’ ” (p. 15)

Every creation myth recognises the initial emergence of form from chaos as the primal act of creation. In our Western tradition we have the Greek story of Gaia, the first divinity and the goddess of the Earth, emerging from primordial chaos. Hesiod, the Greek poet who lived in the eighth century, B.C., tells in his Theogony how Chaos, the yawning chasm of disorder, gave rise to Gaia and Eros. Eros is the principle of relationship expressed as creation through Love. These three powers or beings constitute the mysterious, magical forces underlying the whole of creation, Eros being expressed through the forms of nature. These primordial powers were worshiped by the Pythagoreans, among others, as the Orphic Trinity that takes its name from Orpheus the legendary musician, physician and spiritual leader who was also variously known as Dionysus, Osiris, Marduk, and Shakti in ancient traditions. And of course this Orphic Trinity of Father, Mother and Love became the basis of the Christian Trinity, though transformed by a patriarchal culture into Father, Son and Holy Ghost. The Orphic Trinity of Chaos, Gaia and Eros appears to be an appropriate mythology for our present age, which is seeking a reunion of humanity with nature after four centuries of separation resulting from the mechanical world view.

It is significant that the archetypes of Chaos, Gaia, and Eros re-emerged in Western culture in the 1960s, while Bateson was articulating his visions.

Chaos, in the form of the mathematical clarification of sensitivity to initial conditions in dynamical systems and the use of the term deterministic chaos, appeared through the computer simulations of Edward Lorenz at MIT in the 1960s. Gaia theory emerged when James Lovelock discussed his ideas of a living earth in 1969 with his Devon neighbour, William Golding, whose suggestion that this inspiration be called Gaia Theory was embraced by Lovelock. And the phenomenon of the 1960s revolution that swept Western society was powered by music and Eros, flower power and love-ins. The human psyche responded to the loss of meaning that resulted from the mechanical world view of modern science in the 16th century by re-articulating and re-experiencing the Orphic Trinity. This may restore a pan-sentient view of the world (Griffin, 1998; de Quincey, 2002), a perspective that reunites all beings in a communion of subjects instead of a collection of objects (Berry, 1999). The result could be that indeed we become the things that dreams are made of through the imaginative power of both nature and culture, bringing into being a unified planet in which community, diversity and creativity are celebrated in a new Age of Meaning.

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# Chapter 10
# Gregory Bateson's "Uncovery" Of Ecological Aesthetics

**Peter Harries-Jones**

**Abstract** UN reports generally concentrate upon quantitative analysis of the direct drivers of ecology on global poverty and ecosystem change, but the contributors to the Millennial Ecosystem Assessment (MA) have initiated a discussion of 'indirect drivers' – the relation of culture, aesthetics and spirituality to global climate change – and, for the first time, have made this qualitative evidence endogenous to their models. The MA validates ecological aesthetics as a science of quality but finds difficulty in presenting evidence in support of its claim. Ecological aesthetics has achieved prominence at local level as well, among those in forestry management of national, provincial and state parks in the United States and Canada. Yet they too find difficulty in assessing evidence; indeed their attempts to derive a match between perceptual categories of aesthetic beauty and ecological sustainability have generally failed. The qualitative science of ecological aesthetics which Bateson developed towards the end of his life offers several avenues out of the near impasse in these two cases. Bateson studies ecological aesthetics at a second order level, stressing the contextual difference between industrial society's understanding of basic categories of space, time and connectivity, and the same categories perceived from a more 'holistic' point of view – ecological aesthetics as a form of "conservation of time".

**Keywords** Climate change, difference as second-order event, ecological indicators, meta-pattern, sustainability and aesthetics

## Introduction

The purpose of this paper is to present some recent initiatives in the field of ecological aesthetics, to remind and articulate aspects of Bateson's approach to this subject, and to elaborate on how an understanding of Bateson's approach helps unravel difficulties

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J. Hoffmeyer, (ed.), *A Legacy for Living Systems: Gregory Bateson as Precursor to Biosemiotics*

of interpretation which confront those dealing with this field of enquiry[1]. In the mid-1970s when Bateson began to turn his full attention towards this field, it was scattered and unfocused. It is now a subject that warrants appropriate attention in United Nations reports and which, at local level, has become of major concern to administrators of national parks in North America and to a variety of bureaucrats, public and corporate, in the regulation of forest industry and urban ecology practices.

In the mid-1970s only the Darwinians seemed to present a coherent account of the role of aesthetics in nature, and as always they presented a very narrow view of the aesthetic domain. They argued that natural beauty was mostly correlated with competition for a sexual partner. To give credit to Darwin, he did take the view that animal and other proto-human nervous systems were fully capable of aesthetic judgement. Yet down the years his supporters, particularly evolutionary psychologists, narrowed this perspective to the notion that visual aesthetics and artistry in nature are entirely products of natural selection for sexual ornamentation is a reliable visual indicator to potential mates of an animal's health and fertility. This narrow construction of aesthetics was then generalized to the human condition. In the view of evolutionary psychologists, the presence of fine arts in human society is the most recent evolutionary example of the universal instinct for visual self-ornamentation "which in turn is a manifestation of sexual selection's universal tendency to ornament individuals with visual advertisements of their fitness." (Miller, 2005).

Thankfully, the straitjacket of natural selection – which everywhere imprisons discussion of beauty in both nature and human art, – has been broken open by a recent United Nations report. This authoritative document opens up an alternative discourse on ecological aesthetics. The report is a detailed examination of current change, and projected change, in global ecology in the context of global warming and its effect on ecosystems in relation to human poverty. In its language, aesthetics is a driving force – a "driver" – for human activity in a wide range of areas relating to ecology. Its reference is not to natural selection but to a wide variety of practices in which aesthetics is deemed to be an "indicator" intricately related to ecological health and well-being, and towards which a variety of bureaucrats, public and corporate, must turn their attention.

## The U.N. Millennial Ecosystem Assessment Report

Make no mistake, the recent United Nations Millennial Ecosystem Assessment Synthesis Report (Reid et al., 2005; referred to here as MA), is a notable document which will not easily disappear. In the first place it reverses the usual order of importance between economy and ecology by placing the products of economy inside the overall effects economic production has had on global ecology. It argues that the substantial net gains in human well-being and economic development have

[1] In fact, 'deutero-adaptation' is not Bateson's term but was elaborated from Bateson's notion of deutero-learning by O. E. Rossler (Rossler, 1979).

been achieved at the expense of degradation of ecosystem services and exacerbation of human poverty. Yet the world's national accounting systems do not include either measures of resource depletion nor degradation of resources so that national accounts, supposedly the world wide indicator of human prosperity, do not give a true picture of their economic performance (MA, 2005:22).

The Assessment also marks the change about global warning in the majority perspective among scientists in recent years. Until the last year few years, the majority perspective presented climate change as proceeding in a continuous pattern, leaving human beings to adjust and adapt gradually – in short, in classic neo-Darwinian manner, as a smooth curve in a statistical array of events. Now the MA states that there is strong but incomplete evidence that climate change will bring about non-linear changes in ecosystems; that is to say, more and more ecological events will display the abrupt, discontinuous changes. Although it is careful in its language, the MA implies that the prospect of non-linear discontinuities bring with it a whole different perspective to global climate analysis including possibilities of ecosystem collapse at various scales. An example of ecosystem collapse that has already occurred is the very sudden demise of the Newfoundland cod fishery in the early 1990s.

The report is quite clear that human modification has altered not only the structure of ecosystems in a material dimension, but their process and functioning as well. For the most part the MA considers the process and functioning of ecosystems as an aspect of a material energetic order and relates these to the "direct drivers"of ecosystem change and ecosystem services. In this respect, the MA is far from Bateson. There are some clues in the sections on biodiversity that parallel a discussion of communicative order in ecosystems, as Bateson would certainly have done. The report examines how distribution of species throughout the planet are becoming more and more homogeneous in relation to changed material and energetic dimensions – the bio-geochemical cycles, i.e., the water, carbon, nitrogen and phosphorus cycles that have been significantly modified. Thus differences between one set of species at one habitat or location of the planet and the set at the other are, on average, diminishing. These changes in biodiversity have numerous indirect impacts on ecosystems over long time periods, influencing the capacity of ecosystems to adjust to changing environments. It goes on to show how biodiversity losses result in disproportionately large and sometimes irreversible changes in ecosystem processes, influencing potential increase in disease transmission, crop failure, impacts of pests and increased pathogens. In other words, biodiversity losses, losses in the organization of life within the biosphere, results in a feed-forward of a multi-level but interconnected hierarchy of events that do not reduce entirely to changes in material force, but derive from species patterns of interconnection (MA, 2005:77).

The more the MA takes up indirect effects, or "indirect drivers" such as distribution of species, the more it invokes discussion of non-linear feedback in ecosystems, and the more familiar the language becomes to those who have undertaken a close reading of Bateson – nonlinearity and feedback being a prime characteristic of Bateson's ecological interpretations. Indeed, the report lingers on examples of instability, oscillation, threshold change. Surprisingly, the MA investigation of threshold change is presented not merely as a first-order phenomenon, the degradation of ecosystem buffering or resilience, but as initiating second-order changes, the changes ongoing in adaptation to change. In effect, it introduces, without attribution, a major framework of Bateson's thinking, the second-order interrelationship between information and adaptation, specifically referenced in Bateson's ideas of deutero-adaptation.[1]

The "indirect" in the term "indirect driver," refers to factors which influence the rate of change. It is through this categorization of "indirect" that the assessment brings aesthetics, along with culture and spirituality, into this pattern of non-linear change. By this means the MA is able to distinguish itself from most other reports on global warming which have rendered such qualitative features exogenous to the models proposed. Technically, however, the term "indirect driver" is not as accurate as it might be, for although information is qualitatively different from energy, there are "direct" correlations. In standard interpretations of information theory used since the 1940s, the relation of information to energetic entropy is always expressed in terms of a rate of change. Claude Shannon held that the correlation of information to the rate of change in energetic systems referred to the capacity of a communicative channel to overcome disorder or noise. Another cyberneticist, Ross Ashby, elaborated Shannon's view. Ashby noted that information considered as entropy, was not a uniform stream of events, like energetic flux, but was constituted by variety. Information, in this sense was synonymous with "variety." When Bateson himself considered Ashby's notion of "variety" he noted that variety is in some senses synonymous with "difference" but that "difference" is a more elemental term: further, difference (as variety) occurs as patterns of difference. In addition, Bateson noted that entropic patterns of difference occur in the form of feedback loops: they are ordered as a recursive form.

Bateson's pursuit of the recursiveness of feedback resulted in his changing Ashby's initial notions. For example, recursive loops are forms that re-enter their own domain, so this gives ordered feedback loops some reflexivity. In other words, if the form of variety, at least in the biological world, is constituted as recursive patterns of difference, then at a second order level, i.e., as the form of the form, second order difference is reflexive, "the difference that makes a difference." At second order level, the difference that makes a difference establishes a relation between observers and the pattern of differences observed (Umpelby, 2004).[2] Thus Bateson's "the difference that makes a difference,' produces a new and lasting definition of "information" to denote presence of patterns of meaning in physical relations of variety. It allows meaning to enter into an otherwise physical definition of information, depicts how meaningful information conserves time, and in this process of conservation of time, how nature becomes both subject and object (Harries-Jones, 1995:106–108).

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[2] Umpelby's interesting paper on how Bateson's notion of "difference" links to physical relationships among matter, energy and information neglects to recount how Bateson plays upon the second order aspect of difference when Bateson became dissatisfied with Ashby's definition of information, as "variety," at a first order level.

## Aesthetics and the MA Report

For some years, it had become a convention in ecological planning to draw up a list of 'indicators' representing the number of heterogeneous events that ecological planners had to attend to when considering change in ecosystems. Each indicator was in some way interconnected with each other, but all indicators interconnected with human well-being. This line of thinking had led to the concept of ecosystems not only as a natural external manifestation to which humans have to adapt but, reciprocally, as providing "services" to humanity. This idea is as far as ecological planners would go in treating nature as 'subject.' The indicators approach to the many "services' that ecology provides humanity is a general framework of the MA. Through linking one "indicator" to another" indicator," the MA is able to acknowledge the importance of all of them to human well-being and show how "services" which were in process of becoming degraded. So the MA attention to aesthetics, spirituality and culture as ecosystem services to humanity in a report on global climate change, while original in its scope, is not so revolutionary as it might first seem.

In fact, the MA gets stuck in a very uneven approach to aesthetics. One segment presents aesthetics in terms of educational and recreational contexts, for example, the contribution of aesthetics to eco-tourism and the need for scenic parks. Against this concrete representation of aesthetics as an amenity, another segment links aesthetics with culture and spirituality. Clearly this places aesthetics in a very different dimension, but the distinction of dimensions, between aesthetics as amenity and between aesthetics influencing cultural landscapes or individual's perception of the world is by-passed without comment. Though the two domains, aesthetics-as-recreation and aesthetics-as-spirituality, are not commensurate, the MA tries to bridge the difference by presenting one cultural approach, that of the Quechua (Inca) to the cyclical nature of ecosystems and to traditional knowledge about adaptation. Its example was intended to relate aesthetics to abstract representations of space and time (epistemology) within a particular cultural landscape. Despite these good intentions, the bridging argument is not made. Instead the MA notes how local knowledge "allows local communities to take ownership of their assessment process – using their own knowledge and principles of well–being …" (MA, 2005:146). Clearly the Quechua tradition is different from modern industrial society. The discussion leaves hanging the vital issue of what general insights about ecological conservation might be drawn from presentation of aesthetics and spirituality in this cultural example.

Faced with the integration of qualitative data alongside quantitative data, but a total inability to deal conceptually with presentation of second order pattern, the MA authors begin to make excuses. Their evidence about aesthetics, they state, is anecdotal. This is because aesthetics, as an indicator of ecological health, often pertains to public rather than private goods, and – being a part of common property – has non-specific marketable values. The report resigns itself to the conclusion that aesthetics is only a weak driver with regard to human security and human health. It suggests that the effects of aesthetics, as with spirituality and culture, are mainly limited to "good social relations" and only indirectly to ecological activity.

It supports this view by referring to some standard phrasing of social science (MA, 2005:81).

What is missing is an epistemological discussion of how the "time grains" of existence that an industrial society values, for example productivity and growth, enter into so many decisions about the organization of life in all societies, most particularly in industrial society. Had it examined its own presuppositions about value and the pervasiveness of industrial notions of time, the report might have then have discussed how industrial notions of time, in contrast to Quechua, are decontextualized in response to the recursive loops of nature and so tend to defeat so many remedial approaches to ecological conservation. A second order analysis would have revealed how aesthetic values about "the time grains of existence," is related to human adaptation through conservation of time and is further related to rate of ecosystem change. These are the links the MA fails to discuss in undertaking its qualitative approach to drivers, aesthetics and ecosystem services. Instead, the MA tries to resolve the multiplicity of ecosystem events through methodological elaboration of the notion of scale (Hassan, 2003).

One has to re-frame evidence presented, in order to capture the broader significance of the relation between aesthetics and temporality. Aesthetics will probably always be 'indirect' with reference to immediate human *action*, as the MA argues, but is far more immediate with reference to human *meaning*. For aesthetics is related to *contexts* of meaning. The same is true of spirituality. While neither can be evaluated as a direct "driver" for security in human–ecological relations, neither can be regarded simply as run of the mill "indicator" of the services ecosystems provide. If we treat aesthetics as a run of the mill context for unraveling the meaning of beautiful forms in nature, we rapidly run into trouble both conceptually and perceptually.

## Aesthetics and Gregory Bateson

In Bateson's view, aesthetics is a meta-context. Aesthetics is a responsive means of engaging or uncovering pattern. It enables perception of the recursive and holistic aspects of ecology and, at the same time, is a means for uncovering the underlying order of ecology. To repeat one of Bateson's best-known quotations: "So by 'aesthetic' I mean responsive to the pattern which connects. The pattern which connects is a meta-pattern. It is a pattern of patterns. It is that meta-pattern which defines the vast generalization that indeed it is patterns which connect" (Bateson, 1977).

It is this reflexive understanding, Bateson argues, which must be attached to and incorporated within the fragmented western scientific approaches to ecological order.

Bateson drew the connection between aesthetics and ecological understanding in terms of a forked riddle: 'What is man that he may recognize disease or disruption or ugliness?' 'What is disease or disruption or ugliness that a man may know it?' (Bateson and Bateson, 1987:181). The riddle's two aspects present a dialogical oscillation between form and temporal process. The one side of the dialogical pattern refers to perceptual acuity in recognizing a difference between beauty and ugliness; the other, an observer's knowledge of pattern of disease, and disruption as percept and concept at differing levels of observation. The perceptual process is continuous; the conceptual understanding of temporal structure marked by bumps and discontinuities. In forked riddles, as he stated in *Angels Fear*, the pattern of the percept does not flow easily into the pattern of the concept and numerous tensions lie in the fork between the two.

At the outset there are issues of perception stemming from perceiving pattern flow. Next there is the tension between appearance (ecological change) and descriptions of 'reality' applied to appearances. This set of tensions, tensions between the non-linear pattern of events which are characteristic of ecological activity and the linear conception of activity in industrial order, becomes a problem of epistemology. Bateson suggests working away at the fork of their contradictions. A new interface between aesthetics and epistemology, Bateson suggests, will likely promote a new conception of holism, and perceptually will draw us toward an awareness of beauty in a larger more inclusive system. Then the interwoven regularities of the structure, a qualitative structure, may – as in all sacred realms – become the basis for awe.

## A New Interface? The National Parks Issue

Remarkably, Bateson's deductive stance has proved to be predictive of a set of empirical events though revealing that there is no easy path to perceiving a larger more inclusive system. Mandating ecological aesthetics is unusual, and the case I have in mind is that of forest management of provincial and federal parks in North America. The management of these parks is also mandated to run them according to the principles of ecological sustainability. Now one might expect that mandating aesthetic values would accord hand-in glove with the overall mandated requirements of sustainable forest practices in these parks, so that forest health, and biodiversity, would evoke aesthetic values of scenic vistas and vice versa. Yet this has not happened. Management practices developed for creating and maintaining ecological aesthetics have come into direct conflict with forest practices for sustainability, and park managers have discovered that the preferences of people beholding forest land in parks lies in a different evaluative loop from the evaluative loop of professional foresters practicing ecological sustainability. The result has led to ambiguities which cannot easily be disambiguated, and to a nightmare of ecological fittedness that does not fit (Gobster, 1999, 2001).

Park management dilemmas arose from one of those rare instances in which aesthetic perception of badness and awfulness led to political action. In the 1960s in the northwestern part of the United States and increasingly during the 1980s in western Canada, the public began to take issue with the lumber companies practices of clear-cutting forest land. The public regarded clear-cuts as unsightly, unhealthy, degenerative and despoiling of the public's environment. In British Columbia, Canada, despite the logging industry's repeated claims that clear-cutting was good forest management, public protest against clear cuts, and by extension, the large logging companies, reached such a peak that it became a primary focus of a Provincial election. It led to a left wing victory in the polls. And a successful boycott of Canadian wood products in Europe, led by environmental NGOs, helped persuade the major logging company in British Columbia, to announce its ending of this practice. As part of a political solution to stop clear-cutting, Clayquot Sound was turned into a United Nations Biosphere Reserve.

In the United States there was an earlier attempt to defuse public protest of clear-cutting through non-political means. By the early 1970s, the U.S. Department of Agriculture had begun to introduce a Visual Management System in parks in order to undertake a series of studies of public preferences toward scenic vistas in parks. The initial assumption was that park scenery would bear some correlation with the literature on aesthetic preferences in art. The results of these surveys were twofold. In the first place they revealed that landscape-aesthetic preferences are culturally derived and, second, owed little to aesthetic preferences in art. Instead of a sense of beauty correlating with Kantian notions of aesthetic judgement, they found widely different cultural perceptions of park landscapes. In the United States people favoured scenic themes in their parks based on notions of "taming the frontier." Cultural preferences were for a type of idealized, naturalism in national parks, correlated, perhaps with the type of scenery of the great north-west of the United States portrayed in Hollywood's cowboy movies. For the public at large, a forest had to be mature, tidy and unchanging to be aesthetically pleasing. The landscape in which the forest was viewed had to be a static, formal composition that could be taken at face value, accepted as a given and unchallenging in response to people–nature interaction (Gobster, 1999, 2001).

A second revelation was that the way in which the survey itself had unknowingly encouraged these views. The tests for preference given in the survey had encouraged high ratings for static, unchanging forest scenes. The exercise in aesthetic preferences had consisted of presenting interviewees with snap-shots of scenery – photographs or slides – and then asking respondent to check their responses through simple rating scales. As ecologists, park managers knew that the forest was a dynamic construct that changed its visible dimensions over the years in the setting in which it was placed, and that these dynamics were necessary for the forest's survival. The way the surveys were presented allowed little or nothing for this type of preference in the public response.

The spotted owl controversy in the late 1980s, introduced supplemental requirements to the sustainability mandate, namely to keep keystone species alive and maintain biodiversity. This new requirement increased tensions between the two mandates, visual quality management and sustainability. The two seemed bound for inescapable conflict, so much so, that some park managers took the position that biodiversity and ecosystem health were demands incompatible with scenic aesthetics. Others realized that the aesthetics they were mandated to provide and empirical findings in which aesthetic patterns were deemed to derive from visual objects, was somehow faulty. There was increasing acceptance among park managers that ideas of ecological health and integrity should be the primary guides to a new form of *ecological aesthetics*, instead of relying upon visual preferences of the way in which landscapes strike our senses. Step one was an agreement that visual preference would be replaced by a broader idea of *ecological appreciation*, material gathered about the interplay between perception and knowing in which knowledge, experience and learning about the dynamics of change in ecosystem would have an important role.

Step two was a recommendation that educational programmes aim at helping people to understand the deeper values of an ecological aesthetics in order to "build ecological aesthetics into landscape perception theory." There was a risk in supporting this idea because landscape sustainability is inevitably a shifting mosaic, covering a large area. It is difficult to conceptualize, particularly since most visitors to national parks see only a small portion of the landscape at any one time (Kimmins, 2001:49). Interpretative programmes could give some notion why temporary undesirable states of forest from a visual perspective may herald potentially more desirable conditions in the ecological future, but such educational programmes offer little comfort to the visual sensibilities of current visitors to national parks (Daniel, 2001:18).

## Some Theoretical Issues about Aesthetics

Bateson's writings are not referenced in either of the cases I have cited above, neither in the MA, nor in the national parks literature. The theoretical writer most commonly mentioned is Aldo Leopold. Memorable as the descriptive links Leopold made between aesthetic perception and the ecological integrity of landscapes, Leopold's writing was largely descriptive and he did not undertake investigation of the linkage in the systematic manner of Bateson. On the other hand Leopold, unlike Bateson, has great appeal to park administrations because he provides an easy path from a descriptive version of ecological integrity to a normative ethics.

Bateson's greatest contribution to ecological theory was to conceive of an ecological system as a system of information composed of many levels of communicative interaction. Novelty and emergence in ecosystems, as well as ecosystem injury, become displayed not only among its various levels of ordering but also between its various levels as a result of feedback. Ecological events undergoing change do not occur individually, or in patches, but express some sort of unity of ecological interactions through feedback and will display characteristics of injury in their communicative and interactive order before succumbing to the various entropies of biomass and energy.

Once a second order level of aesthetics is taken into account, then "the pattern of the entire scene as a coherent or unified whole [is comprehended.]." These are not simply Bateson's words, but the judgement of a whole band of literature in the psychology of perception. 'The integrationist view' argues that perception cannot be separated from, and cannot be independent of knowledge, about the scene being perceived. Thus non-perceptual factors are added to patterns perceived, and give rise to “aesthetic qualities perceived by the observer, such as coherence, complexity or mystery” (Bell, 2001:135, 143). Bateson evidently has friends at court supporting his position. Events which evoke an aesthetic response are different from physical events in that they are able to “trigger” (Bateson’s term) coincident events at different orders of meaning. By ‘different orders’ he means an immediate percept of beauty, a descriptive recounting of the percept, events that evoke ideas about ideas of unity. Together they provide a meta-context.

Bateson was pursuing a qualitative science that would deal with “the genesis of information of a new logical type out of the juxtaposing of multiple descriptions” (Bateson, 1975), in other words, a methodology which required at least two descriptions derived from the same contextual level, or, as in this case, a description of non-linear ecological interactions as context conjoined by aesthetic meta-context. There is no mystery in the fact that ideas about holism are a meta-context to the contexts of ecological interaction among living organisms in ecosystems. The issue in this case is how recognition of these multiple levels of description clarifies the range of difference between a percept of beauty and an understanding of sustainability.

What is Bateson’s case? Ecological aesthetics, as meta-context, is a self-referring domain within the system of ecological information. Ecological aesthetics is inherently reflexive but is also a scientific subject which investigates itself in order to achieve as holistic perspective as possible. Ecology, as science, has very little room to stand outside of and observe, or attempt to experiment with, a fully integrated ecological system. Yet aesthetics, in the guise of perceiving patterns of part–whole relationships, enables the making of statements about ecological systems from within the system itself.

In contrast to this well-worked conception of aesthetics, the International Union of Forestry Research Organizations could not, after a thorough review of Aldo Leopold and other literature, seem to account for the fact that in some cases they could find clear patterns of correspondence between the variables of landscape aesthetics and sustainability, while other patterns indicate an inverse relationship. Thus, their conclusions stated: “no single overall relationship between aesthetics and sustainability can be expected across the wide range of variation that may be encountered” (Sheppard, Harshaw and McBride, 2001:265). They were unaware that the conjunction of percept and concept required juxtaposing categories of events at different levels of meaning at the same time. Following Bateson would have led to a very different conclusion.

## Scanning the Interface

In Bateson’s approach, an ecological aesthetic gives rise to ideas about unity. Aesthetic ideas must be brought to an interface with an epistemology in order for systemic thinking about ecosystems to occur. Once the domain for an ecological aesthetics is confirmed, then epistemology requires attention. His notion of an aesthetics/epistemological interface seems a very abstract argument until the alternatives are taken into account. These are of two main types: (A) the interface of ecology and ethics and (B) the interface of ecology and technical control.

## A. *The Interface of Ecology and Ethics*

Let us go back to Aldo Leopold. Leopold's influence is represented in the following quote (Carlson, 2001:38):

'Those landscapes we aesthetically prefer will typically be the ones that express the things that we ethically prefer … a landscape also expresses things such as care, concern, prudence … . By contrast non-sustainable landscapes express not only their non-sustainability, but frequently also express vices such as waste, greed, exploitation – things we rightly ethically despise … . In short, what is required is that we not only see a landscape, but we also know its true nature.'

Leopold's approach offers some elegant solutions, elegant because of their simplicity and because they can be easily grasped by the public. The Leopold resolution of the debate between public perception of natural beauty and sustainable management is that "if it looks good, it is good, and if it looks bad, it is bad." The whole idea of humanity taking care, concern and prudence has reverberations outside management of national parks. It has struck a chord with mainstream NGOs campaigning on environmental issues, and with the Protestant churches supporting environmentalism in the name of good stewardship. It has also prompted a fine range of environment scholarship, from environmental economics to cultural critique, especially in the case of Wendell Berry (Berry, 1977).

Bateson's epistemological approach suggests that in passing from 'is' to 'ought' we are passing too quickly over a fundamental issues. The epistemological issues in this case should highlight the question of why techniques of clear-cutting forests came to be accepted in the first place, despite bad aesthetics. The epistemological answer, which is clear in Bateson's writing – even though he never wrote about forestry and national parks issues – is that forestry scientists believed that they were practicing good management in recommending and supporting clear-cutting; they thought they were indeed acting with attendant care and prudence. Until recently, forestry science thought of forests as steady-state systems in which groups of species maintained themselves in an equilibrium of birth, regeneration and death, and had convinced itself that clear cut harvesting mimicked this natural process. In other words the forestry science supporting clear cut harvesting was part of an ideology that drew its justification from a physical description of nature. It therefore supported methodologies and practices drawn from physics being applied to forestry ecosystems. The fragmentation that clear-cutting produced was disregarded because forestry science believed that the regenerative capacities of nature would not be affected. One may repeat the same story with the same set of beliefs in the case of the ecological collapse of the Newfoundland cod fishery mentioned above.

### B. The Interface of Aesthetics and Technical Control

The issue here is how to place the public's perception of landscape and ecosystem within the temporal framework of ecosystem movement and change. A solution offered is to resolve this enormous difference in temporal cycles between ecological events and human temporal events through use of computerized visual management techniques. For example, sustainability practices require the downing of trees as a part of a dynamic integration with trees that are growing in the same patch, but landscape aesthetics surveys consistently showed that dead and down wood had one of the biggest negative impacts among the public's perception of visual qualities. The chief issue from an educational perspective is how to make the 30+-year human cycles, many of which the public experiences as part of living, fit into the realm of 1000-odd-year ecological cycles, most of which are unknown to the public (Daniel, 2001:18).

The technical answer suggested is "The interface should enable the user to navigate within the environment in all dimensions and traverse the world as if it were real,"(Orland and Uusitalo, 2001:212). In other words, displays in park interpretation centres would demonstrate these differences through presentation of virtual ecosystem dynamics. The virtual environment would provide the illusion of immersion within the environment, while the use of simulation techniques would enable the viewer to "attain a broader perspective, a glimpse or a projection into the future." And because such simulations can realistically portray changing landscape conditions over time, they argue, simulations can also deal effectively with issues of emotional attachment to particular sorts of landscape. The detailed sensibilities of the simulated landscape would allow the viewer to choose his or her own path through matching cognitive ideas of sustainability to sensory information (Luymes, 2001:195). In this way anger and disgust at clear-cutting might be modified and a more neutral affective disposition prevail. Once more there is an absence of understanding about levels of distinction. At the aesthetics/technical interface, there is a collapse of levels hidden in the supposed solution that technique offers. The emotional response to visual landscapes emerges from individual human response to perception. On the other hand, the key domain of the notions of sustainability pertains to the human grasp of ecosystem structure, and these notions are systematic. The argument from technics confuses this distinction. Individual and system *are not* at the same level of analysis. Precisely because ecosystems are systemic, and because they are cognitive constructs, they are not within the same dimension of visual–sensual description as landscapes. Despite claims for helping the public to understand scenarios of the future, the aesthetic/technical interface begins to drive in the wrong direction, toward individual understanding and disregard of systemic understanding.

## Conclusion

Bateson's ecological aesthetics is his evident attempt to draw natural science towards understanding that "meaning" in ecological order cannot be derived simply from rational investigation into its material manifestations – energy and biomass.

It would seem that ecosystems do not live by biophysical requirements alone. Total inattention to communicative interactions which give meaning to the biophysical interactions of living systems cause rapid breakdown, even before too much fragmentation of their complex interactions physically degrades them. Ecological science should pay far more attention to manifestations of meaning within a science of qualitative appreciation.

The interrelation of meaning and coherence is invested in, and derived from, formal properties of nature. Change in the formal properties of natural order is perceived by human beings as either ugly or beautiful; both are examples of an aesthetic response of intelligence or mind in nature. While ugliness is a clearly located phenomenon with its attendant emotions of fear, beauty is a weaving of relations among and between unlocated sensibility. It remains a patchwork of feeling and impressions which, unlocated and difficult to communicate, are nevertheless coherent and impelling. Bateson's uncovery of ecological aesthetics is entirely consistent with his widely recognized definition of information, "the difference which makes a difference" which, as he shows, is also a second-order phenomenon.

There are other, more cognitive aspects that aesthetic appreciation prompts: what is part and what is whole: what part have we, as human beings, had in these ecosystem changes? To answer this question invokes issues of space and time. The gap between a human sense of time in the western world and ecological time-spans is one of the most potent uncertainties in ecological knowledge and a major source of difficulty in judging the severities of ecological events.

The MA and the parks managers have resorted to technical solutions in attempting to surmount this systemic gap in knowledge. Bateson's focus is upon the qualitative properties of temporality, the recursive temporal rhythms in ecosystems, their systemic patterns, together with acknowledgement of the sort of systemic dilemmas that arise and which are endemic to recursive patterning. He emphasizes that the question of temporality, the sense of time, is profoundly epistemological and must be explored in its epistemological sense. The problem (in the western industrial world at least) is that our own sense body time, and of the ecological, recursive time of organic structure, is bound together with clock time and clock time combined with a sense of individual control over events. The latter, linear, de-contextualized quantified time of an industrial order merges into our conception of 'social time' and once the two are merged, they become an undifferentiated, deeply embedded extension of our daily life of which we are mostly unaware (see also Adam, 2004:101). It is hard for industrial society to extract itself. Humanity always seems to uncover its own sense of the epistemological significance of time from which it projects its attempts to correct ecological oscillation, far too late, if at all.

Bateson suggests that any attempt to undertake self-extraction must conjoin aesthetics with epistemological investigation. By scanning the interface between the self-reflexive stance of aesthetics, on the one hand, and questions of belief, on the other, an interface emerges that brings one into relation with one another. Our survival, Bateson said, is dependent upon constituting this interface, for the gods of ecosystems are unforgiving, more determinate in their activity than the gods of religions or fate.

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# Chapter 11
# Collapsing the Wave Function of Meaning: The Epistemological Matrix of Talk-in-Interaction

**Donald Favareau**

**Abstract** Devoted to an explication of how interacting agents mutually and micro-temporally provide for each other the grounds for immediate next action in the seemingly transparent give-and-take of ordinary conversation, empirical findings from the disciplines of Interaction Analysis suggest that "language" as it is actually realized in naturally occurring, everyday talk-in-interaction, may derive its semiotic efficacy more from the active co-participation of situated speakers in creating contexts of relevancy, constraint and possibility for each other's immediate next re-shaping of the cybernetic surround than it does from the computational recombination of referential tokens within the bounds of some predetermined, category-structuring syntax.

The twin purposes of this article are to: (1) to serve as an introduction to some of the basic principles, methodologies and research data of Interaction Analysis, and (2) to attempt to situate such research and its findings within the broader study of meaning-making among living agents that is the goal of a Gregory Bateson-inspired *biosemiotics*. Here I hope to show how the former can well illuminate latter's efforts to explicate the principles whereby not only our human social worlds – but our very biological world itself – comes into being not as a "pre-given" in the furniture of the universe, but as a locally organized, massively co-constructed, participant-fashioned *accomplishment* in that universe instead.

**Keywords** Natural constructivism, contingent responsivity, talk-in-interaction, Conversation Analysis, Batesonian "mind"

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J. Hoffmeyer (ed.), *A Legacy for Living Systems: Gregory Bateson as Precursor to Biosemiotics*

## Introduction: No Mere Words

Communication between individuals, cybernetic system theory, and the ecology of causality interlinking human society with the natural world constitute the three main axes around which Gregory Bateson's innovative thought and work revolved. Refusing to settle for simplistic explanations of what he intuited was a highly complex, massively interdependent world, Bateson examined a wide variety of systemic interaction in his efforts to discover the orderly relations defining alcoholism, schizophrenia, bilateral symmetry, dolphin communication, international policy, biological evolution and learning – to name just a few of his many investigations into what he called, famously, "the pattern that connects" them all (1979:8).

In so doing, Gregory Bateson distinguished himself as an intellectual of a more classical disposition than that of many of his contemporaries, as he was not content to limit those investigations simply to what can be gleaned from the results of academic field work and scientific laboratory data. Rather, Bateson also sought to bring into the "data set" of the natural world that he was seeking to explicate the evidentiary canons of human literature, art, mythology and philosophy, as well as – if not even more fundamentally – the ubiquitous mechanics of the ordinary and the everyday: that vast realm of "seen but unnoticed" phenomena that form our own most immediate *ecology of mind*.

For like Wittgenstein at least in this sense, Bateson understood that one of the hardest tasks of both the scientist and the philosopher is the cultivation of an ability to see "what lies in front of everybody's eyes" – that which by its very never-absent ubiquity makes it extraordinarily difficult for us to consciously conceptualize and articulate (Wittgenstein 1953:§129; 1984:63e). Indeed, learning to "see through your eyes, not with them" was an admonition of William Blake's that Bateson was much fond of quoting. It is not surprising then that much of Bateson's writing concerns itself with trying to bring to light such *systemic relations* out of which the experiential "patterns" of subjectivity themselves emerge.

Consider, for example, the following Batesonian "metalogue":

D: No, Daddy, it doesn't make sense. I don't smile now so as to be able to tell you I am angry by not smiling later on.

F: Yes – I think that *is* part of the reason for smiling.

[…]

F: Anyway, it's all nonsense. I mean the notion that language is made of words is nonsense … And all the syntax and the grammar and the rest of it is nonsense. It's all based on the idea that "mere" words exist – and there are none.

[…]

D: Would it be a good thing if people gave up words and went back to only gestures?

F: Hmmm. I don't know. … But it might be fun – it would make life a sort of ballet – with dancers making their own music.

(Gregory Bateson, *"Why do Frenchmen?"* 1951/2000:11;13)[1]

Here, as in so many other places in Gregory Bateson's work – the reader follows Bateson's wide-ranging intellect and curiosity as it alights for a moment on some suggestive pattern of sign-meaning-and-consequence in interaction that Bateson apparently feels worthy of one of these suggestive little dialogues, but then does not himself systematically follow up on as a fully fledged research project – instead leaving its later explication as a "thread" for other researchers to pick up on, should they wish, so as to see where it might lead.

And indeed, 30 years later, we find empirical language researcher Charles Goodwin reporting that:

> [In observing the micro-regularities that participants can be shown to be attending to in the seamless back and forth of talk], an analogy which readily comes to mind is the music that trapeze artists use to coordinate their separate actions. However, in conversation, the "signal" used to synchronize the action of the participants, the stream of speech, is *itself* a product of their coordinated action – much as if the music in the circus was not a preformulated melody, but rather an emergent product of the coordinated actions of the performers, and simultaneously a resource employed to achieve that very coordination.
>
> (Charles Goodwin 1981:28)

Yet it is significant for more than just the discipline of "language study" that the thread that Gregory Bateson dropped about the nature of language in 1951 (and that Goodwin and his colleagues would independently pick up on several decades later) laid unfollowed for almost 30 years. For six years after Bateson's observation about the paucity of the "mere words" hypothesis, the publication of Noam Chomsky's withering critique of B.F. Skinner's (equally anti-Batesonian) behaviorism as an approach to language study in 1957 altered the direction of "language study" away from the locus of interacting individuals, and placed it squarely within the province of the genetically determined alleyways of the "individual brain." It was at this point that

> … sociology left the study of "language" to linguistics. … [There,] Saussure's focus on the study of language as an autonomous formal system to be investigated in isolation from other social processes … set the agenda for modern Linguistics, and was in fact intensified by Chomsky [in] his programmatic argument [1965:3–4] that actual talk is so flawed and degenerate that the linguist interested in competence should ignore it. (M. H. Goodwin 1990:3)

Indeed, with the widespread acceptance of Chomsky's purely theoretical postulation of a "context free universal grammar" and Language Processing Module assumed to be hard-wired into every individual's brain at birth (1968:79, 1980:65, 241–245; *et passim*), his aptly titled "Cartesian Linguistics" approach became the default way of understanding and investigating human language structure for the next 30 years

[1] When referencing the most recent (2000) re-issue of Gregory Bateson's seminal collection of essays, Steps to an Ecology of Mind, I will always include the original publication date of the particular essay cited, as here.

– having by now become so mainstream as to have become literally synonymous with the academic discipline of "Linguistics" itself.

Thus, in order to appreciate just how radically divergent the Platonic, top-down, mentalist Chomskian approach to language is from the interactive, ecological and autopoetic approach that Gregory Bateson was pointing to when he scoffed at the purported existence of "mere words," one has to first understand what the Chomskian linguists themselves feel that they are doing when they are analyzing language use. Afterwards, we will see what a more Batesonian approach to languaged interaction looks like.

## Language as Newtonian "Natural Law"

Writing at a time before any researcher began systematically examining recorded instances of real-time language use (and long before subsequent brain imaging studies ruled out the existence of any such known dedicated "Language Acquisition Module" in the brain), Chomsky himself declared that "performed" actual language was a derivative and degenerate form of the unseen and Platonic construct of an underlying innate Universal Grammar:

> In the technical sense, *linguistic theory is mentalistic* [wrote Chomsky] since it is concerned with discovering a mental reality underlying actual behavior. *Observed use of language* or hypothesized dispositions to respond, habits, and so on may provide evidence as to the nature of this mental reality, but *surely cannot constitute the actual subject matter of linguistics*, if this is to be a serious discipline … [For] a record of natural speech will show numerous false starts, deviations from rules, changes of plan in mid-course, and so on. The problem for the linguist, as well as for the child learning the language, is to determine from the data of performance the underlying system of rules that has been mastered by the speaker-hearer and that he *puts to use in actual performance*. (Chomsky 1965:4, *italics* added)

The averred entailment of the Chomskian view of language is that what both the analyst and the child learning language must be attentive to in the actual performance of other language speakers are those elements of a posited Universal Grammar which would allow them to recognize the underlying and causative Deep Structure rules, as evidenced in the representative Chomskian linguistic analysis shown in Figure 11.1.

What both the analyst and the child learning language are *not* supposed to be attending to, under this view of language structure, is the simultaneous presence of any

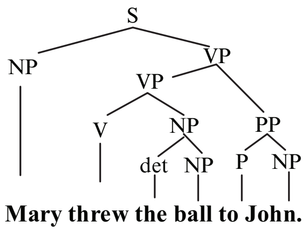


**Fig. 11.1** *Chomskian analysis of an instance of language use* (Hierarchically, from top: S – Sentence, NP – Noun Phrase, VP – Verb Phrase, V – Verb, PP – Prepositional Phrase, Det – Determiner, P – Preposition)

*other* elements as routinely show up in human language use, such as those "perturbations and disfluencies" (*ibid*) that are marked by question marks in Figure 11.2.

Certainly, if one takes a Chomskian view of language – taking the artificially self-controlled style of *written* texts as one's fundamental example of what "language" consists in the first instance[2] – one might easily be led to see such a transcript of naturally occurring everyday talk as some kind of "flawed and degenerate" instance of language use. For in between all the supposedly meaning-carrying lexemes (Bateson's "mere words") is all this seemingly random *junk*. Thus, were one to attempt a Chomskian linguistic approach to analyzing such data, one would have to disregard a full 50% or more of what is actually occurring here as "performance errors." From that Platonic standard, it appears as if the speaker here is having trouble putting his or her words together so as to produce a grammatical utterance – despite the alleged innate ubiquity of a neurally instantiated module for the processing of Universal Grammar.

Yet is it at all reasonable to assume prior to empirical investigation that everything which is being discounted from a traditionally disciplinary linguistic analysis in the data depicted in Figure 11.2, i.e, the very publicly shared volitional human events that outnumber the so-named grammatical language elements by a ratio of 2:1 – constitutes ungrammatical "performance errors" on the part of this language user? Or that such manifestly noticable sign tokens as: "you–you" "hmmm" and "…?" are not themselves deliberately deployed carriers of linguistic meaning that are attended to and acted upon as such by both speakers and hearers alike?

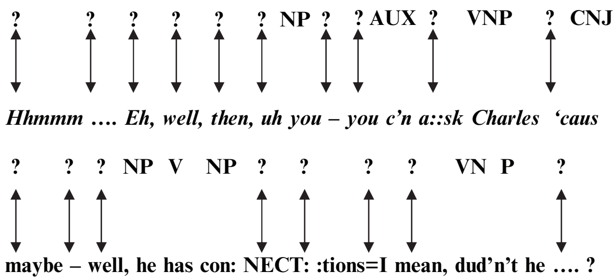


**Fig. 11.2** *Transcribed section of naturally occurring talk (Favareau, in Iacoboni 2005)*

[2] It is significant that the "data" of Chomskian linguistics consists in sets of analyst-created sentences such as the one diagrammed in Figure 1. Such "data" were originally presented to native speakers of a language to solicit their "native speaker intuitions" regarding which sentences were and were not "acceptable" in the target language (Chomsky 1965:21). However, since such "native speaker intuitions" – thought to reflect the locally set parameters of the underlying Universal Grammar – were as reliably available to the native-speaking analyst as they were to the "experimental subjects," eventually the subjects were done away with entirely. Thus, it is not uncommon practice now for the Chomskian linguist, i.e., the very same person who creates the artificial "data set" to also provide the "native speaker intuition" about its "grammaticality" that determines the "result" of the so-called linguistic experiment.

Doing so would be to assume *a priori* that the phenomena that is being so designed is "meaningless" in regard to the underlying "structure" of language – and, by extension, of "thought." Yet robust research findings now suggest that this approach may be analogous to the once equally misguided dismissal of what was formerly mischaracterized as "junk DNA." For the 30-year project that I will be referring to in this paper under the umbrella term of Interaction Analysis offers compelling evidence for the claim that the precise placement of all these so-called "perturbations and disfluencies" – and the way that those placements are registered, recognized, and acted upon by their recipients – itself constitutes a "system of rules that has been mastered by the speaker-hearer and that he puts to use in actual performance" (Chomsky 1965:4).

Thus, it is to a brief overview if this research – Batesonian in both spirit and methodological rigor – that we now turn.

## Boiling Clean the Data Set of Languaged Interaction

When one spends enough time examining the empirical evidence, the claims that "uh" and "eh" and "you – you can" are instances of language processing disfluency turn out to be surprisingly specious. Contrarily, in fact, it has been shown that such performances evidence a language processing *fluency* on a level of fine-grained resolution previously unrealized. Accordingly, we will return to an interactional analysis of the above episode of talk shortly. For now, however, the point that needs to be taken by those readers who have never been exposed to anything other than the traditional view of language as primarily a grammatically sentential and propositional bearer of meaning is this:

The transcribed specimen pockmarked with question marks above represents not a *deviation* from the semiotic structure of linguistic interaction, but rather, an altogether typical example of interactionally *competent* real-time, meaning-making language use. For it has been verified overwhelmingly that almost all empirically collected specimens of naturally occurring language use exhibit a similar type of seeming "ungrammaticality," as exemplified below:

> An's – an'( ) we were discussing, it tur-, it comes down, he s – he says, I – I – you've talked with thi – si – i – about this many times. *I* said, it came down t' this : = our main difference, *I* feel that a government, I – the main thing, is – th – the purpose of the government is, what is best for the country.
>
> *(Schegloff 1976)*

Dispelling the naïve assumption that such "disfluency" is a hallmark only of informal, careless or otherwise un-educated talk, Ochs, Gonzales and Jacoby (1996) furnish ample representative data of scientific interaction as it occurs during the working deliberations of experimental physicists:

M: Yeah not only that you – we did experiments where we (.) we uh
M: (0.2) we (.) brought the system : uh : (0.8) *he*re

R: Mm hm
M: And then we uhm (0.2) °or was it there?° (0.2) uh : that's right.
M: *He*re. Then we lowered the field (0.2) *raised* the field.

*(Ochs, Gonzales and Jacoby 1996)*

Scientific empiricism establishes this kind of language use as our *default* form in interaction, and one can scientifically replicate this investigation (and get to experience the attendant difficulties in transcending the overdetermination of the written form thereby) merely by recording ten to twenty minutes of one's own naturally occurring language interactions and then carefully transcribing *all* of the inarguably produced vocal sounds, pauses, re-starts and gestural displays with which meaning is being produced and received. It is an illuminating experience that, for the scientifically inclined, raises more questions than it answers.

Bit by bit, however, such answers have been forthcoming, as the findings from the 30+ years of empirical research into the actual mechanics of language use reveal not only that this kind of communication between individuals *is* invariantly so, but that, semiotically speaking, it *must* be so – and that all of these elements that have been dismissed from analysis as "excrescences" and "disfluencies" are, in fact, structural *necessities* for the real-time making and taking of messages and of meaning during the course of face-to-face interaction.

As Figure 11.3 reveals, almost all of the "perturbations and disfluencies" that have been traditionally thrown out of the non-empirical "data" of linguistic analysis as meaningless noise, have been empirically proven since to carry recognizable, utilizable and consequential meaning for the interacting participants. Indeed, the result of studying such research findings reveals that to *not* attend to such deliberately deployed meaning-making resources as denoted above would render any prospective language speaker – much less any child trying to learn language – grossly incompetent in taking and making meaning within the society of other language users.

Accordingly, a major difference between a Batesonian cybernetic approach and a determinist innatist approach to an complex interactive system such as language is the understanding that the analyst observing the system from the outside cannot

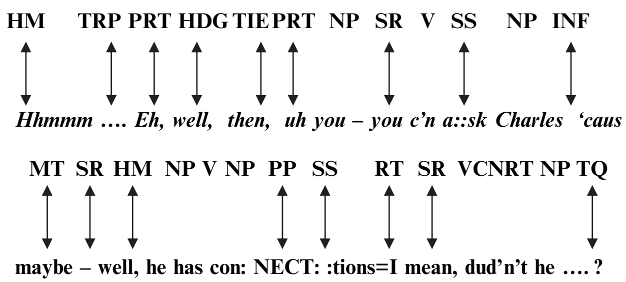


**Fig. 11.3** *Partially complete designation of some major sign-vehicles for meaning-making in talk* (HM: Hesitation Marker, TRP: Transition Relevance Place, PRT: Perturbation, HDG: Hedge, TIE: Tie, SR: Self-Repair, SS: Sound Stretch, INF: Informal Register, MT: Mitigation Marker, ACCT: Account, PPK: Pitch Peak, RT: Rush Through,, TQ: Tag Question)

*a priori* be certain what within the operation of the system counts therein as "signal" and what as "noise." Only *observation of change in the system's internal configuration as it is working* can confirm such observer analysis – and, of course, in a system such as language, it is the subjects under study whose own real-time (and immediately consequential) analysis on the incoming data set of signs establishes the referential "meaning" of words, acts, sounds – and silence.

Thus, by unconsciously conflating the grammaticality conventions that are the cultural product of *written* language as the standard by which "language" *per se* should be understood and investigated (and then further postulating that such conventions reflect the structure of an innately biological "mentalese" [Pinker 1994:82]), the Chomskian notion of "language" as fundamentally a mental phenomenon that one translates into public action not only reverses language's historical and ontological precedence ("a sort of Orwellian rewriting of the evolutionary past in the terms of the present" as Terrence Deacon once remarked),[3] but leaves the would-be language analyst "blind for the significance"[4] of how "mere words" get their referential and relational powers to begin with.

## A Cybernetic Modeling of Language as an "Ecology of Signs"

Such face-to-face real-time interaction between individuals *gives rise* to the communally developed sets of tools that Bateson calls "mere words" and the network of practice that allow those tools to function as symbols in the human "ecology of mind." Yet here, as in so many other investigations into the ubiquitous, taken-for-granted world, it took a certain kind of visionary to really "see" what is never not in front of everybody's eyes. One of the first such "seers" in this case was a man whose mind was very much, in fact, like that of Gregory Bateson – an independent and original thinker named Harvey Sacks (1935–1975).

A sociologist impatient with the "analyst-determined" categories imposed upon social life by the majority of that discipline's practitioners, Sacks wanted to use the empirical data of real, everyday talk and interaction – what Emmanuel Schegloff, Sack's collaborator and co-founder of the discipline of Conversation Analysis, refers to as "the primordial site of sociality"– to discover how structure and meaning-bearing pattern was put into the visible environment for use in real-time between agents.

A Batesonian, and indeed, an eminently *biosemiotic* undertaking both in spirit and in practice, Sacks and Schegloff's project was to found an empirically driven social science that sought to explicate the patterns of relations that the participants in social

[3] Deacon 1997:53.

[4] Bedeutungsblind, of course, being the term most famously used by proto-biosemiotician Jakob von Uexküll to decry the practice of letting the requirements of our technical model of some natural phenomenon circumscribe our ability to observe such phenomena, and not vice versa. (Rüting 2004:1).

life themselves were attending to, interpreting and acting upon as they jointly co-construct the "mutual intelligibility" – of a shared social world. In this, Sacks and Schegloff were not looking to theorize about some set of "invisible power relations" that human beings had supposedly "internalized" – nor did they ascribe much value to the kind of "dormitive hypotheses" based on an assumption that that the individual agent is but a puppet either of their biology, or of their society, or of both.

Rather, eschewing the tradition wherein an underlying or "secret reality" invisible to the actual agents of interaction is made visible by the work of a more insightful analyst (a tradition that Sacks felt ran through far to much of sociological analysis and through the Western tradition generally, from Plato through to Marx and Freud and beyond) Sacks instead set himself the far more Batesonian challenge of trying to understand the "seen reality" of public experience – the coenoscopically falsifiable techniques and methods of "what it is that people seem to know and *use*" as they go about making sense of each other, themselves, and the world together (Sacks, in Heritage 1984:233).[5]

Like Bateson, Sacks realized that "mundane" real-time interaction between human beings constituted a kind of context-dependent and context-creating system – and that the "orderliness" and "regularity" of that system's mechanics are not properties that are pre-given or imposed on it from without, but are qualities that the system itself has to accomplish and maintain autopoetically.

And as Terrence Deacon illustrates masterfully in the diagram that appears in Figure 11.4, the real-time building and maintenance of such interactive and generative *system order* allows its users access to a knowledge-bearing set of relations that is the stably held, emergent product of the aggregate activity of the system users themselves, as each takes meaning from and contributes meaning to a historically evolving system of sign use embodied in both (analog) individual activity and in (digital) inscription and artifact.

Though Deacon's diagram in Figure 11.4 might first appear as a straightforward Peircean schematic of operations taking place "inside an individual mind," both Deacon and Peirce insist (as does Bateson) that such operations fundamentally derive their referential and semiotic power from a system of relations external to, though including, the individual agent. For again, as Gregory Bateson reminds us: "If we then say that a message has "meaning" or is "about" some referent, what we mean is that there is a larger universe of relevance consisting of message-plus-referent,

[5] In this, Sacks and his colleagues were building – albeit in their own unique and scientifically systematic way – upon earlier work, such as the verstehen "social phenomenology" of Alfred Schutz (1899–1959), Erving Goffman's (1922–1982) micro-sociology of everyday life, and Harold Garfinkel's (b. 1917) "ethno-methodological" study of social practice. Subsequently, Sacks and Schegloff's own project of Conversation Analysis has since been extended to the micro-examination of the use of gesture, body position, and material artifacts in human face-to-face interaction (e.g., Kendon 1990, Streeck 1996, Goodwin 2000). Thus, for the purposes of this paper, I will use the umbrella term Interaction Analysis to refer to all of the work on human interaction that proceeds from and incorporates the Sacks and Schegloff methodology.

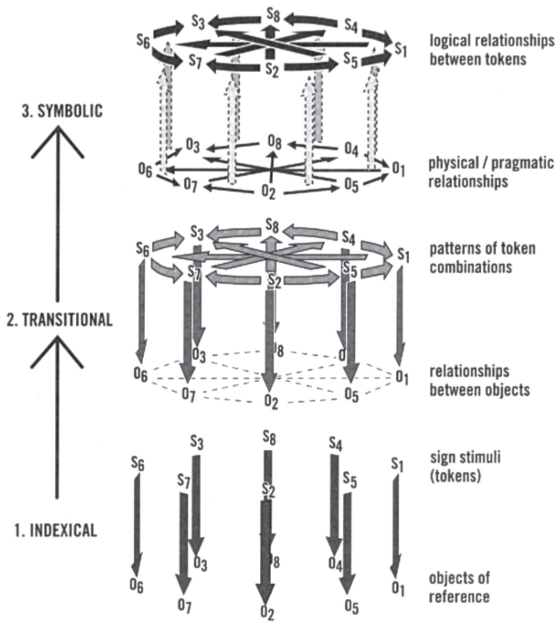


**Fig. 11.4** Deacon's matrix of referential relations necessary for the accomplishment of symbolic reference *(Deacon 1997:79)*

and that redundancy or pattern or predictability is introduced into this universe by the message" (1967/2000:413).

Such redundancy of pattern is iconic at its lowest levels (Bateson's "difference that makes a difference"), associative (or indexical) in its mediation between regularly conjoined *sets* of such iconic "differences," and symbolic (or virtual) as the patterns – or more properly, the *relations* – being realized experientially are the "relations between relations" as these relations are recognized over and above their instantiation in "mere things." Accordingly, the experience of such interactively emergent "top-level" symbolic relations then comes to exert downwardly causal effects on the system reception (or "understanding") of the "lower-level" iconic and indexical relations from which the symbolic relations themselves originally issued, initiating a kind of self-supporting and generatively recursive matrix of meaning.

However: even this characteristically human, characteristically *languaged*, referential matrix yet still – like all instances of semiosis – requires a community laboratory of real-world cause-and-effect wherein even the most "virtual" semiotic posits can be tested for veracity and effectiveness – a public domain of interactively constituted sign-exchange whereby purely "symbolic" meanings can be created, negotiated and, most importantly for human beings, co-operatively sustained.

Anthropologist Michael Tomasello (1999) makes this point succinctly when he notes that the ability to dialectically "ratchet" semiotic representations by off-loading them publicly into the very environment in which the community lives "is the crucial step in the ontogeny of human social cognition [that allows successive members of the community] to culturally mediate their understanding of the world through … the perspectives and understandings … embodied in the material and symbolic artifacts created by other persons far removed in space and time" (1999:92–93).

Such an understanding changes the way one approaches a study of language (and languaged cognition) considerably. "Rather than being instantiated in autonomous cognitive structures, the crafting of meaning is intrinsically an interactive process, something that people do in collaboration with each other," writes Interaction Analyst Charles Goodwin, noting that the 40 years worth of empirically collected, naturally occurring data of moment-by-moment human interaction "support the argument that the really difficult, and crucial, issues in cognition involve not the problem of abstraction but just the reverse: the work of building the particulars of concrete events in locally relevant contexts" (2002:11).

Rather than a depiction of the calculus of private experience, then, Deacon's matrix depicts a real-world, knowledge-bearing system of sign relations that human beings enter (or more properly, are ushered into), learn to master, continuously navigate, and perpetually sustain and build. And, indeed, it is exactly the micro-mechanics of this publicly available, cybernetically interactive, complex, adaptive *system* of sign use that I want to focus on in this article. For – just as Bateson discovered when he examined the popular notion of the "autonomous" individual or mind (e.g., 1969/2000:490; 1971/2000:319; 1972/2000:339; *et passim*) – the popular notion of this meaning-bearing system of real-world agent–object interactions also has a tendency towards idealization, reification, reduction and misleading causal autonomy.

Fighting this trend and set upon discovering the everyday, coenoscopic principles by which sign users themselves develop and maintain a generative real-time *system order*, Sacks and his collaborators broke with a long standing tradition in sociology – and in Western inquiry more generally – by attempting to determine empirically what the relevant units of analysis of this phenomenon are, not for the linguistic or sociological "analyst" – but *for the participants of sign exchange* themselves as they go about analyzing and acting upon each other's publicly displayed activity in the joint construction of information and meaning.

What I will attempt to do in the remainder of this article is to provide the reader unacquainted with such research just the most summary overview of the findings of the first 30+ years of Interaction Analysis – whose empirically collected corpus of video- and audio-taped naturally occurring data shows the moment-to-moment practices of semiotic agents attending and orienting to signs for action opportunities (and not just for "propositional content") and symbiotically creating, out of the patterns emerging out of such interaction, the very structures upon which subsequent interaction may be created and contained, in a real-time unfolding "ecology of mind."[6]

[6] Given the impossibility of summarizing almost forty years of research in the space of a journal article, only most broad-brush examples and analysis will be presented here, as a way of introducing the relevant congruence of Interaction Analysis to Batesonians and biosemioticians. A more detailed discussion of this same congruence is available in Favareau 2004, and more in-depth overviews of the history of Interaction and Conversation Analysis are available Heritage 1984, Ochs, Schegloff and Thompson 1996, Levinson 1983 and Prevignano and Thibault 2003, noting – most importantly – the primary source material cited therein.

## Fundaments of System Order: The Contingent Responsivity of Turn-Taking

A naturalist collecting empirical evidence of interaction between members of the same species in their natural habitat recorded the following few seconds worth of transcribed data, said data being absolutely typical of said species' moment-to-moment interactions. The species activity that the members are collaboratively engaged in here has been named "shopping" and the environment in which the activity is taking place is understood by all of them to be "a clothing store."

Ana: How's that?
Ben: Uh …
Ceil: Perfect!
Ben: Mmmm
All: ……
Ceil: You don't think so?
Ben: [splays hands]
Ana: Too seventies?
Ben: For my tastes.
Ceil: *Tsk!*
Ben: Still …
Ana: Something plainer.
Ben: [nods head]
Ceil: *God!*

*(author data 'Marui')*

In the data transcribed above, three autonomously acting individuals are each co-ordinating their actions towards one another simultaneously, without any overt direction regarding who is to talk at what point or for how long. Yet, here we find that no one individual's speech overlapping on the top of any another; that there is no breakdown in the turn-taking choreography, despite the obvious absence of a pre-given order, or of centralized control; and that there exists no overt disputation over who should be speaking and who should be remaining silent at any given point along the rapidly unfolding stretch of instantly created interaction. Rather, the split-second back-and-forth choreography of the talk is actively being managed from within, with the actions of each speaker/hearer (for all participants, of course, must shift constantly back and forth between roles) at all times being reflexively contingent upon the immediately just actualized decisions of all the others.

Careful examination of this data – and of all the data that will follow – moreover, shows that it cannot be the completion of grammatical sentences on the part of each individual speaker that accounts for the micro-coordination of speaking opportunities that allows this altogether typical spate of ordinary interaction to run off as a fast-paced, three-way juggling act – as the far majority of utterances are not actual grammatically complete sentences, and many are not even words:

| | | |
|---|---|---|
| Ana: | How's that? | SENTENCE |
| Ben: | Uh … | SOUND |
| Ceil: | Perfect! | WORD |
| Ben: | Mmmm | HUMMING |
| All: | | SILENCE |
| Ceil: | You don't think so? | SENTENCE |
| Ben: | [splays hands] | GESTURE |
| Ana: | Too seventies? | ADJECTIVAL PHRASE |
| Ben: | For my tastes. | CLAUSE |
| Ceil: | *Tsk!* | TONGUE CLICK |
| Ben: | Still … | WORD |
| Ana: | Something plainer. | NOUN PHRASE |
| Ben: | [nods head] | GESTURE |
| Ceil: | *God!* | WORD |

Notice that in the majority of cases above, these "minimal units of meaning" most certainly are not the S → NP + VP constructions of the Chomskian "Universal" Grammatical sentences. Rather, what we see here as being *understood by the participants* as relevant and "meaningful" are grammatically incomplete phrases, clauses, single lexical items, throat-clearing, laughter, pauses, tongue-clicking "uh", "mmm" "tsk," body gestures and, perhaps tellingly, quiescence – because, of course, at the conclusion of utterance 4, any of the three participants could have chosen to speak – and all chose not to.

Now, it should be acknowledged at the outset investing even this much energy in describing something so mundane and insignificant may strike most conventionally minded people as somewhat ludicrous or absurd.

And so in fact it might be, if it weren't for the fact that in order for such kinds of interaction actually *happen at all* in the way that the 30 years worth of empirical evidence reveals repeatedly that it does, the *participants themselves* have to be attending to at least this multiply layered cascade of transiently appearing and disappearing events and opportunities within the split-second unfolding of every instance of communicative interaction.

And indeed, four decades of sustained, empirical research investigating the online co-construction of talk reveals that so fine-grained is the kind of mutual synchrony that underlies the locally managed turn-taking of conversational talk-in-interaction, that the micro-beat between the time that one person stops talking and another begins has been found to be well under two-tenths of a second.

| | |
|---|---|
| Ana: | **(<0.1)** How's that? |
| Ben: | **(<0.1)** Uh … |
| Ceil: | **(<0.1)** Perfect! |
| Ben: | **(<0.1)** Mmmm |
| All: | **(2.3)** |
| Ceil: | **(<0.1)** You don't think so? |
| Ben: | **(<0.1)** [splays hands] |
| Ana: | **(<0.1)** Too seventies? |

Ben: **(<0.1)** For my tastes.
Ceil: **(<0.1)** *Tsk!*
Ben: **(<0.1)** Still …
Ana: **(<0.1)** Something plainer.
Ben: **(<0.1)** [nods head]
Ceil: **(<0.1)** *God!*

Silences in excess of this 0.2 s beat as it occurs in this "transition space" thus become *audible* as salient events in their own rights to participants in interaction, and become incorporated as further resources for the communal making and the taking of meaning. For as Interaction Analyst John Heritage notes – and as we shall have more opportunity to examine and discuss in-depth later – "when the *'relevant next'* is provided, it is treated as requiring no special explanation … but when the relevanced next does not occur, the move becomes specifically accountable" (Heritage 1984:247, 253), as evidenced below:

A: Is there something bothering you or not?
**(1.0)**
A: Yes or no?
**(1.5)**
A: Eh?
B: **(<0.1)** No.

*(Atkinson and Drew 1979:52)*

So robust is the consequential normativity of such "relevant absences," in fact, that they are evident as meaning-carriers even to young children:

A: We have to cut these Mummy.
**(1.3)**
A: Won't we Mummy?
**(1.5)**
A: Won't we?
B: **(<0.2)** Yes.

*(Atkinson and Drew 1979:52)*

For just as Bateson reminds us in regard to neural function: "Quiescence differs as much from activity as activity differs from quiescence. Therefore both quiescence and activity have equal informational relevance. The message of activity can only be accepted as valid if the message of quiescence can also be trusted" (1972:319).

Accordingly, the intricately and bi-directionally choreographed motor activity *across* agents constitutes the basic conversational turn-taking system. This is enabled in part by participants' monitoring the stream of each other's ongoing speech, tracking it for the appearance of some fairly invariant "affordances", i.e., transiently appearing opportunities for action, as in Gibson's (1950) sense – which are not exclusively grammatical, but rhythmic, pitch contour-intonational and body postural as well.

## Transiently Emergent Order: Transition Relevance Points

1 Deb : Can you wait till we get home? We'll be home in five minutes.
2 Anne : Even less than that.
3 Naomi: But could we – could I stay up?
(0.2)
4 Naomi: Once we get home.
5 Marty : For a few minutes.
6 Deb : Once you get your nightgown on.

*(Schegloff, Jefferson and Sacks 1977:366)*

A: Somebody said looking at m [*:y, son – my oldest son
B: ((_____gaze_____)[*gaze breaks](___gaze__))

*(Goodwin 1981:130)*

Overwhelmingly, the data collected over the course of the last 30 years on naturally occurring communicative interaction demonstrates that participants track the trajectory of each other's stream of speech, body postures, and orientations in the shared semiotic surround for what interactional analysts refer to as, variously Transition Relevant Places (TRPs) or Possible Completion Points (PCPs).

Such "places" in the stream of talk are *not* synonymous with grammatical sentence completion points, nor are they deterministic signals for the transition of speakers to take place. Rather, they are intonationally, interactionally and grammatically "possibly complete" points that are understood by participants-in-interaction as *sanctioned and probabilistic opportunity spaces* for another speaker to begin. For a hearer who is tracking the unfolding event of speech in real time cannot possibly distinguish "possibly complete" from "complete" utterances, save in retrospect – for unlike with the written word, speech never comes to us complete and ad hoc, but piecemeal and in real time. (Covering this line of text with your hand and pulling your hand rightwards to reveal the text letter by letter and word for word is the closest approximation to real time language processing that the present medium will afford.) Below, then, is a schematic example of such intonational and possibly grammatically complete opportunity spaces as they present themselves through the moment-to-moment unfolding of everyday talk:

TRP 1 ↓ (after "Oh,") TRP 2 ↓ (after "trains") TRP 3 ↓ (after "into")

Oh, there must be <u>some</u> trains into the city.

Accordingly, here is how an actual participant in interaction responded to such talk:

TRP 2 TAKEN ↓

A: Oh, there must be <u>some</u> **trains** **[**into the city.

B: **[There** <u>must</u> be, but …

*(Jefferson 1984:17)*

Note that participant B does not come in "just anywhere" during the course of A's unfolding stream of speech. She does not, for instance, come in during the course of the construction of the verb phrase "there must be" or after the projectives "some" or "into the" – rather, the overlap that happens here (signified by the parallel open brackets) occurs, as studies prove robustly happens, at an interactionally sanctioned Transition Relevance Place.

Moreover, so attuned are interactional participants to the transiently appearing and disappearing opportunities of such Transition Relevance Places [TRPs] that it is not uncommon for participants to recognize the same TRP at the same time, and to "overlap" each other's talk in the simultaneous attempt to actualize the opportunity presented there.

Lil: Bertha's lost, on our scale, about fourteen pounds

| | TRP ↓ | TRP ↓ |
|---|---|---|
| Damora: | Oh [::no::. | |
| Jean: | [Twelve pounds I think wasn't it.= | |
| Daisy: | | [Can you believe it? |
| Lil: | | [Twelve pounds… |

*(Sacks, Schegloff and Jefferson 1974:707)*

Working with a large collection of such materials, Jefferson (1984) finds that such "overlap" is overwhelmingly "not a matter of 'people just not listening to each other' but quite the contrary … a matter of fine grained attention" to the action opportunities continually opening up for them – and just as continually, closing down on them – during the production of each other's turns-at-talk (Jefferson 1984:11).

Such simultaneous onset is far from random, and again points to the fact that the ongoing production and reception of talk is *not* accomplished in the way that a pre-completed text or utterance is "read" or "heard." Rather, talk is "developing" in real-time and participants, like tennis players, must somehow contrive to position themselves everywhere at once in order to successfully accomplish the seamless back-and-forth of semiotic interaction (cf. Iacoboni 2005 for a brief analysis of the motoric neuro-physiology underpinning everyday talk).

Desk: What is your last name [Loraine?
Caller: [Dinnis.
Desk: What?
Caller: Dinnis.

*(Sacks, Schegloff and Jefferson 1974:702)*

Ken: I saw 'em last night [at uhm school.
Jim: [They're a riot.

*(Sacks, Schegloff and Jefferson 1974:721)*

Louise: I think it's really funny [to watch.
Roger: [Ohhh God!

*(Sacks, Schegloff and Jefferson 1974:721)*

Writes Jefferson:

> I want to stress about [these] and other such 'transition place' overlaps that at the point of overlap onset, the recipient/now-starting-next-speaker is doing something perfectly proper, perfectly within his rights and obligations as a recipient/next speaker. He is *not* doing what we commonly understand to be 'interrupting' – roughly, starting up 'in the midst of' another's turn at talk, not letting the other finish.' On the other hand, the current speaker is *also* doing something perfectly proper. He is producing a single turn at talk which happens to have multiple components in it [some of which, unavoidably, are TRPs]. (Jefferson 1984:16)

Often compared with the experientially familiar "sidewalk dance" that pedestrians engage in as each recognizes the *same* immediately available open space and simultaneously moves into it (often blocking each other anew with every mutually recognized opportunity taken), overlap onset is recognized by participants to interaction as introducing "trouble" in the smooth flow of choreography that all participants are necessarily invested in attempting to accomplish and maintain.

Thus, there are a number of interactional resources that participants can and do employ to negotiate "out" of such interactional bottlenecks. And although we will not be reviewing those resources here,[7] suffice it for our purposes to observe that, overwhelmingly, participants are able to successfully negotiate these simultaneous onsets quickly and transparently, without breaking the back-and-forth of conversation by introducing overt discussion into the talk regarding who should proceed and who should "drop out" when the simultaneous onset of turn-taking occurs.

R: We'll be home way before then.
R: [And I …]
B: [So could …]
R: Sorry.
B: No, go ahead.
R: No, no, what were you going to say?
B: Well I was wondering if …

*(author data BR:Car)*

For our purposes now, the important point to register is that these TRPs are mutually recognized *as such* not only by those hearers who are waiting to come in, but also by those speakers who – recognizing the contingent possibility that they are providing in these spaces – deploy a number of potentially "pre-emptive" and

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[7] Interested readers should see particularly Sacks, Schegloff and Jefferson 1974, Goodwin 1979, 1980, 1981, Jefferson 1984, Goodwin and Goodwin 1987, 1992, Lerner 1996, and Schegloff 1997, 1980, 1982, 1988, 1992 and 2000 for satisfactorily detailed discussions of such resources.

counteracting" resources to attempt to secure the turn and to circumvent their hearers from coming in at just these mutually available points. Such resources include speeding up the rhythm of the ongoing utterance at just these points ("rush-throughs"), elongating a Possible Completion Point *through* the TRP ("sound stretches") and the insertion of the familiar – seemingly gratuitous but strategically efficacious – resources such as "but, then" "and ya'know what?" "see," and "like…"[8]

Indeed, recognizing a TRP *as* a TRP is itself an online, real-time interactively instantiated accomplishment – which leads us to two points needing at least cursory addressing here. The first is that the Interaction Analysis (IA) method of inquiry is not, unlike traditional linguistics (or even "text semiotics"), an analysis of how hypothetical agents engage with a physically pre-completed message or text. Rather, the meaning-making going on here takes place piecemeal, bit by bit, in real time and is *interactionally collaborative* through and through – neither speaker nor hearer is assured of the emerging content of a message in any way but *a posteriori*.[9]

Second is that the onus of analysis in Interaction Analysis defers always to the *displayed* understandings of the participants themselves as the empirical warrant for determining what any given bit of interaction "means." As in biosemiotics, signs are only "signs" because the agent in a sign relation (not the analyst observing that relation) *acts* upon them as being so.

Thus, by studying the moment-to-moment unfolding of semiotic interaction, we find that in the organization of conversational interaction – just as in organization of ecosystems, social species and symbiotic organisms, the signs that participants are both putting into the shared public surround and attending to for the mutual

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[8] Here, too, even a summary discussion of such resources is beyond the space allotted here. But excellent accounts can be found in Schegloff, Jefferson and Sacks 1977, C. Goodwin 1995b, 2002, Schegloff 1986, 1991, 1995b, Heritage 1984, Goodwin and Goodwin 1987, Jefferson 1987, and Ford, Fox and Thompson 2002.

[9] Some of the more obvious examples of which include the everyday phenomenon called "collaborative completion", where the "authorship" of a given utterance is literally distributed, as evidenced below:

| | |
|---|---|
| David: | So if one person said he couldn't invest (.)= |
| Kerry: | =then I'd have to wait. |
| R: | And if you don't put things on your calendar (.)= |
| D: | =you're out of luck. |
| Louise: | When he gets his eyes like this and he starts thinking, you know= |
| Ken: | =then you get to worry. |

(*all from Lerner 1991:445*)

Moreover, Goodwin (1986, 1995a, 2000a, 2000b, 2000c) has collected a corpus of evidence that establishes decisively that listeners' moment-to-moment gestures, body torque, eye movements and even breathing can be and often are causally influential factors in how a spate-of-talk "in progress" will alter it's very content, as well as its form.

accomplishment of action are not in the first instance propositional or conceptual ideas to psychologically operate with, but indexical and iconic signs to operate interactionally on.

## Stepping into the Immediate Next: Adjacency Pair Interaction

In discussing the emergence of physical order, complexity theorist Stuart Kauffman (1995:22) refers to the "adjacent possible" as that set of all of the possible "next" reactions that have just "become possible" by the actualization of, for example, the present molecular state. Out of this variously delimited set, only one such possibility is actualized at the expense of all the others, and this single actualized possibility becomes the substrate upon which the next set of as yet unactualized possibilities are made immediately available.

In rigidly deterministic systems, the set of possibilities made available by any given actualization is small. As such reactions become embedded in systems and as these systems themselves complexify and become recursively embedded, however, the degrees of freedom opened up by any given actualization increase exponentially, while at the same time systemic pressure biasing the directionality of such actualizations begins to exert a shaping or canalizing effect of the kinds that can be seen both phylogenetically and in embryogenesis, and in post-natal neurogenesis and epigenesis in general.

In talk-in-interaction, too, the notion of the "adjacent possible" plays a critical role in the self-organization of order, as may be evident even from the short examination of the turn-taking phenomena presented above. I stated earlier, however, that this public structure that participants are creating for each other is not just a "substrate" upon which pre-formulated, "already meaning-bearing messages" are *exchanged*, but is instead the primary epistemological *resource* out of which real time meaning is *created*.

This understanding – that one really does *not* know in advance exactly what one's utterance (much less entire spate of talk) is going to be, even at the outset of producing it, but that one is actually building one's utterances as one goes along, in moment-to-moment reaction to, and consideration of, the semiotic constraints and possibilities that are opening up and closing down in each immediately actualizing "adjacency" moment – is common to everyday experience upon a few moments reflection, but lost utterly to an over-formalized theory of language (and thought) as computation and as an exchange of messages that are first fully pre-formulated in the brain, translated into words, delivered into the public environment via "the minimal meaning-bearing units" of *sentences*, decoded in full as such, and then replied to in a reciprocal manner.[10]

[10] Cf. Chomsky's programmatic equation of language as a "set of sentences" (1957:13–15).

Thus, the competing IA and Chomskian understanding of how "language" works really do reflect profoundly opposite understandings of how "minds" work. The Chomskian speaker is an autonomous actor with regards to his environment, but genetically highly determined from within. Language, like Mind, is a property of individuals in the first instance (and ultimately a physical property, no less). The IA speaker, conversely, is interactively constituted through and through (and knows this if the IA speaker is also a biosemiotician!) For while the agent himself is a physical entity, both Language and Mind are system properties emerging from the interactive relations of groups of individuals (and with the sets of naturally occurring relations) of which the physical agent is a part.

"The elementary cybernetic system with its *messages in circuit* is, in fact, the simplest unit of *mind*" Bateson reminds us, and the transform of *a difference traveling in a circuit* is the elementary *idea*" (1970/2000:465, italics mine). Let us keep in mind, then, Bateson's insistence that "mind" is not co-extensive with "individual consciousness" and that "the 'self' is a false reification of an improperly delimited part of a much larger field of interacting processes" (2000:331 [as well as: 242, 319, 466, 490, 492, *et passim*]) as we continue to consider the Batesonian (and biosemiotic) implications suggested by the empirical research findings of Interaction Analysis.

Canonically, the term "adjacency pair" is used to refer to those sequences of talk that have the following features: these sequences are (1) two utterances in length, with (2) different speakers producing each utterance. Furthermore, they are: (3) *ordered* (i.e., not interchangeable) as "first pair parts" (FPP) and "second pair parts" (SPP) and (4) *typed*, such that certain first pair parts *make relevant* a range of certain, but by no means any and all, kinds of second pair parts. (Schegloff and Sacks 1973:295).

Such a broad-brush definition, as will immediately become apparent, requires more meticulous articulation at every point. The paired parts need not be verbal utterances, for example, as is made striking evident in Goodwin's work on aphasia (1995, 2000b, 2000c, 2002), and the "immediately next" adjacency positioning may be interstitially expanded through the insertion of intervening adjacency pairs, as we shall see below. Yet as a first-pass description of the kinds of meaning-bearing structures that agents collaboratively bring into existence – and then subsequently orient to and *use* in order to understand one another – such description and these canonical examples at least reflect a flavor of what it is that the participants themselves are seeing "as such."

Perhaps the robust ubiquity of participants' orientation to the collaborative completion of adjacency pairs is best illustrated by examining how adjacency pairs can be inserted within adjacency pairs to constitute the meaning-bearing actions that interaction analysts call *insertion sequences*. A well-cited example of this everyday phenomenon appears in the second set of data specimens below:

*Consecutive Adjacency Pair Sequence*:

| | | |
|---|---|---|
| A: | What time is it now? | FPP 1: QUESTION |
| B: | Uh, seven o'clock. | SPP 1: ANSWER |
| C: | We'll all meet in Hawaii and celebrate Christmas. | FPP 2: ANNOUNCEMENT |

| | | |
|---|---|---|
| D: | Good. I like that idea. | SPP 2: ASSESSMENT |
| E: | Come quickly! | FPP 3: COMMAND |
| F: | No way. | SPP 3: REFUSAL |

*(Morita 2005:41;43)*

*Adjacency Pair Sequence Inserted Within an Adjacency Pair Sequence*:

| | | |
|---|---|---|
| A: | May I have a bottle of Mich? | FPP 1: QUESTION 1 |
| B: | Are you twenty-one? | FPP 2: QUESTION 2 |
| A: | No. | SPP 2: ANSWER 2 |
| B: | No. | SPP 1: ANSWER 1 |

(*Merritt 1976:333)*

Moreover, the fact that participants to interaction can and do leave an adjacency pair "open" – though not forgotten and, in fact, very much "in play" – while they negotiate the details relevant to its closing, can be seen in the following example wherein no less than 81 turns are passed back and forth before the FPP initiating the discussion receives its relevant SPP.

| | | | |
|---|---|---|---|
| B: | **hhh. n I was wondering if you'd let me borrow your gun** | **REQ 1** | **FPP A** |
| | (1.2) | | |
| J: | My gun? | Q1 | FPP 1 |
| B: | Yeah. | A1 | SPP 1 |
| | (1.0) | | |
| J: | *What* gun? | Q2 | FPP 2 |
| | (0.7) | | |
| B: | Don't you have a BB gun? | Q3 | FPP 3 |
| J:: | Yeah. | A3 | SPP 3 |
| | (0.8) | | |
| B: | (I'm a) It'[s | | |
| J:: | [I have a lotta guns. Hehh | A3 | INCR |
| B: | You do? | Q4 | FPP 4 |

I have deleted the majority of this ensuing exchange as, remarkably, it is not until a full 81 turns after B's initial and as yet uncompleted First Pair Part receives its Second Pair Part, as marked in bold below.

| | | | |
|---|---|---|---|
| J: | You a good – (.) uh::: (1.8) *a*ctress? | Q*n* 1 | FPP |
| | (1.0) | | |
| B: | No. heheheheh. | A*n*1 | SPP |
| | (0.5) | | |
| J: | Then how'd you come out to be Annie? | Q*n*2 | FPP |
| | (1.0) | | |
| B: | no – I'm – it's just that – everybody in the class | A*n*2 | SPP |
| | Has to do a different pantomime, you know? | Q*n*3 | FPP |
| J: | Uh-huh. | A*n*3 | SPP |
| | (0.4) | | |

B: An:::
J: **Yeah; you can use it.** **REQ 1** **SPP A**

*(Schegloff 1990:56)*

The critical point to attend to in examining such "minutiae" is this: The very ubiquity of our *own* heretofore unexamined use of (and reliance on) such interactively achieved and meaning-secreting structures as the adjacency-pair system blinds us to the significance that "answering" and "question" or "assessing" an "announcement" are *not* physically deterministic "reflexes" that simply *have* to be done.

Rather, in each and every instance they are *voluntary* actions deliberately undertaken and absolutely freely chosen. No physical forces or causation are determining, nor physical sanctions of punishment for non-compliance impending (most of the time) that would make "natural" the split-second supplying of a very particular type of Second Pair Part to the enregistered existence of a First Pair Part in the shared sensory surround.

Participation in this meaning-making circuit is voluntary and in no way rules out, in principle, supplying as a Second Pair Part to the First Pair Part question, "What time is it now?" a handshake, a whistle, a non-sequitur, a tap dance, or to handing your interlocutor a shoe. In fact, it is the almost infinite number of possible responses to any given linguistic interaction that virtually *never* get made (save by lunatics, and even much of their behavior falls within strictly delimited interactional order) that alerts us to just how profoundly attentive we are aligning our own actions (and understandings) within the virtual, non-physically causal system properties of *normative interactional order*.

As in complex-adaptive (and autopoetic) systems generally, such order emerges, over time, from the bottom-up interactions of face-to-face human interaction and results (Deaconian matrix-style) in upper-level system properties that then exert downwardly organizational order – as can be seen most clearly in instances of historical language change, as well in the popular ("ontogenetic') creation and incorporation of neologism (eg, Silverstein 2003). There is even a built-in mechanism for self-correction in the system (Bateson's ultimate criterion in the constitution of a true "mental system" (1969/2000:490) as we shall see) – but the point to be stressed here is that human beings both create and must act so as to *continually sustain* this interactional order on a level of fine-grained resolution unimagined before the painstaking second-to-second analysis of audio- and video- taped everyday interaction by Interaction Analysts (again, as we shall see).

And while Interaction Analysis is resolutely committed to *no* overarching theoretical commitments, seeing itself as purely an empirical science, I want to argue in this paper that the findings of 30+ years of IA research support the Batesonian (and biosemiotic) understanding that the reason human individuals put in all the moment-to-moment work of *maintaining* this "system order" is that public signs-in-interaction (including, but not limited to, the primordial site of sociality that is human-to-human talk) constitute a knowledge-bearing system that individuals must *partake of* for the realization (or construction) of their individual-specific experience of "mind."

Thus, in considering the robustness with which participants to interaction create, orient to and use "adjacency *meaning"* as a resource for organization and interaction, Duranti and Goodwin note that "a defining characteristic of true sequences is the property of *conditional relevance*: a first action creates a slot for an appropriate next action such that even the absence of that action can be perceived as a relevant and noticeable event" (Duranti and Goodwin 1992:191–192).

We saw examples of such "silences made hearable" due to their positioning earlier in this discussion. The example below shows that not only do the *recipients* of an utterance orient to the normativity of adjacency positioning as a resource for deriving meaning, but that the *speakers* of an utterance must do so simultaneously, as well.

A: They have a good cook there?
(1.7)
A: Nothing special?
B: No…

*(Pomerantz 1984:76)*

Knowing, then, that even silence is hearable as a meaning-bearing message, participants to talk-in-interaction therefore have an *intrinsic motivation* to distinguish and, if need be, explicitly identify for each other what any given silence is meant to be "doing" in the talk.

A: Do you really want to go there with me?
(2.5)
A: You don't, do you?
B: (<0.1) I'm thinking.

*(author data, IKEA2)*

So deeply entwined in each other's productions (as we saw when we examined the phenomenon of "collaborative completion"), and so intrinsically motivated to participate in the ongoing, moment-to-moment co-construction of meaning wherein their own positions will be defined with or without their own explicit agreement, participants to interaction co-construct a *necessarily participatory world* wherein: "adjacent positioning [is] found to be the major means by which individual speakers could be assured of exerting some local influence over the conduct of their co-interactants" (Heritage 1984:265).

For as Schegloff (1995a) reminds us:

> "First" and "second" do not refer merely to the order in which these turns *happen* to occur; they refer to design features of these turn types and sequential positions. The very feature of "first-ness" sets up the relevance of something else to follow: it projects the relevance of a "second." (Schegloff 1995b:10).

In Peircean terms, the *iconicity* of an FPP taken *as* an iconic sign as such, *indexicalizes* (here: "makes relevant") the provision of an SPP from the set of possibilities just actualized – and the *system* of interactions that emerges as the historical *result* of actualities so chosen ("conventional understanding," or the culture of *symbolic reference*) comes to downwardly shape and bias subsequent decisions for choosing amongst such sets. In this way, the participants to real-time semiotic interaction – by their very participation in the system – create and traverse an intelligible and literally *knowledge-producing* pathway through what at first seems like the dizzying tangle of Deacon's matrix of lived, embodied sign relations in Figure 11.4.

## Place as Meaning: The Stigmergy and Structure of Sequence Organization

In our discussion above, we saw that the general principle of "the adjacent possible" wherein the directionality of development takes place, but is not mechanistically determined, is – in talk-and-interaction just as in microbial organization, animal interaction, and in embryogenesis – provided by the actions of the agents in a system which both emerges from those actions and recursively embeds them.

So too, then, does the principle of "the adjacent possible" that underlies the semiotic efficacy of Adjacency Pairs, make possible the semiotic efficacy of sequences that are "adjacent to Adjacency Pairs" as a resource for meaning-making and interaction, as the following examples of "pre-" adjacency pair structures reveals:

| | | |
|---|---|---|
| B: | Would you do me a favor? Heheh. | PRE-REQUEST |
| J: | Ehh depends on the favor:::= | HEDGE |
| J: | =Go ahead. | GO AHEAD |
| | | *(Schegloff 1990:56)* |

| | | |
|---|---|---|
| C: | Say, what are you doing? | PRE-INVITATION |
| R: | Well we're going out. Why? | BLOCK |
| | | *(Atkinson and Drew 1979:143)* |

| | | |
|---|---|---|
| Bee: | So you gonna be around this weekend? | PRE-INVITATION |
| Ava: | Uh:::m. (0.3) *Po*ssibly. | HEDGE |
| | | *(Schegloff 1995a:24)* |

| | | |
|---|---|---|
| J: | Uhm. (0.?) Can I ask you something? | PRE-QUESTION |
| M: | Yeah. | GO AHEAD |
| J: | What has happened to Standard Prudential? | QUESTION |
| | | *(Schegloff 1980:133)* |

This tight connection between sequence opportunity and meaning is why many "pre-" sequences of all kinds are deployed: for if a projected action is to be rejected, one can preclude the explicit realization of such rejection "in advance" – as would have been the case in our third example, had the SPP to the pre-request "Are there any aspirins around here?" been "No." So robust, in fact, is the participatory anticipation to "pre" moves among agents that such "pre's" can effectively function "in lieu" of requests – and can be granted or denied accordingly – as in the following sequence, where *no explicit request ever actually manifests* – but is nonetheless made relevant and acted upon as such:

A: We told Kathy that we'll help her move on Saturday. It's gonna be a lot of work.
B: Saturday I have baseball practice.

*(author data, KH)*

These everyday examples suggest something critically important about how we create, organize and use *meaning* (as opposed to mere denotational "reference") during conversational sign-exchange. For the forward-pointing relational property of "pre-ness" is always one that is understood as signifying that " something was done not as an action/move in its own right and analyzable in its own terms alone, but for its relevance to and bearing on some action/utterance projected to occur." (Schegloff 1995b:20).

Here we find signs taken not straightforwardly as signs of what they iconically or indexically denote (e.g. the common "Do you know what time it is?" is not taken as a yes/no question about one's knowledge), but as signs pointing away from themselves, even *as* signs, to interpretations and understandings that have only become conventional-ized (read: become *symbolic*) through their *use* in an entire network of interlocking signs, agents, and interpretants.[11]

And here we see why it would be a mistake to conclude from such investigation that these agents are busily "processing propositional information" back and forth like so many packet switches in a computer motherboard. Rather, the meaning-making that the agents here are constructing together is visible, hearable and in a real sense "out there" in the world between them. For it is also out there in this embodied interface that the participants themselves constitute that they must be actively aligning their own breathing, body torque, facial expressions and motor rhythms in order to bring off the kind of fine-grained reflexivity of temporal and motor coordination that allow them to *collectively accomplish* the built order of apparently "seamless" transitioning and structural stigmergy that is the hallmark of everyday talk.[12]

Such stigmergy is of a piece with the understanding of *natural constructivism* that I have argued for elsewhere (Favareau 2001, 2004; Schumann, Favareau, et al. 2006), and that makes scientifically sensible the statement that: "Subjective experience is an organizing principle in nature." For in attending to the moment-to-moment, ever unfolding cycle of *perception, action, consequence* that is (recursively) the life-world of all organisms, we see this exact same type of locally constructivist self-organization taking place in the building and inhabiting of eco-systems; in the actions undertaken in interaction between animals; and (with the appropriate allowances made for the use of the word "perception") on the level of the individual cell as it

[11] And this, of course, is why computerized "language processing" programs fail so miserably at taking "inference." Such non-literal, non-binary interpretation is a higher-order system relation that "is not vested in any individual sign-object pairing" and that actually requires the suppression of such indexical associations as termini, in favor of a higher-order interpretative logic that is situated (at least partly) outside of the interpreting agent itself (Deacon 1997:93).

[12] Noting that, again, there are even more semiotically relevant phenomena that may be co-present simultaneously during the course of interaction – and that participants must recognize, use and be attentive to in order to successfully make meaning with each other – than are to be found merely in the stream of sound or even in the actions of the other participants themselves (cf. Goodwin and Goodwin 1987, Goodwin 1995b, 1997, 2000a, 2002a, 2003, Streeck 1996, Schegloff 1998, Latour 1993, 1999, Latour and Woolgar 1979).

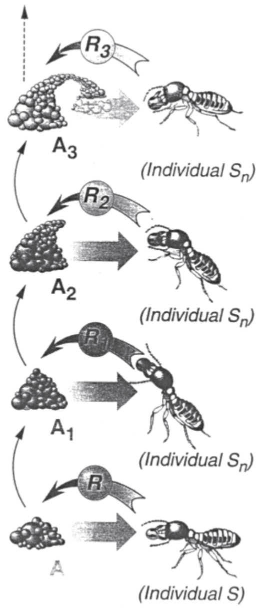


**Fig. 11.5** *"Stigmergy: As individuals create structures, the emerging spatial configurations (A, A1, A2, etc.) change the behavioral patterns of the individuals"* (Solé and Goodwin 2001:153)[13]

functions within a systemic whole. Figure 11.5 illustrates one of the less complex examples of just such context-dependent and context-creating semiotic agent interaction out of which issues the "order" of the natural world.

Depicted here in Figure 11.5, just as may be seen in the generative contingency-and-consequence of real-time talk in interaction, we see agentive individuals orienting to, acting upon, and entering into the shared public surround of signs for the mutual accomplishment of action – and in so doing, symbiotically creating, out of the patterns emerging out of such interaction, the very structures upon which even more such communally life-sustaining organization and interaction may be realized, modified and maintained. In human conversational interaction, no less than in the built configuration of snowflakes or proteins whose "open ends" make *available* the realization of some possibilities while effectively eliminating the possibility of some others, the historically shaped product of each actually realized interaction serves as the substrate constraining and making possible (though not mechanistically determining) the next.

Thus the point of analyzing interaction this way is to detail the micro-precise ways in which the participants *themselves* are experiencing and creating interaction *as it comes to them* piece by piece, in real-time – and here it remains semiotically incomplete at every point until some such action is made by those immediately situated

[13] The term "stigmergy" first appears in the works of biologist Pierre-Paul Grassé (1959). "Formed from the Greek words stigma, "sign", and ergon, "action" [it] captures the notion that an agent's actions leave signs in the environment – signs that it and other agents sense and that determine their subsequent actions" (Therauluz et al. 1998:3) – a concept central to the heart of both Interaction Analysis and Biosemiotics.

participants that changes the ever-developing growth of its trajectory. For talk-and-interaction, like all of biosemiotics, is grounded in the ever-present moment of "what to do right now, given this?" – a fundamentally *experiential* "question" that whose "answer" likewise is the immediate next *action* that is responsible for the subsequent unfolding of events that is the "history" of life on earth.

Understood as such, we see that the forward movement of conversational interaction is enabled not by the encoding and decoding of unambiguous "signal information" but by the active negotiation of co-acting participants *making* both meaning *and* structure out of the plenum of next action possibilities. Emergent and downwardly causal *order* is coming into existence here and is being defined for *use* by the actions of the participants at every bifurcation point – with such structure becoming itself the substrate for even more complex and recursive meaning *and* order.

The interaction depicted in Figure 11.6, for example, might seem to us extraordinarily pedestrian until we begin to "chart out" the kind of moment-to-moment meaning-making and order-making that the participants themselves are bringing into existence solely by their real-time exchange of semiotically constructivist acts::

Mutually recognizable and collaboratively co-constructed sequences are being built within sequences here, with the superordinate sequences themselves the

R: Why don't we all have lunch? (A)

C: Okay(B), so, that would be in St. Jude's would it? (C)

R: Yes. (D)

(0.7)

C: Okay so::: (D)

R: One o'clock in the bar. (D)

C: Okay(D)

R: Okay? (E)

C: Okay(E)then thanks very much George= (F)

R: =All right. (G)

C: [See you there. (H)

R: [See you there. (H)

C: Okay (H)

R: Okay(H) [bye (I)

C: [Bye. (I)

**Fig. 11.6** *Schematic diagram of a typical "closing" sequence* (data from Levinson 1983: 316–317)

**KEY** (A) Closing Implicative Topic Offered (B) Closing Implicative Topic Accepted, (C) Closing Implicative Topic Initiated, (D) Closing Implicative Topic Negotiated, (E) Closing Implicative Topic Closed, (F) Pre-Close Offered, (G) Pre-Close Accepted, (H) Closing Passing Turns, (I) Close.

relatafor yet higher-order sequences of actions getting done and communication taking place in the world. And while space considerations prevent us from examining the construction of such sequences in depth, suffice it to say that the empirical data of Interaction Analysis reveals participants rigorously creating and attending to fine-grained and mutually coordinated sequences for opening and closing conversations, for securing enough multi-unit turn space in advance in order to launch a storytelling sequence, for following such a storytelling sequence with a "second story" sequence of one's own, for exiting story-telling cycles entirely so as to move on to something else, for negotiating assessments, for giving and for receiving various kinds of information, news and announcements, and for negotiating literally as many different contingencies as arise in communicative interaction itself.[14]

Because such practices have become ubiquitous to the point of invisibility, however, the major point that we want to emphasize here is that *all* of these everyday, seemingly effortless and transparent acts have to be *individually enacted* and *mutually accomplished* between agents. The everyday closing down of a telephone conversation, for instance, is not something that naturally "just happens" by itself, but is *each time* an individually negotiated agreement that requires a good deal of fine-grained, semiotically constructivist *work*. The diagram above sketches out just *some* of the online organization being created and attended to in "ending" or "closing down" an altogether unexceptional conversation. And while all this: "OK?" "OK." "OK." "See you." "See you." "OK." … might seem unnecessarily redundant and peculiar to just this particular example, tape-recorded empirical evidence of your next experience in just this precise situation will prove to be remarkably the same.[15]

Such "redundancy" – like so much of everything else we find when we look at "language" in its natural habitat – is doing not so much "propositional" work as it is doing *semiotic* and *interactional* work. Thus, if "propositions" (and the ability to create and to understand them) are the evolutionary product of semiosis and interaction – as maintained by Bateson (1966/2000:367) and by biosemiotics (Hoffmeyer 1996:112) – then the research findings of IA can tell us much about how these more fundamental relations still literally shape our cognition today.

## "Repair" and the Participatory Maintenance of System Order

That the participants are orienting to the developing structure of their conversation as we have been noting is made evident by their behavior (indeed, such actual response behavior is the only acceptable analytic warrant in IA). However, it is

[14] Reviewing even a significant portion of such literature is impossible here, and readers are directed, as always, to the sources referred to in the in-text citations for satisfactorily full accounts.

[15] Schegloff (1986), for example, examined a corpus of over 450 telephone call "openings" finding remarkable adherence to a conventional eight-turn opening sequence that proves robust across the Dutch, Egyptian and American instances of telephone conversations studied.

obvious that no such "labels" as the kind that we have glossed the talk with above are available to participants to real-time, spontaneously self-organizing talk-and-interaction. Thus, the accomplishment of displaying to each other what the currently ongoing moves themselves "count as" instances of is also one that has to be interactionally negotiated, as we see in the data below:

(1) Mom: Do you know who's going to that meeting?
(2) Kid : Who?
(3) Mom: I don't know!
(4) Kid : Ou::h probably Mr. Murphy and Dad said probably Mrs. Timpte …

*(Teraski 1976:45)*

Here, at least two potential "breakdowns" in the meaning-bearing system order take place, are noticed, and corrected by the participants in this less than 4 second interval of interaction. In the first, K takes M's "question" in Line 1 as a "pre-announcement" and therefore supplies the preferred relevant next, a "go-ahead" in Line 2. In the second, M, in turn, takes K's "go-ahead" in Line 2 as a "question" and provides the preferred relevant next of an "answer" – as opposed to continuing on with her "announcement" as would have been relevant next if, indeed, Line 1 was intended as a "pre-announcement" and not as a straightforward "question."

This very misalignment (or technically: the conflict between two equally reasonable but mutually exclusive alignments) in the system order has the effect of: (1) localizing the "trouble" that has arisen in the last few second's talk, (2) providing resources for the defining the nature of that trouble, and (3) providing K the resources to re-frame the proceeding talk and thus "repair" the trouble by (4) "re-setting" the interactional framework to a straightforward "question/answer" sequence, accomplished mutually by the participants in Line 4.

By examining this altogether ordinary episode of interaction, we can begin to appreciate how the naturally emergent system of talk-and-interaction makes publicly available the means by which its participants can and do validate and invalidate each other's "understandings" of what is happening at the current moment – without the matters of "who meant what and who misunderstood what when and who now re-understands what and why" being explicitly spoken of by the participants.[16]

Rather, because "the action template aspect of adjacency pair organization has a vitally significant *interpretative* corollary … [in that] however the recipient analyses the first speaker's utterance and whatever the conclusion of such an analysis,

[16] The accomplishment of such "transparency" is, of course, a design feature of repair itself. "In conversational order," wrote Goffman (1963:34), "the problem is to employ a sanction which will not destroy by its mere enactment the order which it is designed to maintain." Overt negotiation specifying each element of conversational trouble explicitly would similarly serve to derail episodes of current talk-and-interaction into nothing but talk about the current episode of talk-and-interaction itself. Thus we never hear the phrases "You owe me the second half of my adjacency pair" or "Please return to me your eye-gaze" though we see, continually, plenty of such interactive work done on the part of the participants to accomplish just these specific goals.

*some analysis, understanding or appreciation of the prior turn will be displayed in the recipient's next turn* at talk … the interpretations embedded in these treatments of the prior turn are publicly available as the means by which previous speakers can determine how they were understood" (Heritage 1984:254–255).

Thus, instead of merely being a *propositional* "error-correcting" mechanism, interactional "repair" is used by participants to meaning-making interaction as a resource whereby the question of "what constitutes the semiotic order *per se*" at any given moment is abducted, accessed, and creatively engaged with by each individual agent. As such, it is the inescapably available "reality check" against which both public and private understandings must live or die, succeed or fail in a network of relations that includes, but far exceeds the individual system-using agent, i.e., in the public domain of interactively constituted sign-exchange whereby meanings are created, negotiated and, most importantly for human beings, co-operatively sustained.

## Intersubjectivity and the Co-Creation of a "Known in Common" World

The "problem of intersubjectivity" has a long history in the literatures of philosophy and psychology, where it is usually posited as a cognitive "ability" inside of an agent that allows the agent to empathize with, and to imaginatively "stand in the place of" another individual (cf. Wisdom 1952, Baron-Cohen 1993, Gallese and Goldman 1996). An understanding of human beings' communal reliance on publicly available, knowledge-bearing sign system of their own creation, however, offers a less mysterious explanation of how it is that reality may be experienced "inter-subject-ively" (literally: "between experiencers" – or here, between individual users of the one same mutually created semiotic system).

Following the example of proto-ethnomethodologist Alfred Schutz (1899–1959), however, Interaction Analysts likewise eschew the attempt to reify "intersubjectivity" as an "autonomous mental capacity" emerging from and residing *within* a Cartesian mind, seeking instead to – like the everyday world of subjects they are studying – treat its situated and real-time "*achievement* and *maintenance* as a practical 'problem' which is routinely 'solved' by social actors in the course of their dealings with one another" (Heritage 1984:54).

Certainly, innocuous exchanges like the following:

A: Why did I turn out this way?
B: You mean homosexual?
A: Yeah.

*(Schegloff, Jefferson and Sacks 1977:373)*

C: But was I actin stupid w[ith them?
D: [Nope, no, =And

*(M.H. Goodwin 1990:289; Goodwin and Goodwin 1992:175)*

E: Ohh man, that was bitchin.
F: That was.

*(Pomerantz 1984:67)*

G: Where do you want me to leave it?
H: Right over there.

*(author data, KH)*

function in the world to "resolve more informational uncertainty" (to use the Shannonian terminology) faster and more decisively than could recourse to "private intentional" system wherein:

"To *mean* something by *x, S* must intend:

(a) *S's* utterance of *x* to produce a certain response *r* in a certain audience *A;*
(b) *A* to recognize *S's* intention (a);
(c) *A's* recognition of *S's* intention (a) to function as at least part of *A's* reason for *A's* response *r*."

(Strawson's formulation of Grice 1971:155)

Thus, rather than having to discern all of the invisibilities of each other's intentions so as to reach rational certainty about what another "means" (and despite the fact that it has never been made clear how such a thing could, even in principle, be reliably done), participants to interaction here, as in the entire biosemiotic world, need only learn how to successfully manipulate a publicly available system of signs.

The accomplishment of such "shared knowledge" is less straightforward and effortless than it might first appear however, in that all four of the above examples "point outward" from the talk itself to a larger world of agent–object–action interpretations that, too, have to be negotiated *prior* to the exchanges above if those exchanges are to make any sense. Such prior orientation to a mutual understanding "makes sensible" (not just for we as analysts, but for the actual participants) the at first glance odd-sounding sign exchange below:

A: I have a fourteen year old son.
B: Well that's alright.
A: I also have a dog.
B: Oh I'm sorry.

*(Sacks 1968 April 17/1995:LC1)*

The setting of the above exchange is a motel desk upon attempted registration. Here, as everywhere in semiotic interaction (human, verbal or otherwise) what is unsaid and implicit and what needs to be "negotiated" are not in the first instance "the private thoughts" inside the heads of individuals, but the public situation in which and through which agents' co-actions emerge and are embedded.[17]

[17] That such actions and their relations can, in human beings, become recursively embedded so as to result in the subjective experience of "languaged thought" is entailed by this observation, though cannot be justly discussed here. Suffice it to say by way of a review here that such thought derives from the symbolic reference of public activity both phylogenetically and ontogenetically, and not vice versa.

The cultural aspect of this situation we have defined as the participant-accomplished matrix of symbolic reference (i.e., Deacon's diagram in Figure 11.4). And by attending carefully to the locally administered co-construction of talk, we can catch empirical glimpses into the ways in which the "arrows" of that diagram work together to hold such reference stable.

Indeed, as we saw in the examples of "repair" and of "enregistered silences" examined in this article earlier: "through [such] procedures, the participants are thus released from the task of explicitly confirming and reconfirming their understandings of one another's actions. Mutual understanding is thus displayed … 'incarnately' in the sequentially organized details of interaction." (Heritage: 1984:308, 258)[18]

For in the moment-by-moment updating of each other's understandings (and misunderstandings) that is continuously *created* in the back-and-forth of naturally occurring interaction, agents solve "the problem of other minds" not by seeking Cartesian "absolute proof" regarding the essential nature of each other's interior mental experience, but in accepting as entirely sufficient the situated "pragmatic proof" whereby actions and understandings are publicly accepted, rejected, negotiated and sustained.

Thus, we can now reformulate the "problem" of intersubjectivity as not an intensely private and insolvable question to be satisfactorily answered, somehow, through the logical operations of an individually isolated mind, but as the real-world situated challenge that is effectively and continuously accommodated by the public engagement with a Deaconian referential matrix system that, at least in humans, enables the very taking of signs itself to be taken as a sign, generating the recursive semiosis from which "ideas" become languaged, and the "thoughts" of oneself and of "others" are made literally available as genuine semiotic objects of experience.

Moreover, because such interaction is not dyadic, but triadic at every point, agents are not locked within a prison of autonomous sign-construction taking place entirely within their brains, but can literally participate in the construction of an inter-subjective semiotic world. In biosemiotic terms, such meaning-assigning interaction is not a privately held "theory of mind" so much as it is a communal "practice of mind" – the triadic semiotic locus wherein the unlabeled things of the world are carved into useable entities (icons), those entities are joined into relations (indexes), and both those entities and their relations are named (sign-ified) to be used not as entities or relations in themselves, but as self-acknowledged signs (symbols).

"Most simply put," writes Schegloff, "without systematic provision for a world known and held in common by some collectivity of persons, one has not a

[18] For example,: "A: God isn't it dreary! B: (silence)" where such silence is heard as indicating disagreement by the refusal to supply an interactionally sanctioned "agreement token" within the appropriate <.10/sec SPP window. While: "A: I'm getting fat hh?" B: (silence)" where the exact same such silence is now understood to indicate agreement by the refusal to supply an interactionally sanctioned "disagreement token" within the exact same <.10/sec SPP window (data from Levinson 1983:338).

misunderstood world, but no conjoint reality at all" (1992:1296). Interaction Analysis is thus the empirical investigation into the "systematic provision" of such a conjoint reality that arises as the emergent product of interacting, sign-exchanging agents.

## Building the Ecology of Signs

> Mundane actors operate on the assumption that others will perceive and recognize the same world as they do. This assumption is overwhelmingly confirmed in routine procedures of "looking" and "telling" which routinely interlock with other's "looking" and "confirming" … [by such socially canalized practices] a 'known in common' world is incorrigibly assured as, simultaneously, the process, presupposition and product of the reasoning practices involved. … It is, moreover, produced as an incorrigible product, as an objective world which could not have been otherwise. By these means, the transcendent objectivity of the world is produced in such a way as to be invariant to all exigencies. Through these means, the intersubjective availability of real world events is produced and reproduced as the indubitably given, stable features of real world events which, for producers, it has always been. (Heritage 1984:216).

It has been argued through this article that such work as Interaction Analyst John Heritage describes above is the project not of individuals in the first instance, but of a society of agents held together through their use of signs for the accomplishment of action in the world (such accomplishment including, in the human case, the collaborative use of ever-more semiotically embedded signs, such as language, that are themselves readily acknowledged *as* signs).

Born into such a society, the practices and methods of such real-time semiotic constructivism are available to the future system participants virtually from birth, where the earliest of sign-object-interpretant relations are embedded in the relations between accomplishment of successful action in the world and the collaborative motoric bodily rhythms and micro-coordinated alignments of back-and-forth biological interaction.

Indeed, studies of infant–parent affect synchrony, co-ordination of breathing rhythms, and "mutually attuned selective cueing" based on eye-gaze (Feldman et al. 1999, Fogel and Branco 1997, Trevarthen 1987, 1993, Schore 2001) reveal the development of a suite of critically important auto- and inter- regulatory skills of that may form the substrate upon which the later fine tuned and microtemporally choreographed "give-and-take" of moment-to-moment linguistic (and non-linguistic) communicative interaction can occur.[19]

Proceeding from such a system of previously established intersubjective normativity even prior to the beginning of "worded" language use, Interaction Analyst Charles Goodwin (1981) finds that in analyzing such empirical data as:

> "Somebody said looking at my --- son, my oldest son …"

[19] See Endnote to this paper.

in its natural role as part of the experiential data of a child being exposed to naturally occurring adult talk, the fine-grained semiotic repair work made visible thereby provides a range of information, for the child being exposed to it, about how linguistic structures may be utilized in the language. For the child learning how to "put together" his of her native language, this everyday instance of self-repair:

> First, separates out a relevant unit, a noun phrase, from the stream of speech. Second, it shows where that unit can itself be subdivided. Third, it provides an example of the type of unit, an adjective, that can be added to the noun phrase. Fourth, it locates at least one place in the noun phrase where such an addition is permitted. Finally, in the contrast between the first and second version of the noun phrase, the repair shows that such an addition is optional. (Goodwin 1981:171)

Thus, the naturally occurring "stimulus" of semiotic interaction for child language learners – far from being that degenerate and impoverished "poverty of stimulus" that Chomsky claims supports his argument for the existence of an innate grammar – is instead, extremely fine-grained and semiotically rich. Moreover, given the data that we have been examining here, the "grammatically formed sentences" of traditional linguistic analyses may themselves prove insufficient for gaining competence in *and* in understanding language use – were such invariably grammatically formed sentences the exclusive "input data" for native language users in the first place, which, as obvious, turns out not to be the case.[20]

Moreover, now we find that, having come to recognize that the hitches, perturbations, re-speaks and even such traditionally disregarded alexicalisms as "uh" and "huh" are all carrying extraordinary semiotic meaning and performing causally efficacious interactional work, we *still* have not sufficiently examined how fine-grained the semiosis of conversational interaction really is.

For when Goodwin inquired as to *why* the utterance:

> "Somebody said looking at my — son, my oldest son …"

"needed repairing" in the first place, he discovered that what was happening in that micro-second of interaction, was that Speaker A had lost the eye gaze of his recipient, B, precisely at this point in the utterance:

A: Somebody said looking at m[*:y
B: ((_____gaze_____)[*gaze breaks

Accordingly, at precisely the point that his recipient's gaze is lost (marked here as *), A elongates the word that had already been under construction in that micro-second ("m **y:**"), pausing audibly and by so doing "breaking the symmetry" of his prior talk with a marked change in rhythm. And just as "symmetry breaking" almost always leads to immediate-next consequence in complex systems, so too, does it constitute a

[20] Cf. Schegloff: "The notion of an utterance as the sole product of a speaker, or of a mind, could hardly have been entertained had real[-time] talk-in-interaction been what investigators [had set out] to come to terms with' (1995a:20).

Batesonian "difference that makes difference" in the emerging structure of ongoing talk-and-interaction.

In particular, writes Goodwin, "such actions may be heard as displaying that the speaker is having difficulty in producing the next item in his utterance. [One result of this is that] because of the display of trouble they provide, such repair initiators function to request the gaze of a hearer" (1981:143).

And indeed, A's split-second introduction of a trouble-indicating repair initiator into the stream of talk in response to B's unanticipated gaze withdrawal accomplishes exactly this purpose of re-securing B's gaze, as illustrated below:

A: Somebody said looking at m[*:y son ---, my oldest son
B: ((_____gaze_____)[*gaze breaks]((___gaze__))

Thus, by repeating the part of the utterance spoken as his recipient was turning away from him, the speaker succeeds in producing the entire utterance constructed in his turn while his recipient *is* gazing at him (1981:130).

A discussion of the normative orientations that make it relevant for a speaker to have a hearer's gaze (or vice versa) across a variety of what Goodwin calls "engagement frameworks" exceeds the space constraints of the current paper. Suffice it to say, however, that in spite of all the elements of talk-and-interaction we have discussed in this overview so far, it is yet analytically insufficient to speak of meaning-making and semiotic intersubjectivity as if it were the only words, turns, sequences and propositional understandings that were being co-constructed and co-assigned relevance, value and reference collaboratively by participants.

Rather, Goodwin's work both on aphasia and in workplace environments (in particular: Goodwin 1979, 1981, 1995a, 2000a, 2002), reveal how even more micro-temporally attuned is the collaborative interactive work being done *simultaneously* with all of the above semiotic activity by eye gaze, gesture, bodily posture, and the co-presence of a manipulable surround of material artifacts to be used as online structure-making and meaning-making resources.

Thus, in addition to displaying a micro-attunement to iconic and indexical signs (signs of breathing, silence, speaking rhythm, eye-gaze, etc. taken as signs of transition relevance spaces, first and second pair parts, insertion sequences, etc.), we find talk-in-interaction so semiotically laminated as to allow for participant's micro-attunement for signs whose referents are signs about the unfolding architecture of the current act of semiosis itself.

## Conclusion: IA's Contribution to Bateson's Remedial Metaphysics of "Mind"

> "Both grammar and biological structure are products of communicational and organizational process" (Gregory Bateson 1971/2000:154)
> What is a person? What do I mean when I say 'I'"? Perhaps what each of us means by the "self" is in fact an aggregate of habits of perception and adaptive actions plus, from moment to moment, our "*immanent states of action* (Gregory Bateson 1960/2000:242)

Even with all that has been said here, we have but yet scratched the surface of the many provocative findings that Interaction Analysis has discovered about the participant-driven, micro-co-creation of talk. Hopefully, a cursory enough overview has been presented, however, such that researchers working with a cybernetic and biosemiotic perspective will be inspired to examine the primary IA research materials for the purposes of informing their own work.

In summation, there are four main points that I hope have become particularly salient to the reader from even the brief foregoing discussion. These four points are as follows:

(1) That in every actualized instance of talk-in-interaction, it is the participants themselves that are collaboratively self-organizing and maintaining a generative system order based on contingent responsivity and the opening up and closing down of action opportunity spaces. "Structure-for-use" in the world is built upon the microtemporal back and forth of situated interaction. This is as true for the interactions holding living entities together as it is for systems such as economies and cultures and ecosystems. Such a "metaphysics of the present moment" is the bedrock foundation of *reality*, the record of those statistically rare possibilities that have been actualized.

(2) That such structure as these participants are "secreting into the publicly shared environment" (to use interactional analyst Charles Goodwin's terminology) provides not only a "substrate" for message exchange, but is *itself* the primary semiotic resource behind the crafting of "mere words" (or "difference transforms") into cognition-enabling *information* (or "meaning"). For even in the symbolic matrix of virtual reality depicted in Deacon's diagram, the agents, whose actions constitute that system order, are still making meaning using *real-time cause and effect* as their fundament, as their scaffolding structure, and their proof-procedure. Their immaterial relations of semiosis yet have material consequences for the perpetual reshaping of the physical world. And, like every other living organism, by perpetually "collapsing the wave function of meaning," each moment's real-time actuality alone brings to these creatures into the next moment of irreversibly consequential possibility – and of situated, inescapable choice.

(3) In Wittgensteinian terms, individuals learn to play the language game by learning its moves, as those moves and their consequences are made publicly visible and available. Interaction Analysis thus lets us see the technology of language-use "carved at its natural bones and joints" in much the way the child learning to use language does – as holistic and irreducibly triadic practices of *sign, use and meaning* corresponding to the fundamental sign-object-interpretant relation of Peircean biosemiotics. Moreover, it has been suggested in this article that the existential situation of always having to collapse the wave function of possibility based on one's best possible "understanding" of such signs is ubiquitous throughout not just human language, but throughout the entire natural world. Indeed, the existential condition of "what action must I take now?" that nature forces upon all organisms at every moment of their existence is the ever-present cause and ground of *semiosis* itself.

(4) An in-depth look at the characteristics of this multi-party, self-organizing and self-maintaining system is instructive, I believe, in that it reveals to us once again how ubiquitous Batesonian principles of sytematicity and biosemiotic principles of sign-use are in organizing the worlds of living agents. For just as the investigations into chaos and complexity theory, into fractals and into insect sociality, into biosemiosis and emergent order, have all profitably extended Bateson's notions of cybernetics and system order – so, too, I hope I have shown here, does this examination into the micro-positioning and re-positioning of bodies, possibilities and signs reveals that this system does not just "express" – but *is itself an integral part of* – the very "thing" that we are looking for when seek to locate the source of human cognitive ability, or "mind."

Consider, then, the following "mentation-enabling" characteristics of this system:

***"Mental" Characteristics of the System of Talk-In-Interaction***
*Turn-Taking Organization*
Recursively self-maintenant structuring of understanding and action
*Contingent Responsivity*
Intrinsic motivation for interaction; relevance at all points
*Transition Relevance Monitoring*
Embodied, real-time motoric apperception and tracking of action possibilities
*Adjacency Pairing*
Context dependent and context creating anticipatory resource; future-determining and present-manipulating
*Repair*
System-detectable error; participant maintenance of normative calibration and system function
*Intersubjectivity*: Publicly created joint definitions, subject to confirmation and falsification within the success and failure parameters of the encompassing system (cybernetic feedback; functional circle)
*Functional Heterarchy*: The emergence of a genuinely adaptive Epistemological Web that is publicly available, stably held, internally navigable, individually accessible, information receiving and information bearing.

My claim is that such a system qualifies as an "ecology of mind" in the following Batesonian sense: "The total self-corrective unit which processes information, or, as I say, "thinks" and "acts" and "decides," writes Bateson, "is a *system* whose boundaries do not at all coincide with the boundaries either of the body or what is popularly called the "self" or "consciousness – and it is important to note that there are multiple differences between the *thinking system* and the "self" as popularly conceived:

> (1) The system is *not a transcendent entity* as the "self" is commonly supposed to be. (2) The ideas are *immanent in a network of causal pathways* along which transforms of difference are conducted. … (3) The network is *not bounded by the skin* but includes all external pathways along which information can travel …It includes the pathways of sound and light along which travel transforms of differences originally immanent in things and *other people* – and especially in *our own actions*. (1971/2000:319). (4) Many events within the system shall be *energized by the respondent part* rather than by impact from the triggering

> part. (5) The system shall show *self-correctiveness* in the direction of homeostasis and/or in the direction of runaway. Self-correctiveness implies *trial-and-error*. Now these minimal characteristics of *mind* are generated whenever and wherever the appropriate circuit structure of *causal loops* exists. (1969/2000:490). [Because, again:] the *elementary cybernetic system* with its *messages in circuit* is, in fact, the simplest unit of *mind* and the transform of a difference *traveling in a circuit* is the elementary *idea*" (1970/2000:465).

Taken all together, I think that picture of real-time semiotic structure building and communication cybernetics offered by the findings of Interaction Analysis can help us think more fruitfully – which is to say, in more richly informed cybernetic and biosemiotic terms – not just about words and language – but also about cognition, and about agency, and, above all, about consequential efficacy of "meaning" and the implications that a *natural constructivism* offers as a framework for giving us a more accurate understanding about ourselves – and about how all systemic organization in our world of ever-possibility collapsing, interdependent irreversibility, unfolds.

## Endnote

### *A Biological Readiness for Intersubjective Accomplishment?*

The idea that human beings are biologically adapted to the synchrony of turn-taking is one which has never before been examined formally, but a cursory study into the biosemiosis of the human embryo during ontogenesis may at least allow us to suggest a profitable area of future study here.

Embryonic parcellation, heartbeat, digestion, metabolism, and development are all critically dependent upon the back-and-forth activity taking place between embryo and mother, and development at all stages of ontogenesis has shown to be delicately sensitive to those body rhythms whose activity help determine the embryo's environmental surround (Greenough, Black and Wallace 1987, Moore 2001, Lewontin 1983, 2000). Rhythm and responsivity to it, in this sense, form a crucial part of every human's subjective experience long before birth – while prenatal auditory enregisterment of experimenter's speech has been detected as early as seven months prior to birth (Turkewitz and Devenny 1993, De Casper and Fifer 1980).

Thus, it is not surprising that recent research into the biological co-ordination of body rhythms between newborn infants and their caretakers (Lester, Hoffman and Brazelton 1985, Bergman and Fahey 1999, Fogel and Branco 1997, Feldman, Greenbaum and Yirmira 1999) reveals that within weeks after birth (and thus many years prior to the adoption of any system of grammar, syntax or even meaning-bearing "content" lexemes) infants master the critically important auto- and inter- regulatory skill of coordinating their own breathing and other biological rhythms to the rhythms of the other people around them – and these people, in turn, regulate their own physiological rhythm patterns to those of the infant (Feldman 1996, Fogel and Branco 1997, Trevarthen 2001).

Such mutually achieved synchrony and co-regulated interpersonal coordination of body rhythms, wherein "both partners simultaneously adjust their attention and stimulation in response to their partner's signals" (Feldman, Greenbaum and Yirmira 1999), may itself serve as the necessary substrate for participation in the fine tuned choreography of moment-to-moment linguistic (and non-linguistic) communicative interaction to occur.

In this way, the orientation to subtle action patterns arising transiently between agents – *and* to the consequences of one's *own* actions within the patterns (what Schore 2001 refers to as the ability for *contingent responsivity*) – can itself become an emergent *structure* for *interpreting* experience, long before the capacity for "understanding or producing a single word, and before conceiving of the fact that objects and events in the world are named" (Schore 2001:166).

Earlier research of W.S. Condon and associates (Condon and Ogston 1967, 1971, Condon and Sander 1974) found that the onset of changes in body movements in 1-day-old infants was precisely synchronized with the onset of changes in syllabic output and other auditory boundaries in the stream of speech, but not with isolated vowel sounds or other non-linguistic input such as tapping.

The production of an interactively coordinated stream of speech, as we have seen throughout this article, itself provides a kind of carrier wave or "reference signal" capable of allowing separate participants to mutually synchronize their linguistic behavior. Thus the development of the foundationally interactive skill that allows one to rhythmically and motorically micro-attune one's attentions and actions to the oscillations of another participant's rhythmic behavior (and to, in so doing, initiate a reciprocal alignment) may play a critical role in enabling the kind of recursively contingent back-and-forth of communicative interaction of the type that we have been examining here.

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# Chapter 12
# Re-Enchanting Evolution

## Transcending Fundamentalisms through a Mythopoeic Epistemology

**Gregory Mengel**

**Abstract** The opposing ideologies that constitute the cultural conflict over evolutionary theory in the United States share the idea that reality can be encompassed within a single literal interpretation. That fundamentalist Christians claim their literal interpretation of the Bible to represent the one correct meaning of human history is well known. That many spokespersons for evolutionary theory make a similar claim regarding natural history is less often recognized. Both groups fail to appreciate the degree to which all human knowledge is shaped by myth and metaphor. The continued resistance to biological evolution by large numbers of Americans, therefore, may not be an irrational rejection of science, grounded in religious fundamentalism, as much it is as a rational response to the scientific fundamentalism implicit in many popular accounts of evolution. Indeed, to many people, the unqualified reductionism of these accounts is a threat to the very meaningfulness of human life. I argue in this paper that to understand the mythopoeic character of human thought is to see beyond religious and scientific fundamentalisms and to begin to glimpse the ways in which the human mind is inextricably intertwined with the evolutionary creativity of which it is a magnificent expression. Perhaps, based on this insight, we might begin to imagine poetic and spiritually nourishing stories of human origins, which are inspired by, rather than opposed to, the findings of natural science.

**Keywords** Fundamentalism, foundationalism, reductionism, metaphysics, evolution, darwinism, Bateson, epistemology, mind, metaphor, myth, dualism

## Introduction

Some of the most important questions and problems facing the world today concern biology. Among these are genetic engineering of both the food supply and of humans, as well as stem cell research, human cloning, new disease epidemics, and,

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last but not least, the mass extinction of species, resulting from the radical transformation of the biosphere by human activity. It surely ought to be cause for alarm, therefore, that so many people in the United States lack the conceptual tools required even to contemplate these problems. For the last 15 years, polls have consistently shown that nearly half of the American public believes that humans were created by God in their present form a few thousand years ago (Brooks 2001). This portion of the U.S. population is unable to grasp the significance of evolutionary theory as the basic theoretical framework of biology. This ignorance makes them vulnerable to the skepticism and pseudoscience of groups that attempt to distort and undermine science for religious, political and economic reasons. Unfortunately, rather than trying to discover the real reasons that this resistance to evolution continues to strike a chord, the scientific community and the secular media typically circle the wagons and insist that evolution is simply beyond doubt. The Earth is round, the moon is not made of cheese, and Darwin was right. Period.

What these cultural elites are missing, however, is that this is not primarily a disagreement about facts; it is at heart a disagreement about *meaning*. As evolutionists insist on the truth of their *facts*, many ordinary people continue to reject what Darwinism seems to *mean* about who and what we are. Moreover, even many nontheists avoid what Darwinism seems to mean by taking refuge in the myth of the human as a uniquely moral being, ennobled by our capacity to rise above "nature, red in tooth and claw." The apparent meaning of Darwinism, however, is not determined by scientific facts, but arises with the particular framing of those facts. Metaphors originally meant to expunge teleology from scientific explanation have been reified into a metaphysic of mindlessness and brutality.

A fresh look at the Scopes Trial underscores the fact that, when it began, the anti-evolution movement in the United States was not simply an effort to protect a literal reading of Genesis, but a reaction against particularly objectionable interpretations of Darwinism. This is partially a consequence of the metaphors chosen by Darwin and his successors and the historical circumstances that motivated those choices. In what follows, I argue that misplaced concreteness has hardened these metaphors into a largely unexamined philosophical stance that I call *metaphysical* Darwinism. Finally, I suggest that evolutionary theory ought to be reframed based on a post-foundationalist, mythopoeic epistemology, which emphasizes the immanent creativity of the human and the natural world.

## Origins of Conflict

In the public imagination, the American conflict over evolution originated in the summer of 1925 with the so-called Scopes Monkey Trial. In March of 1925, the Tennessee legislature passed the Butler Act making it unlawful to "teach any theory that denies the story of the Divine Creation of man as taught in the Bible" (Kogan 1960, 149). The American Civil Liberties Union decided to challenge the law and recruited 24-year-old Dayton school teacher John Scopes to be the defendant in a test case. After the story was picked up by major newspapers, national politician and long time champion of progressive causes William Jennings Bryan volunteered to help with the prosecution, and noted defense attorney Clarence Darrow volunteered to defend Scopes. The trial is perhaps most remembered for Darrow's cross-examination of Bryan, in which Darrow forced Bryan to defend literal interpretations of various Bible stories. This tactic made Bryan's position seem ridiculous and, by extension, the beliefs of his fundamentalist Christian supporters. Although this event did actually happen, recent scholarship suggests that the significance of the confrontation between Darrow and Bryan has been exaggerated to fit the Scopes Trial into a larger myth in which science and individual freedom fight a noble battle against the forces of religious ignorance (Larson 1997; Wood 2002). This familiar story, first developed in the press, then preserved in the Broadway play and Hollywood film *Inherit the Wind* plays the bombastic piousness of the elder Bryan against the open-minded earnestness of the young Scopes, effectively transforming them into symbols of traditionalism and modernism.

In the rush to portray Bryan as an aging fool, what is usually overlooked is the pivotal role he played in the events leading up to the trial, as well as his actual motivation for championing Biblical creationism in the first place. According to historian Edward Larson, Bryan began to speak out against the dangers of Darwinism in 1921 (Larson 2004). Over the next few years, he launched an all out movement, giving hundreds of speeches and publishing three books as well as many articles on the subject. Bryan was even instrumental in the passage of the Butler Act itself and saw it as the first major victory in his national crusade to "drive Darwinism from our schools" (Larson 2004, 208). Indeed, the contemporary conflict over the teaching of evolution in public schools may owe its very existence to Bryan's efforts.

But what inspired this legendary progressive politician to spend the last few years of his life defending Biblical literalism? The real motivation for Bryan's tireless efforts was not in fact theology; it was his conviction that Darwinism is a dangerous ideology, a conviction that was actually justified given the grotesque misuses of Darwin's ideas in the early 20th century (Gould 1999). Stephen Jay Gould points out that it was after reading *Headquarters Nights* by Vernon Kellogg, in which the author details the use of Darwinian Theory by German generals and intellectuals to justify their militarism and aggression, that Bryan became convinced that Darwinism is destructive to basic human morality. Moreover, it turns out that Bryan's fears were actually justified in the case of Dayton, Tennessee. The very biology textbook that was being used in Dayton High School when John Scopes was arrested contained passages affirming both enforced eugenics and racism (Gould 1999).

Thus, despite the portrayal of the Scopes trial as a triumph of science and reason over ignorance and irrationalism, it was, for William Jennings Bryan, simply a defense of human dignity against the virulent misuse of science (although he may not have recognized it as *mis*use). We must ask ourselves: to what degree is the continuing popularity of the anti-evolution movement motivated by similar fears? Although the most egregious expressions of social Darwinism are behind us, the metaphorical framing of evolutionary theory continues to foster considerable misunderstanding.

## Metaphors of Evolution

Since Darwin, people have objected that evolutionary theory seems designed to thwart their desire to believe that human life has religious or spiritual significance. One need look no further than the popular writings of Richard Dawkins and Daniel Dennett for examples of the way that, ever since T. H. Huxley, authors have used evolutionary biology as a hammer to drive home the "fact" that human existence is nothing more than an accident. However, certain evolutionary theorists (including Darwin) are inclined to accept limits to the relevance of science for moral and spiritual questions. Gould developed a modern formulation of this idea with his principle of NOMA—Non-Overlapping Magisteria. He asserts that, because science and religion are concerned with different realms, roughly fact and value, there is no cause for conflict. Science should explore what *is*, and religion can speculate about morality and meaning. This sounds reasonable enough, but, unfortunately, it is not entirely realistic. Insights gained from the philosophy of science and the sociology of scientific knowledge demonstrate the ways in which these realms necessarily overlap. In addition to the sociological aspects of theory formation, scientific discourse abounds with metaphors that derive from and contribute to the context within which scientific theories are understood. They reflect and reinforce values and assumptions in non-obvious ways, having potentially far-reaching and unforeseeable consequences both for society and for further scientific theorizing. Moreover, since biological facts have a potential bearing on what it means to be human, the metaphors chosen to express ideas in biology are of particular importance. Unfortunately, some of the best known Darwinian metaphors contribute to a framing of evolutionary theory that ends up having significant consequences in the realm of morality and meaning.

A good place to begin is with *natural selection*. While natural selection may well be the most important metaphor in the history of biology, it may also be one of the most misunderstood. It is sometimes suggested that, reduced to its logical essence, the principle of natural selection is a truism—what lasts longer outlasts that which does not last as long (Bateson 1979). This is certainly an oversimplification, but one with which attempts to formalize the logic of selection sometimes seem to flirt. Darwin himself did not arrive at the principle of selection by way of logic. Rather, as a consequence of painstaking observation of the natural world, he recognized that (1) many organisms produce more offspring than have any reasonable chance of survival and (2) individual progeny exhibit variations that may affect their odds of eventually reproducing. Natural selection is simply a way of expressing how this phenomenon of differential reproduction accounts for the *appearance* of design in the fit of contemporary organisms to their environments. This formulation enabled Darwin to communicate with elegant parsimony how favorable variations could accumulate over time, producing adaptation. Natural selection thus solved a major mystery of biology, and, whether or not it is a complete solution, it stands as one of the great scientific achievements.

The formidable capability of natural selection to clarify what, in hindsight, seems obvious, derives directly from its power as a metaphor. Unfortunately, it is precisely this metaphorical power that has produced so much confusion and resistance among non-scientists. According to Lakoff and Johnson, conceptual metaphors enable us to understand and experience something unfamiliar in terms of something familiar (Lakoff and Johnson 2003). In the case of Darwin's natural selection metaphor, *persistence* or *survival* can be understood in terms of *selection*. The concept of selection is familiar from agriculture, where farmers improve varieties of domesticated plants and animals by choosing which individuals will be bred to produce the next generation. A fundamental entailment of this metaphor, therefore, is the notion of an *outside* agent, selecting varieties based on *external* criteria. The metaphor more or less determines that natural selection will be treated as if guided by a selector, as if Nature were *choosing* the fittest varieties for its own predetermined purposes. Darwin was made aware of this potential for misunderstanding, and, in later editions of *Origin*, he admitted that "in the literal sense of the word, no doubt, natural selection is a false term" (Quoted in Barlow 1994, 75). Yet he kept it, insisting that "with a little familiarity such superficial objections will be forgotten" (Quoted in Barlow 1994, 77). He was right of course; these objections were forgotten. Biologists, nowadays, think nothing of referring to particular traits as having been "designed by natural selection." This very forgetfulness, therefore, contributes to the way the metaphor continues to suggest something quite different from what Darwin intended.

In addition to potential confusion stemming from the structure of the natural selection metaphor, the flavor of this and other metaphors, as well as the phrasing chosen by Darwin and his followers, are also a source of difficulty. The way that early Darwinians chose to explain the theory of evolution was apparently intended to counter two specific tendencies in Victorian thought: the tendency to assimilate evolution into a view of history as progressive and the tendency to idealize nature as a realm of "all things bright and beautiful." To many Victorians, human history appeared to be an inexorable advance toward greater cultural complexity and general social improvement. Therefore, if the natural world is supposed to have evolved, biological evolution can be seen as an earlier phase in the same grand process of maturation that produced the British Empire. The Victorian tendency for a naively romantic view of nature is of course consistent with this progressivism. Like the cultural refinement of British society, the natural world was seen to exhibit a perfect harmony resulting from a gradual process of improvement.

These Victorian attitudes were implicit in natural theology and fit well with the argument from design. Most famously developed by William Paley, the argument from design holds that the magnificent complexity and precise adaptedness of natural forms is evidence that they must have been designed by a Creator. Indeed, many scientists in Darwin's time were still convinced by Paley's reasoning, including his famous metaphor of the watchmaker. Natural selection, therefore, should be understood, in part, as an explicit refutation of Paley. There is a logical parallel, in fact, between Paley's designer and Darwin's mindless forces of selection, and this is no coincidence. The emphasis Darwin places on the undirected and haphazard character of evolutionary change was intended to counter both design and progress. As Gregory Bateson points out, this intent required Darwin to use language that carefully denies any role for mind in the processes of evolution (Bateson and Donaldson 1991).

Furthermore, early proponents of Darwinism responded directly to the romantic idealization of nature with what they considered to be a more realistic outlook. They frequently cited examples of nature's pointless brutality and suffering, such as the ichneumon wasp, which lays its eggs inside the body of another insect so that the latter will be slowly eaten alive from the inside by the larvae (Gould 1999; Larson 2004). The emphasis on nature's ruthlessness is evident in the deployment of other Darwinian metaphors, such as "survival of the fittest" and "the struggle for existence." This attitude toward nature became a touchstone, and evolutionary discourse since Darwin is replete with metaphors of war, struggle, competition and selfishness, while metaphors that suggest cooperation and mutual flourishing are often treated with suspicion. In *The Blind Watchmaker*, for instance, Richard Dawkins recommends against what he calls "overenthusiastic analogizing" before presenting his own analogy between international arms races and the coevolution of predators and prey (Dawkins 1996, 195). He does not elaborate on what constitutes excessive enthusiasm, but I would not be surprised if he reserves this appraisal for analogies that cast nature in a more positive light.

The preference many biologists have for a cynical view of nature establishes a context that has direct consequences for the way new scientific ideas are evaluated. This is evident, for example, in the negative reception that first greeted the Gaia hypothesis. Gaia implies a comparatively optimistic view of nature, and this, I believe, has been one of the main impediments to its acceptance. Gaia theory suggests that the conditions for life on Earth are brought about and maintained by the activities of living organisms themselves. Consequently, the organization of the biosphere, as a whole, is regarded as exhibiting a large scale self-regulation, analogous to the homeostasis of an organism. Though significant elements of Gaia theory are now generally accepted, when first proposed, the hypothesis seriously challenged the dominant understanding of how life interacts with the planet. Additionally, Lovelock and Margulis's original formulation included some problematic claims that eventually had to be revised. Of course, Darwin's theory as well was scientifically controversial and incomplete when originally published. The problems with Darwinism were so significant, in fact, that the theory lost much of its influence during Darwin's own lifetime. Yet, while Darwin's ideas were initially embraced, the Gaia hypothesis met with strong resistance even before it was seriously evaluated (Capra 1996).

The most significant problem for Gaia theory, I believe, is that the Gaia metaphor entails purposefulness, mutuality, and, to some, even beneficence. Most of the controversy over Gaia theory arises from confusion over its teleological implications, and this confusion is shared by supporters and detractors alike. For example, proponents of Gaia theory claim that the temperature of the planet is kept within a range suitable for life by negative feedback mechanisms that depend on the activities of various life forms. In other words, the earth and life together form a complex system of which temperature stability is an emergent property. James Kirchner points out, however, that the theory is often framed in a way that implies more than mere cybernetic stability (Kirchner 2002). Indeed, Gaia proponents often explain the phenomenon of temperature stability by comparing the planet to the mammalian body, suggesting that the self-regulation exhibited by the two systems is essentially equivalent. This claim is much stronger than the argument from cybernetics because it suggests that the temperature is not merely stable, but *optimized* for life. This crucial notion of optimization, however, is a covert teleology smuggled in by the physiology metaphor. The claim that the temperature is stable is different from the claim that it is *necessarily* kept within a particular range. The latter claim may not be false, but, as Kirchner suggests, it also may not be falsifiable (Kirchner 2002).

Certain Gaia critics, meanwhile, point out an apparent contradiction between Gaia theory and Darwinian natural selection. Dawkins, for example, doubts that a system like Gaia could result from evolution, insisting that natural selection can only favor traits that enhance the reproductive advantage of individuals. In other words, the Darwinian competition for survival has no mechanism to favor individuals whose activities benefit the biosphere as a whole. This critique, though applicable against strong versions of Gaia theory, relies on a strong version of Darwinism that precludes more nuanced interpretations of Gaia. Because Dawkins's selfish gene metaphor, like certain other Darwinian metaphors, emphasizes competition among individuals in a more or less fixed environment, any behavior or trait that benefits the larger group and not the individual must be explained in terms of how such "altruistic" genes might be propagated. Since all cooperation is deemed altruism by these individualistic Darwinian metaphors, Gaia theory can only be interpreted as teleological, and therefore it appears untenable. Thus, this theoretical contradiction is based primarily on a conflict between the metaphors. As we shall see, conflicts such as this are common because scientific metaphors, just like religious metaphors, are too often taken literally.

## Modernism and Literalism

The apparent preference of many biologists in the Darwinian tradition for metaphors that depict the natural world as a battleground or an accident rather than as a community or an integrated system is exacerbated by the unfortunate tendency many of us have to interpret metaphors literally. This tendency, which Whitehead called the fallacy of misplaced concreteness, and which social scientists refer to as reification, is almost always problematic. While metaphors are invaluable for scientific inquiry and discourse, both of these activities are hampered when metaphors are reified. Disagreements can ensue over the metaphysical implications of a metaphor, which have as much to do with unstated values and assumptions as questions of science. In the case of evolutionary biology, where the metaphors consistently depict the world as brutal and mindless, the consequences can reach far beyond science. Like Biblical literalism, scientific literalism can harden into orthodoxy and make the already precarious terrain separating the discourse of science from the rest of society practically impassible. In this section, after discussing some examples of literalism in evolutionary biology, I suggest why this problematic habit may be an inevitable consequence of modern thought.

Literalism produces confusion both inside and outside of science when scientists treat their heuristic categories as objective features of reality. For example, categories of behavior that have proven useful for modeling complex interactions can too easily be reified into laws of nature, especially when the categories imply values that fit a dominant ideology. This tendency is exemplified by the decades-old debates over whether inter- or intra-species cooperation can be considered a significant factor in evolution without contradicting the theory of natural selection. Peter Corning (Corning 1997) points out that group selection theory (an idea first proposed by Darwin) became part of an “emotionally charged” debate mostly because it implies forms of cooperation that are difficult to reconcile with the competition entailed by natural selection. The basis of this difficulty is exposed when the anthropomorphic values implied by competition and cooperation are made explicit. Dawkins’s insistence on the selfishness of genes and E. O. Wilson’s theoretical concern with the “problem” of altruism reveal the essence of the conflict: if the natural world is essentially competitive, selfishness must be fundamental, and therefore the altruism seemingly required for cooperation could not possibly endure. Consequently, Corning notes, although selfishness and altruism are also useful conceptual tools, treating them as equivalent to the categories of competition and cooperation distorts the discourse. And this problem is only exacerbated by the reification of competitive and cooperative behaviors, which has transformed selfishness and altruism, in the minds of many theorists, from heuristic devices into irreconcilable principles of nature. As Corning’s argument demonstrates, however, if these categories are treated as the working models that they are, it is at least possible to decouple their descriptive and evaluative elements. Models can be applied strategically to highlight aspects of phenomena relevant to particular research questions. Literalism, by precluding such tactics, actually interferes with scientific inquiry in concrete ways. Moreover, when scientific categories are understood as tools, rather than as reflections of objective nature (even provisional ones), more fruitful dialogue becomes possible, not only among scientists, but between scientists and the larger society.

The fallacy of literalism is also committed when a particular level of biological reality is treated as metaphysically fundamental. The gene is of course the favorite level for most modern biologists, and its appeal is understandable. It is basic enough for reductionists to conceive in terms of chemistry, yet it is supposed to be the locus of all the information required to build a new organism. Indeed, the theoretical significance of the gene is ultimately derived from the reification of genetic information. As Jesper Hoffmeyer and Claus Emmeche point out, however, the concept of information typically invoked by biologists conflates our everyday understanding of information with the technical definition of information established by information theory (Hoffmeyer and Emmeche 1991). The latter concerns the amount of redundancy in a message, which, as a measure of improbability, indicates the *quantity* of information potentially present. For there to be a relationship between genes and the traits for which they supposedly code, however, genetic information must have *meaning*; it must be about something. Therefore, to address the meaning of genetic information, biologists must appeal to the non-technical usage of the information concept. For developmental systems theorists, such as Susan Oyama, this latter move is not only an unjustified leap; it relies on a misunderstanding of how information functions in development. Oyama, in fact, rejects the orthodox understanding of genetic information as a DNA encoded representation of the phenotype (Oyama 1985). She insists that the traditional concept of inherited information, independent of environmental and developmental contexts, falsifies the dynamic, interactive character of ontogeny. According to Oyama, developmental information must be understood as a *product* of ontogenesis, brought into being through the interaction of developmental processes as they unfold in time. Genes acquire specific meanings, moment by moment, from their participation in cellular processes called forth by the constantly shifting circumstances of development. Conceptually complex as this issue is, it is more than an arcane philosophical squabble. As Lewontin (1992) and others have pointed out, exaggerated claims about the significance of genetic information are part of a long tradition of biological determinism that has been used to legitimate a wide variety of injustices based on differences between people.

Finally, the problematic consequences of scientific literalism are particularly apparent in E. O. Wilson's 1998 book *Consilience: The Unity of Knowledge*. As is evident from the title, Wilson is heralding the eventual unification of all realms of human knowledge. It is a lofty goal, which has been a dream of Western civilization since the ancient Greeks. As he quickly reveals, however, what he means by consilience is little more than the subsumption of religion, philosophy, and all of the humanities under the natural sciences (Wilson 1998). In addition, Wilson's conception of natural science perfectly exemplifies the sort of literalism I am discussing. In the concluding chapter he writes, "the central idea of the consilience world view is that all tangible phenomena, from the birth of stars to the workings of social systems, are based on material processes that are ultimately reducible, however long and tortuous the sequences, to the laws of physics" (Wilson 1998). Because the Cartesian–Newtonian conception of nature as a realm of inert matter obeying fixed laws has played such an important role in the advance of scientific knowledge, Wilson concludes that mechanistic materialism constitutes an exhaustive cosmology. As Robert Ulanowicz argues, however, every one of the central tenets of this world view is undermined by recent discoveries in ecosystem dynamics (Ulanowicz 2004). Wilson's crucial mistake is that he takes the machine metaphor literally. Once he has reified mechanism as an all-encompassing cosmology, the thoroughgoing reductionism that this cosmology implies is the only approach to consilience available to him.

Instances of literalism such as those described so far are not anomalies; the modern world is replete with similar examples throughout all domains of knowledge because literalism is a keystone of modern thought. Ironically, this fallacy, which so often falsifies what it touches, is a natural consequence of the metaphor upon which modern epistemology is based. The foundationalist theory of knowledge, set down by Descartes at the dawn of the modern era, maintains that knowledge is like a building, erected from the bottom up. As the philosopher Nancey Murphy writes, "upper stories are built upon lower stories, [and] the whole structure collapses if it has no solid foundation" (Murphy 1997, 9). Knowledge claims, in order to be considered valid, then, must be like well formed bricks, laid on a foundation of basic incontrovertible certainties. For the building metaphor to function, the bricks themselves must be clear-cut and univocal, since ambiguity would compromise the stability of the resulting structure. Consequently, the metaphor used for knowledge justification compels the reification of other metaphors, and foundationalism inevitably produces varieties of fundamentalism.

For fundamentalist theology, as Murphy explains, all religious knowledge must ultimately rest on a foundation of inerrant scripture (Murphy 1997). Given the evocative and poetic language characteristic of sacred writings, the dubiousness of this proposition is apparent to the majority of theologians. The fundamentalist impulse in science, however, is rarely recognized, except by philosophers and a few of the more philosophically inclined scientists. For fundamentalist science, theories must be literal descriptions of how the universe *really* is, and this requires a foundation of *metaphysical*, rather than mere *methodological* naturalism. In fact, the validity of science is often thought to depend on (and the success of science to imply) the ultimate reducibility of all natural phenomena to an ontological foundation of purely physical interactions governed by fixed laws (Murphy 1997). Though such a foundation may seem more secure than scripture, it by no means enjoys the indubitable certainty that it did a century ago. Moreover, epistemological foundationalism has been significantly weakened in the last half century by the arguments of Quine, Sellars, and others in the philosophy of mind and the philosophy of science (Quine 1953; Sellars 1956).

## Reframing Evolution

The history of evolutionary thought has produced a robust and elegant body of scientific theory, which, though still developing, stands as one of the great achievements of human inquiry. At the same time, on the cultural level, the way evolutionary theory has been framed has contributed to a worldview that might be called *metaphysical* Darwinism. Roughly, metaphysical Darwinism suggests that the universe is ultimately a collection of meaningless physical events; and biological nature, as a subset of those events, is the province of fundamentally mindless competitive processes by which accidentally self-perpetuating assemblages of passive matter are fine-tuned by external pressures. As I have argued in this essay, this worldview is by no means determined by the facts of evolution, but by particular ideologically motivated choices. Perhaps metaphysical Darwinism is best understood as a cultural monstrosity, the outcome of an unseemly marriage between 19th century materialism and modernist humanism/anti-theism. When this mixture is taken literally, it is both spiritually toxic and philosophically incoherent. Through an alternative framing of evolutionary theory, however, science might actually be a source of nourishment for the human hunger for meaning. With the help of new metaphors, evolutionary ideas can help us to replace our sense of cosmic alienation with a vision of ourselves as microcosms of creativity in an endlessly creative cosmos.

Metaphysical Darwinism is spiritually toxic for the reasons I have been discussing throughout this essay. The metaphors and language originally deployed to counter certain Victorian prejudices regarding evolution, ultimately hardened into a dogmatically one-sided view of nature as brutal and mindless. As a result, it became clear that nature, conceptualized in this way, is no place for the human as a moral agent. The human world of morality and values, therefore, must somehow be exempted from this cold and purposeless realm. But how is the human exemption from nature accomplished? The most familiar approach to human exceptionalism preserves the unique significance of the human through an anthropomorphic theism. According to this view, God explicitly created humanity in his own image, whether on a single occasion six millennia ago, or by steering the evolutionary process toward human emergence. An alternative approach, preferred by anti-theistic intellectuals, yields an analogous exceptionalism based on self knowledge and free choice. According to authors such as Dawkins and Jacques Monod, though we are condemned to a sense of alienation from nature, knowledge and freedom allow us to transcend our lowly biological origins in the service of higher ideals. As Monod writes, "the ancient covenant is in pieces; man knows at last that he is alone in the universe's unfeeling immensity.… The kingdom above or the darkness below; it is for him to choose" (Monod 1971, 180). In other words, the human species is an accidental product of the random interactions of selfish replicators, but somehow we are able to rise above these origins and achieve authentic moral agency. Whatever the logical merits of this claim, it appears to derive some of its narrative force from a deeper cultural source. As Goodwin (Goodwin 1994) and others observe, this story of alienation and transcendence is remarkably reminiscent of the Judeo-Christian myth of fall and redemption.

Whether the approach is theistic or anti-theistic, varieties of nature/human dualism seem to be an unavoidable consequence of metaphysical Darwinism. This dualism is not only philosophically, culturally, and ecologically problematic, it is scientifically unsupportable. Indeed, the dualism embodied in metaphysical Darwinism undercuts the central revelation and primary puzzle of evolutionary theory—that human existence is a natural outcome of evolutionary processes. Regardless of how often this is affirmed as fact, to embrace all that an evolutionary account of human origins implies about the human and about evolution is all but impossible from within the context bequeathed by metaphysical Darwinism. Moving beyond this impasse, therefore, will require a new context for thinking about evolution. We must develop metaphors for biological phenomena that allow us to embrace the full implications of evolutionary theory. In addition, lest this new context become simply another fundamentalism, it must include metaphors not only for knowledge about evolution, but for knowledge itself.

Gregory Bateson's seminal work exploring the relationship between ecology and mind is a particularly promising source of new metaphors. Although primarily an anthropologist, Bateson was interested in understanding the dynamics of interaction, not only among humans, but among all beings capable of communication. He first applied concepts from the emerging fields of cybernetics and communications theory to the study of human systems such as hunter gatherer societies and schizophrenic families. Later, he extended his research to encompass non-human systems, including monkeys playing, porpoises being trained, and ecosystems evolving. Bateson's attention to the formal similarities among the patterns of relationships he observed in these various systems culminated in his conclusion that the organization of ecological systems is formally analogous to the organization of those systems typically classified as minds. Bateson's insight, which he formulated as an ecology of mind, overcomes traditional dualism by recognizing that mind is not a thing, but a kind of pattern, a metapattern that is particular to living systems. He proposed, therefore, that ecology and evolution are actually mental processes and that the particular mental process known as the human mind is best understood as a subsystem of these larger processes.

Metaphors for evolution based on Bateson's ecology of mind circumvent the two fundamentalist conceptions of evolution. Evolution in this framing is neither utterly mindless, nor providential; it is creative. Interaction among living systems brings forth patterns of relationship that then establish the conditions for novel forms of interaction, and so on. Furthermore, since the living world is, according to this view, a province of immanent creativity, there is no need to postulate an external designer and, therefore, no need to counter that hypothesis with the claim that the processes are completely blind. Consider how a metaphor based on human thought might enhance our understanding of natural selection. For traditional Darwinism, of course, natural selection is the foremost source of evolutionary novelty. Without calling that orthodoxy into question, the notion of selection can be enriched through an examination of way it functions in creative thought. Imagine a novel idea that will ultimately be expressed in some final product such as a written work or a painting. When a good idea arises in thought, it must first distinguish itself from bad ideas and other mental "noise." It has to survive multiple iterations of filtering, each of which brings to bear additional formal and aesthetic criteria. Early on, perhaps prior to awareness, an idea must simply make sense and have some internal consistency and coherence. Gradually, it will be evaluated in terms of its coherence with ever larger networks of ideas, or contexts, both "within our heads" and beyond. In addition, an idea that persists will eventually alter the contexts into which it enters, changing the conditions for itself and the other ideas in the network. This metaphor highlights the way that natural selection participates in recursive hierarchies of context-specific constraints out of which new levels of integration emerge. This approach entails a shift in what we consider to be the basic unit of survival. Rather than genes or even species, ecology, according to Bateson, "turns out to be the study of the interaction and survival of ideas … in circuits" (Bateson 2000, 491). Moreover, to the extent that we can conceive of natural selection as a dynamic part of the emergent, open-ended unfolding of coherent pattern and meaning, we can begin to see evolutionary creativity in a significantly richer light.

The analogy between human thought and ecological processes works both ways, of course, and ecology is a rich source of metaphors for the workings of the human mind. Most importantly, an epistemology based on ecological metaphors is resistant to the sort of fundamentalism that is enabled by foundationalist epistemology. Whereas for the building metaphor, knowledge is a collection of clear and distinct ideas, corresponding more or less perfectly to some fixed truth beyond all history and culture, for ecology-based metaphors, knowledge is emergent, enacted, and inescapably contextual. Just as there is no complete or optimal adaptation toward which an evolving lineage is progressing, there is no ultimate truth with which human knowledge could correspond. Indeed, an ecological epistemology makes sense of the very habits of thought discussed in this paper. The contexts formed by metaphor and myth constitute ideologies that both constrain the acceptance of, and establish the possible niches for, new ideas. Whether the relevant context is a scientific paradigm or a particular cultural mythology, normal thought must conform itself to these patterns in order to survive. Furthermore, ecological systems are hierarchical, and ideologies are no exception. Some patterns of thought are more deeply habituated and thus more resistant to change than others. On the other hand, all patterns in an ecosystem have a life cycle. Ideas depend on their context for truth and meaning, and as contexts change, ideas become false and die out. Larger shifts happen, as well. Ideologies are eventually overturned, either gradually through the accumulation of new forms of thought, or more suddenly, through the rapid extinction and speciation of ideas, as in a scientific or cultural revolution.

These examples, though necessarily brief, point to the potential of Bateson's expanded conception of ecology and mental process as an alternative context for thinking about evolution and knowledge. Through the lens of these metaphors, mental process, in nature and in the human, reveals itself to be intrinsically mythopoeic. Human thought and evolution appear as manifestations of a single immanent creativity, through which life constructs its open-ended future. Because the dynamics of this creativity tend to maintain coherence with established contextual ecologies, its patterns inevitably appear meant, and there is no need to confer purposiveness (at least to evolution). Although there may be a temptation to dismiss this supposed patterning as a projection, remember that not even thought could not exist if ecological processes did not already have the capacity to enact patterns and metapatterns. Moreover, to take seriously the continuity between mind and the living milieu in which it is embodied is to confront an inescapable circularity. The human mind is a product of nature, but the *concept* of nature is a product of the human mind; assigning logical priority to either inevitably begs the question. In as much as both phenomena can be illuminated by the recognition of this circularity, however, I think it is a virtuous one.

The epic of evolution, unfolding as a coherent network of patterns and metapatterns, might be thought of as an open-ended narrative, continually inscribing and interpreting itself in countless ways. And the human task of interpreting this ambiguous evolutionary text belongs to natural history. As the primary source of origin stories for the emerging planetary civilization, therefore, natural history must do more than tell us the way the world is; it must tell us who we are and what our relationship to the world is and ought to be. A reframing of evolution in terms of its mythopoeic quality, therefore, may make possible the construction of new narratives that draw on our most advanced knowledge of natural history to affirm the place of the human as participant in the ongoing evolution of the Earth.

## Conclusion

I have suggested in this paper that a significant source of the cultural conflict over evolution in the United States is the exclusion of mind and value from nature by the language and metaphors chosen to frame evolutionary theory. This exclusion, and especially its reification, has necessitated not only the ontological nature/human dualism maintained by antievolutionists in the United States, but the epistemological/axiological dualisms that infect much Darwinian thinking. I then proposed that metaphors based on Gregory Bateson's ecology of mind can be used to reframe evolutionary theory in a way that affirms the role of human and ecological creativity in constructing Earth's history and imagining its future. Perhaps this emphasis on the creativity immanent in mind and nature can help to counter the dualisms that continue to produce cultural and ecological pathology. There can be little doubt that if the human species is to remain viable beyond the changes in the ecological context being wrought by human activity, no single factor will be more crucial in this shift than the human imagination.

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# Chapter 13
# Bateson and Peirce on the Pattern that Connects and the Sacred

**Søren Brier**

**Abstract** Classical mechanicism viewed the world as a self-sufficient machine made by God, but not a part of God or with God's presence in it. Cybernetics and information theory offers an alternative view on science to classical mechanistic physics with its mind–body dualism or eliminative materialism. The informational cybernetics of Gregory Bateson aims to change the understanding of evolution, ecology, mind and nature and the divine. Bateson developed a conception of God as an immanent informational pattern that connects everything in a cybernetic pantheism. Nevertheless Bateson's theory of "Steps to an ecology of mind" as cybernetic recursive processes did not include first person experiences and qualia. Peircean semiotics delivers a phenomenological, realistic as well as naturalistic framework. In his hylozoic theory, mind is feeling on the inside and on the outside it can be seen as spontaneity, chance and chaos with a tendency to take habits, which is the law of mind manifesting itself as thoughts. The pantheistic aspect of Peirce's philosophy is that he sees the evolutionary processes and habits of the universe as evolutionary love. But Since Peirce further argues for an emptiness from where the categories spring, he is a panentheist!

**Keywords** Bateson, Peirce, cybernetic God, panentheism, evolutionary love

## Introduction: What Is the Pattern that Connects?

As a result of the many conflicts between medieval times and the Renaissance, science and religion (mostly in the form of Christianity) have stabilized a peaceful division of territory, where mechanistic science's "Big Bang" theory covered nature, including the human body, and religion covered the area of "the inner world" or "the soul". Subsequently, after the Enlightenment, the scientific worldview has – contrary to expectations – not been able to wipe out the idea of a metaphysic of the

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sacred and of personal and cultural values associated with the sacred at the level of civilization. Institutionalized religion is still one of the major forms of organizing and understanding the existential–phenomenological aspect of human life and science and religion are still in conflict about how to explain the origin of humans and the universe. Basically, the conflict is firstly about mind and matter, where religion explains human consciousness as a soul created by God and the sciences either wants to explain consciousness in term of material evolution and furthermore often also wants to eliminate any causal influence of first person experience on matter (including the body). Secondly it is about meaning and purpose in nature, where religion sees an intrinsic divine meaning and purpose and the sciences work from a metaphysics devoid of a concept of meaning, which again contributes to the paradigmatic conflict between the two cultures, as humanities and the social sciences have to work with meaning as a given interpersonally created (real) process.

The Cartesian dualistic metaphysics embraced by modern science forces it to look for some kind of meeting point of the inner and outer worlds to be found in the dynamics of the human brain. For medicine this is where the psychosomatic link must be. Peculiarly, the inability to find this link might be one of the reasons neurosciences and cognitive sciences have experienced such a big boom over the last decade. A knowledge-seeking-culture wants to find that connection (Penrose 1995, Searle 1986) and it is somewhat of a scandal that our capable scientific and technological culture has not done that yet. The received view of science does not understand how mind – or even life – arises in this world or is able to assert causal influence over matter in living bodies. This is one of the main problems that Peircean biosemiotics grapples with (Brier 2006a and b).
The questions are:

1. Is it possible to arrive at an understanding of man and the universe, which embraces modern science on one hand without seeing phenomenological man as a gypsy on the edge of a dead, foreign and meaningless universe (Monod 1972) on the other?
2. Is it possible to find a ‘pattern that connects’ mind, man, living nature and the universe?

This is the quest that both the semiotician Charles Sanders Peirce (1839–1914) and the cybernetician Gregory Bateson (1904–1980) boldly attempt in their life’s work in philosophy of knowledge and science. They are both truly humbling intellectual giants and daring transdisciplinary thinkers far ahead of their times; living difficult lives through their dedication to renewing the view of the West on the question of science, religion and knowing. Bateson never used Peirce’s semiotics but he came close to aspects of it in developing his theories. Both were unsatisfied with the classical mechanicism and naive realism underpinning classical physics and which underlay the conception of “science.”

Part of this problem has also been formulated by another of my intellectual heroes, Ilya Prigogine (1917–2003), in cooperation with the brilliant philosopher of science Isabelle Stengers. Prigogine and Stengers (1984) claim, that the combination of thermodynamics and quantum physics, seen together, philosophically provides a more realistic and comprehensive worldview, than classic mechanicism. If they are correct, then spontaneity, complexity, irreversibility, time and evolution have made their entrance as basic conceptions in physics (Prigogine 1980, Prigogine and Stengers 1997). This is also true for complexity science, developed more recently.[1] It follows that it is no longer possible for classical mechanistic, reversible and deterministic natural science to uncover either nature's or matter's "inner being" in the form of a "world formula" as Laplace dream of and Stephen Hawking[2] still tries to make true. As new recognition of complex non-linear systems accentuates, it becomes evident that even if one knew the laws that govern a system's basic dynamics, one would not be able to understand its detailed development. The initial conditions are very crucial. Physics also realizes that no version of the Big-Bang-theory will tell us how the Universe was created, because the original "singularity" eludes scientific examination. Physical explanations do not start until after the universe has been initiated.

Both Bateson's and Peirce's philosophies of knowledge and science represents attempts to go beyond the traditional views on scientific knowledge, first person experiential knowledge of meaning and the relation of these knowledge forms to the foundations of religion and the way they cut up and partition the world of knowledge.

## Bateson's Concept of Information as a Difference that Makes a Difference

As indicated, one of Bateson's (1973, 1980) major projects was explaining the nature of mind and nature – or mind in nature – from a modern scientific basis, avoiding the metaphysical dualism of Descartes as well as the mechanicism of Laplace. Through cybernetics, Bateson provides a new delimitation of the concept of information that unites in a more consistent way scientific worldviews with

[1] Complexity science is not a single theory. It is highly interdisciplinary and encompasses more than one theoretical framework. Complex systems are viewed as diverse and made up of multiple interconnected elements that often interact in non-linear fashion. Complexity science is seeking answers to some fundamental questions about living, adaptable, changeable systems such as the behavior of complex adaptive systems, systems that are not only complex but also *adaptive* in that they can change and learn from experience. Systems that can learn from change include the cell and the developing embryo and the juvenile body, the brain and the immune hormone and nervous system and their mutual interaction, social insect's colonies, ecosystems and the whole biosphere, and any human social group-based cultural and social system such as manufacturing businesses, the stock market, political parties and religious sects. Principles of emergence and self-organization are essential partly borrowed from general system theory.

[2] *A Brief History of time* (original 1968, but with ongoing editions op to the present). Is the most popular science book ever. Hawking holds the Isaac Newton Chair at Cambridge University – and rightly so!

concepts deriving from a non-mechanistic view, primarily ethological study of cognition and communication of animals and man. "In fact what we mean by information – the elementary unit of information – is a difference which makes a difference …." (Bateson 1973: 428). This is his key concept that ties mind and nature, and is supposed to give us the key to animal, as well as human mind and behavior.

1. Bateson's worldview is scientific and to a certain degree materialistic,[3] but not classically mechanistic, because he depends on Norbert Wiener, one of the founders of cybernetics, who developed the concepts of circular control (feedback) and goal-directed behavior and tied the theory of information to the probabilistic interpretation of entropy in thermodynamics as developed by Boltzmann and Gibbs, who is the main figure for Wiener (see 1988/1954 p. 8–12).
2. Bateson sees matter and energy is imbued with informational circular processes of differences, which creates "patterns that connect". Deeply interested in anthropology, biology and psychology, he approaches the fields of information, cognition and communication from a cybernetic angle.
3. Bateson's "working hypothesis" is that the world's basic constituents are space, time, elementary particles (matter), energy and differences – and therefore informational relations.
4. He believes that science will end if we endow elementary particles with mind qualities (Bateson 1980:103).[4]
5. His project is to explain mind as a function of complexity and cybernetic organization in the way he conceived cybernetics (see below).
6. Bateson believes that the strength of cybernetics lies in its ability to provide a more profound understanding of what the mental is, by incorporating his concept of information into a universal cybernetic philosophy.
7. Bateson believes that his cybernetics can provide an understanding of mind that is neither subjectively idealistic nor mechanically materialistic.

Before we explore his theory, let me state briefly how I see Bateson's role in developing the field and the limitations of his answers to the two questions I formulated above: Bateson helps push classical cybernetics into second-order cybernetics by leading cybernetics towards a more social and humanistic way of viewing information, cognition and communication. He comes as close to a cybernetic foundation of semiotics as did Jacob von Uexküll previously in biology (although in a different philosophical framework). In my opinion, there are two reasons why Bateson did not quite succeed: (1) He was unable to liberate his concept of information from that of Norbert Wiener. Although Bateson's definition of information seems well suited to

[3] Meaning that he does not include a first person view and/or phenomenological of mind as part of his theoretical framework.
[4] "In a word, I do not believe that single subatomic particles are "minds" in my sense because I believe that mental process is always a sequence of interactions *between* Parts …. Several respected thinkers … have proposed theories of evolution which assumes some mental striving to be characteristic of the smallest atomies." (p. 103)

second-order cybernetics, he tied the definition to the concept of neg-entropy, which gives his theory a physicalistic flavor. (2) He did not develop a satisfactory cybernetic theory of the observer. This is why I find it necessary to compare him to Peirce's semiotic worldview because he deals with the problems of mind and meaning in a complete different way but with the same trans-disciplinary ambition. But his solution, when you unfold it in full, is so different and original that it will probably scare away most scientists, even many Peircean biosemioticians.[5]

## Mind, Information, and Entropy

For Bateson, mind is a cybernetic phenomenon, a sort of mental ecology. The mental ecology relates to an ability to register differences and is an intrinsic system property. The elementary, cybernetic system with its messages in circuits is the simplest mental unit, even when the total system does not include living organisms. Every living system has the following characteristics that we generally call mental:

1. The system shall operate with and upon differences.
2. The system shall consist of closed loops or networks of pathways along which differences and transforms of differences shall be transmitted. (What is transmitted on a neuron is not an impulse; it is news of a difference.)
3. Many events within the system shall be energized by the responding part rather than by impact from the triggering part.
4. The system shall show self-correctiveness in the direction of homeostasis and/or in the direction of runaway. Self-correctiveness implies trial and error.

(Bateson 1973: 458)

Mind is synonymous with a cybernetic system that is comprised of a total, self-correcting unit that prepares information. Mind is immanent in this wholeness. When Bateson says that mind is immanent, he means that the mental is immanent in the entire system, in the complete message circuit. One can therefore say that mind is immanent in the circuits that are complete inside the brain. Mind is also immanent in the greater circuits, which complete the system "brain + body." Finally, mind is immanent in the even greater system "man + environment" or – more generally – "organism + environment," which is identical to the elementary unit of evolution, i.e., the thinking, acting and deciding agent:

> The individual mind is immanent, but not only in the body. It is immanent also in pathways and messages outside the body; and there is a larger Mind, of which the individual is only a subsystem. This larger Mind is comparable to God and is perhaps what some people mean by "God," but it is still immanent in the total inter-connected social system and planetary ecology. Freudian psychology expanded the concept of mind inward to include the whole communication system within the body – the autonomic, the habitual and the vast range of

[5] For the same reason I give a lot of original Peirce quotes in the second part of the paper to document my interpretation of Peirce.

> unconscious processes. What I am saying expands mind outward. And both of these changes reduce the scope of the conscious self. A certain humility becomes appropriate, tempered by the dignity or joy of being part of something bigger. A part – if you will – of God.
>
> (Bateson 1973: 436–37).

Bateson's cybernetics thus leads towards mind as immanent in both animate and inanimate nature as well as in culture, because mind is essentially the informational and logical pattern that connects everything through its virtual recursive dynamics of differences and logical types. The theory is neither idealistic nor materialistic. It is informational and functionalistic.[6] Norbert Wiener (1965/1948) has an objective information concept, which Bateson develops to be more relational and therefore more ecological. He develops a cybernetic concept of mind that includes humans and culture. Bateson's worldview seems biological. He sees life and mind as coexisting in an ecological and evolutionary dynamic, integrating the whole biosphere. Bateson clearly sympathizes with the ethologists (Brier 1993, 1995) when he resists the positivistic split between the rational and the emotional in language and thinking that is so important for cognitive science. He acknowledges emotions as an important cognitive process:

> It is the attempt to separate intellect from emotion that is monstrous, and I suggest that it is equally monstrous – and dangerous – to attempt to separate the external mind from the internal. Or to separate mind from body. Blake noted that "A tear is an intellectual thing," and Pascal asserted that "The heart has its reasons of which reason knows nothing." We need not be put off by the fact that the reasonings of the heart (or of the hypothalamus) are accompanied by sensations of joy or grief. These computations are concerned with matters, which are vital to mammals, namely matters of relationship, by which I mean love, hate, respect, dependency, spectatorship, performance, dominance and so on. These are central to the life of any animal, and I see no objection to calling these computations "thought," though certainly the units of relational computation are different from the units which we use to compute about isolable things.
>
> (Bateson 1973: 438–39)

It thus seems obvious that Bateson's "pattern that connects" includes the phenomenological–emotional dimension in its concept of mind but viewed as computational

[6] Functionalism is a philosophical view of mind, according to which mental processes are characterized in terms of their abstract functional or even computational relationships to one another, and to sensory inputs and motor outputs. The mind should be explained in terms of the function of the human body within a given environment. Bateson expands this idea further into the environment. Its core idea is that mental states can be accounted for without taking into account the underlying physical medium such as the brain. In *the computational view* the mind is seen as the software and the brain as the hardware. As these processes are not limited to a particular physical state or physical medium, they can be realized in multiple ways. Some call it a *non-reductive materialism* others the *information processing paradigm*. It is probably the dominant theory of mental states in modern philosophy (Brier 1992 and 1999). I know that many researchers using Bateson's work do not share this understanding and find it provoking and unfair to their interpretation of Bateson's paradigm. But I find my interpretation clearly supported by the two first chapters in the posthumous published book *Angels Fear* (2005/1987), which Mary Catherine Bateson participated in and finished after her fathers dead, and it is also supported by Hayles (1999) interpretation of cybernetics and in the way Luhmann (1995) uses Bateson in his theory: The view is further developed in this article.

thoughts of relation, not as first person experiences. Cybernetics does not have a theory of qualia and emotion – not even in Bateson's theories.

In my opinion, this cybernetic viewpoint tells a great deal about motivational and emotional functionality as seen through an ecological and evolutionary framework. It avoids physicalistic explanations, but although Bateson developed his theory far in this direction, he never revisited the first-order cybernetic foundation it was built upon. In Mind and Nature (1980:103) Bateson further develops his criteria for a cybernetic definition of mind:

1. A mind is an aggregate of interacting parts or components.
2. The interaction between parts of mind is triggered by difference, and difference is a non-substantial phenomenon not located in space or time; difference is related to neg-entropy and entropy rather than to energy.
3. Mental processes require collateral energy.
4. Mental processes require circular (or more complex) chains of determination.
5. In mental processes, the effects of difference are to be regarded as transforms (i.e., coded versions) of events preceding them. The rules of such transformation must be comparatively stable (i.e., more stable than the content) but are themselves subject to transformation.
6. The description and classification of these processes of transformation disclose a hierarchy of logical types immanent in the phenomena.

(Bateson 1980: 102 and Bateson and Bateson 2005 p.18–19)

Today these criteria are famous and basic within the cybernetic understanding of mind. My critique concentrates on the foundation of the second criteria: "difference is related to neg-entropy and entropy …." I find it problematic that Bateson follows Norbert Wiener's idea that the concept "information" and the concept "negative entropy," are synonymous. He is not only thinking of the statistical concept of entropy that Shannon uses in his theory, since this is not connected to energy. Further, he thinks that this insight unites the natural and the social sciences and finally resolves the problems of teleology and the body–mind dichotomy (Ruesch and Bateson 1987/1951: 177). Regarding how the mystery of mind is resolved through the relation between the concept "information" and the concept "negative entropy" Ruesch and Bateson typically write:

> Wiener argued that these two concepts are synonymous; and this statement, in the opinion of the writers, marks the greatest single shift in human thinking since the days of Plato and Aristotle, because it unites the natural and the social sciences and finally resolves the problems of teleology and the body–mind dichotomy which Occidental thought has inherited from classical Athens.
>
> (Ruesch and Bateson 1987/1951: 177)

This statement characterizes the views of many researchers using this framework within systems, cybernetics, and informatics. To Bateson cybernetics provides a radical new foundation for a theory of mind and communication, as well as cognitive science, with a modern expression that unites the natural and social sciences. Psychology as such is not mentioned.

Shannon's theory of information, however, never had anything to do with the semantic content of messages. In a famous passage, Shannon writes the following about this problem with his theory:

> The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have meaning; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that they are selected from a set of possible messages.
>
> (Shannon and Weaver 1969: 31–32)

Therefore, what people and animals conceive as information is quite different from what Shannon and Weaver's theory of information is about. Von Foerster concludes:

> However, when we look more closely at these theories, it becomes transparently clear that they are not really concerned with information but rather with signals and the reliable transmission of signals over unreliable channels …
>
> (von Foerster 1980: 20–21)

In a conclusive analysis summarizing years of work on the concept of information in the physical sciences and information theory, Christiansen (1984) suggests that it is a materialistic reductionism to claim that one's theory of information is based upon the physical concept of entropy. Using Christiansen (1984) analysis as a tool, Bateson's theory appears to end in a materialistic short circuit. It is well known that to determine the entropy in a system, it is necessary to determine in advance what will count as macro states. Furthermore, it is necessary to determine the probability of every state in advance. There is no room for the completely unexpected (Brier 1992).

As Bateson's original definition goes, it is the observing system that determines which differences make a difference as the system proceeds in its historical drift. With this move, a cybernetic concept of mind is created that is free of any "inner world." How can one, on this basis, expect to explain will, emotion and consciousness – not to mention the semantic contents of messages? Shannon's information theory is thus a quantitative theory used on a set of messages that are presumed to be meaningful. It is a technical theory about how to quantify and mathematically model information as a tool but always operating on human social communication. As such it presents no problem. The problem arises with the reification of information by connecting it to thermodynamics, as Wiener did, that raises foundational epistemological problems that reflect back on the prerequisites for science itself. It is in accordance with the foundation of complexity science, from which theories of self-organization and emergence also try to give a solution to the ontological problems of defining life and mind. This is the place where Peirce becomes relevant in his basic shift in interpreting the basic complexity or chaos. In accordance with the above-mentioned analysis by Christiansen regarding information defined as neg-entropy, where entropy is defined as meaningless chaos.

## Chaos as Peircean Firstness

Peirce sees the foundation of reality as chaotic, but his concept of chaos is developed a step further than Prigogine's thermodynamic chaos, based as it is on Boltzmann and Gibbs just like the cybernetics of Wiener and Bateson. Peirce (1891, 1892) theorizes that randomness or chaos must necessarily precede lawfulness and determination in an evolutionary philosophy because chance in relation to the basis of any law can only be defined in a purely negative sense such as the absence of law, or the absence of knowledge about the laws behind seemingly chaotic processes – as in deterministic chaos. But Peirce's chaos is not a deterministic chaos.

In agreement with modern thermodynamics and to some degree with quantum field physics, Peirce sees the basic quality of reality as randomness or chaos. But he elucidates some important philosophical ontological consequences from this view: if chaos is basic, one cannot explain it as the absence of law, because chance or randomness precedes law. Thus one must explain law from randomness, not the reverse. Chaos, chance, and randomness must therefore be understood not only as emptiness but also as fullness, as a hypercomplex of dynamic processes that include characteristics of mind, matter, and life.[7] He calls this pure spontaneity:

> To undertake to account for anything by saying boldly that it is due to pure chance would indeed be futile. But this I do not do. I make use of chance chiefly to make room for a principle of generalization, or tendency to form habits, which I hold has produced all regularities. The mechanical philosopher leaves the whole specification of the world unaccounted for, which is pretty near as bad as boldly attribute it to chance. I attribute it altogether to chance it is true, but to chance in a form of spontaneity which is to some degree regular.
>
> (Peirce 1994: 6.63)

To explain how law and structure emerge from randomness, Peirce endows chaos with one more quality, namely the tendency to form habits. In order to impart meaning to this philosophy, we must comprehend chaos as spontaneously dynamic with the tendency to form habits. "Symmetry breaking" is the more modern scientific term for the same phenomenon, and is used in both quantum field physics and thermodynamics. If we accept that the concept of chaos is as fundamental as that of natural law, then we should not conceive of chaos as the absence of regularity or the absence of the ability to create structures. It should be viewed, rather, as a hyper-complexity of potential structures and potential information in an infinite, living dynamic. It could thus be possible to transcend the dilemma between determinism and indeterminism; because with Peirce one can understand the creation of law from chance as "habits of nature." The laws of nature are exact only in their mathematical descriptions, whereas the measurements on which they are based are always influenced by uncertainties. The laws are only approximate model descriptions of a far richer and more varied, spontaneous and living reality.

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[7] In itself this observation is compatible with Wiener and Bateson's cybernetic ontology.

Peirce's argues that if chaos is the fundamental concept, then law is unusual and unexpected, and therefore the thing to explain, not the reverse. From the perspective of the statistical information of Shannon and Weaver there is maximal information in chaotic random behavior. But this is not Peirce's point of view. For him, departures from the random are interesting because they provide knowledge about structures and law-like behavior. It is exactly this absolute and deterministic nature of physical law that Peirce disputes:

> The law of habit exhibits a striking contrast to all physical laws in the character of its commands. A physical law is absolute. What it requires is an exact relation. Thus, a physical force introduces into a motion a component motion to be combined with the rest by the parallelogram of forces; but the component motion must actually take place exactly as required by the law of force. On the other hand, no exact conformity is required by the mental law. Nay, exact conformity would be in downright conflict with the law; since it would instantly crystallize thought and prevent all further formation of habit. The law of mind only makes a given feeling more likely to arise. It thus resembles the 'non-conservative' forces of physics, such as viscosity and the like, which are due to statistical uniformities in the chance encounters of trillions of molecules.
>
> The old dualistic notion of mind and matter, so prominent in Cartesianism, as two radically different kinds of substance, will hardly find defenders to-day. Rejecting this, we are driven to some form of hylopathy, otherwise called monism.
>
> (Peirce 1891: 321; 1994 6, 23.24)

By positing law emerging from the random and cosmos emerging from chaos as the habits of the universe come into being, the creation of the universe and our own world melt together in a way that the new cybernetics and constructivism have been pursuing for some time. Like Wiener, and Ruesch and Bateson, Peirce sees this basis as a possible foundation for a kind of monistic view of matter and mind. As Peirce noted, it is necessary to transcend the fruitless antagonism between idealism and materialism:

> On the other hand, by supposing the rigid exactitude of causation to yield, I care not how little it be but a strictly infinitesimal amount – we gain room to insert mind into our scheme, and put it in the place where it is needed, into the position which, as the sole self-intelligible thing, it is entitled to occupy, that of the fountain of existence; and in so doing we resolve the problem of the connection of soul and body.
>
> (Peirce 1892a: 335)

Here we see Peirce move in another direction than the cyberneticist and the received view of the "scientific world view" in inserting mind at the fountain of existence, though he has still not reveal what his concept of mind is. Peirce realizes that such ontology must include a view of the "creation of the world" that does not conflict with our present scientific knowledge, He writes:

> It would suppose that in the beginning, – infinitely remote, – there was a chaos of unpersonalized feeling, which being without connection or regularity would properly be without existence. This feeling, sporting here and there in pure arbitrariness, would have started the germ of a generalizing tendency. Its other sportings would be evanescent, but this would have a growing virtue. Thus, the tendency to habit would be started; and from this with the other principles of evolution all the regularities of the universe would be evolved. At any time, however, an element of pure chance survives and will remain until the world becomes an absolutely perfect, rational, and symmetrical system, in which mind is at last crystallized in the infinitely distant future.
>
> (Peirce 1891: 170)

This statement agrees with classical equilibrium thermodynamics and modern physical cosmology – Big Bang theory and the super string theory – that theorizes the universe as arising from a random sporting in the vacuum field. It begins very small, but expands rapidly, thereby unfolding space–time. Radiation and matter form through symmetry-breaking. Through dissipative structures, matter self-organizes into more complicated structures. The difference between Peirce's perspective and that of modern science is that most modern physicists believe that chaos is non-living and non-mental and that this view is necessary ontology for the possibility of science in general, understood as the search for objective real universal natural laws governing all processes in nature. For this reason I believe that Peirce's theory of basic reality as a hyper-complexity of living feeling with the tendency to form habits is a good supplement to Bateson's, as well as Maturana and Varela and Luhmann's – theories of information, communication, knowing and languaging. I see here a theoretical connection between second-order cybernetics and semiotics that will strengthen both theories.

Cybernetic information theory works with differences in a dualistic system. Information is a difference that makes a difference, was Bateson's definition. But differences only make a difference in a system that somebody has coded from some sort of individual, social or species interest. A code only gives meaning to differences or information in certain contexts. A code is a set of process, rules, or habits that connects elements in one area with elements in another area in a systematic way in a specific meaning context. The correspondence is not a universal natural law, but is local and motivated from a living signifying system. A sequence of differences such as the base pairs in DNA or dots in the Morse-alphabet can be information for coding, but is not a code in itself. Living systems functions are based on self-constructed codes. Machines do not make codes themselves.

Codes are triadic sign processes, where an Interpretant makes the motivated connection between objects and signs (representamens).Logical patterns and types do not have meaning in themselves. The logic of the living includes meaning, emotions, ethics and aesthetics. Thus you need a triadic concept of signification to get to a concept of code plus a concept of first person experiences.[8] A sign is always useful for the system emitting it in some way (also if it is deceptive). Its value can be determined by its contribution to the reproductive and procreative value and/or pleasure of the entire system. A Peircean biosemiotic argument on why cybernetic information as differences is not enough, would then be that semiosis is a crucial part of those processes that makes systems living and thereby lifts them out of the physical world of efficient causality through the informational realm of formal causality in chemistry into the final causation in semiotic processes.

[8] This is where I differ from Marcello Barbieri's theory in that he believes a theory of biological meaning is possible without Peircean semiotics (Barbieri 2006). I do not think he is able to answer the further questions of how cognition, meaning and interpretation can arise in living systems and first person experiences come into existence, without a Peircean philosophical and semiotic framework. A further analysis and argumentation can be found in 2006 a and b and a forthcoming paper: "The Paradigm of Peircean biosemiotics".

Bateson, like Peirce, wants to develop a relational logic, and wants, like Spencer-Brown, to include Laws of Form (1972). Niklas Luhmann (1995) includes them both in his socio-communicative socio-cybernetic theory of society and its functionally differentiated systems. Therefore my critique of Bateson here can be transferred to Luhmann's theory also. Bateson's move is to reduce the phenomenological to the cybernetic. But thereby the access to first person experience is lost. As Short writes:

> The subject or sign-interpreter is essential to semiosis. Without the subject, there is no sign interpretation; and without the possibility of interpretation, grounded in some relation of sign to object, there is no sign. Hence, without the possibility of a subject, there is no sign. And there cannot be a conventional relation of sign to object without subjects who established that convention.
>
> (Short 1982, s. 116–117)

The problem is, that theoretically there are no subjects in cybernetics (Brier 2006a and b), as Luhmann underlines in his theory (Luhmann 1995). Not even the observer of second-order cybernetics is a theoretical subject. There is no theoretical concept of experience and subjectivity as in phenomenology. Therefore no living subjective Interpretant.

## The Basis of Peircean Triadic Semiotics

Semiotics is also defined as the study – or doctrine – of signs and sign systems, where sign systems are most often understood as co-evolved with the evolution of codes. Language of course depends on social and cultural codes. Examples of biological codes are the codes for the reception and the effects of hormones and neurotransmitters on various tissues, which are obvious biological sign systems. Peircian semiotic builds on Peirce's unique triadic concept of semiosis, where the 'interpretant' is the sign concept in the organism that makes it see/recognize something as an object. The Interpretant is the individual interpretation of what the Representamen or the outer sign vehicle "stands for." Meaning is the motivated context in which the relation between the Object and the Representamen is seen. This is the code that connects them in a specific functionality.

Peircian semiotics is founded on his Phenomenologically based theory of consciousness as founded in his theory of "pure feeling" unlike Bateson's mind that is third person cybernetic information processes.[9] But like Bateson's mind, the pattern that connects Peirce's categories, is both inside and outside our heads and all living systems. Mind exists in the material aspect of reality (in Secondness) as the 'inner

[9] This is the crucial difference between the two theoretical systems in my interpretation. It is not that Bateson did not believe in the reality of emotions, but in his theoretical system – consistent with cybernetics in general – they are only represented and functions as dynamic informational patterns.

aspect of matter' (a view called 'hylozoism'). Mind manifests as awareness and experience in animals and, finally consciousness in humans. In this way Peirce makes a philosophy where mind and the mechanical paradigm of classical science can exist together. The price for the mechanical paradigm is that it becomes only a metaphysical frame that works for a limited selection of systems, and not a fundamental reality. As a consequence the laws of nature that it finds are not fundamental laws from, which everything, including mind, is to be understood. These laws only pertain (as good approximation) to some kinds of systems and then even only as approximations. They are in reality not exact! Peirce places mind as pure feeling in Firstness. We might imagine Firstness as being placed behind Prigogines Paradigm, thus enabling the complexity and self-organizing paradigm of thermodynamics work for a limited number of systems, where mind is still not dominant in causal effects. He writes:

> Hence, it would be a mistake to conceive of the psychical and the physical aspects of matter as two aspects absolutely distinct.
>
> Viewing a thing from the outside, considering its relation of action and reaction with other things, it appears as matter. Viewing it from the inside, looking at its immediate character as feeling, it appears as consciousness.
>
> These two views are combined when we remember that mechanical laws are nothing but acquired habits, like all the regularities of mind, including the tendency to take habits, itself; and that this action of habit is nothing but generalization, and generalization is nothing but spreading of feelings. (Peirce 1994: 6.268)

Peirce then works with three types of causality that he has distilled out of his work with Aristotle, but now places in his own evolutionary semiotic framework. (1) Efficient causality works through the transfer of energy and is quantitatively measurable.(2) Formal causality works through pattern fitting, differences and with signals as information in a dualistic proto-semiotic matter.(3) Final causation is semiotic signification and interpretation. Peirce explains how to understand the concept of final causation in his paradigm, which is different from Aristotle's on one hand and the received view in psychology.

> It is … a widespread error to think that a "final cause" is necessarily a purpose. A purpose is merely that form of final cause which is most familiar to our experience.
>
> … we must understand by final causation that mode of bringing facts about according to which a general description of result is made to come about, quite irrespective of any compulsion for it to come about in this or that particular way; although the means may be adapted to the end.
>
> The general result may be brought about at one time in one way, and at another time in another way. Final causation does not determine in what particular way it is to be brought about, but only that the result shall have a certain general character.
>
> (Peirce, 1994: 1.211)

In Peirce's semiotic philosophy production of meaning is brought into "dead" nature – as mechanicism would call it – by the concepts of Firstness and synechism, combined with hylozoism and the development of the universe through the three different kinds of evolution: (1) Thycistic (free or random variation). (2) Anachastic (dynamic dyadic interactions, a more mechanical necessity like Darwin's natural selection). (3) Agapistic (combining the free variation with the dyadic interactions trough habit formation by the mediating ability of Thirdness). This is the law of mind. The Law of Mind is what he calls Evolutionary Love in his philosophy. He writes:

> … the formula of an evolutionary philosophy, which teaches that growth comes only from love, … from the ardent impulse to fulfill another's highest impulse …. this is the way mind develops; and as for the cosmos, only so far as it yet is mind, and so has life, is it capable of further evolution. Love, recognizing germs of loveliness in the hateful, gradually warms it into life, and makes it lovely. That is the sort of evolution which every careful student of my essay "The Law of Mind" must see that synechism calls for.
>
> Peirce Evolutionary Love (6.289)

Organisms are governed by final causality in the sense of their tendency to take habits and to generate future interpretants of the present sign actions. Codes in living systems are correspondences based on final causation that cannot be inferred directly from natural laws. They are based on the formal causation of the protosemiotic differences and pattern fitting information mostly on the chemical level of interaction. The physical interactions are based on laws and efficient causation of energy transfer.

## Peircean Scientific Mysticism

In the article "A neglected argument for God", Peirce contends that the very first step in abductive reasoning is a form of Pure Play, which he calls Musement. This first stage of abduction is to be undergone without rules or restrictions. There should be no censorship as to what can or cannot be considered. To that end you need a positive attitude towards the world and the possibility of knowledge, as a pessimistic outlook would eliminate the 'open' mind attitude. There are all sorts of relations you are not at liberty to investigate if you have decided a priori that they are not worth making. Chiasson (1999) ends her analysis of neglected argument for God in the following way:

> From this criterion, perhaps we could say that we could redefine Peirce's use of the word God into: any hypothesis – formed by means of optimistically undergone abductive reasoning – that leads one into consciously choosing ethical conduct that results in the living of a good life – whether or not the concepts we know as God or an after-life enter into the matter at all.
>
> (Chiasson 1999)

The pursuit of scientific knowledge for the benefit of mankind is seen as a sort of holy quest. Knowledge thus has its origin in the divine stability of the world. As in Descartes, Peirce sees the divine as the guarantee against total skepticism, but in an evolutionary non-mechanistic framework. Peirce goes much further in his evolutionary Agapistic metaphysics. He writes in the Monist paper "Evolutionary Love:"

> Everybody can see that the statement of St. John is the formula of an evolutionary philosophy, which teaches that growth comes only from love, from I will not say self-sacrifice, but

> from the ardent impulse to fulfill another's highest impulse. Suppose, for example, that I have an idea that interests me. It is my creation. It is my creature; …it is a little person. I love it; and I will sink myself in perfecting it. It is not by dealing out cold justice to the circle of my ideas that I can make them grow, but by cherishing and tending them as I would the flowers in my garden. The philosophy we draw from John's gospel is that this is the way mind develops; and as for the cosmos, only so far as it yet is mind, and so has life, is it capable of further evolution. Love, recognizing germs of loveliness in the hateful, gradually warms it into life, and makes it lovely. That is the sort of evolution which every careful student of my essay "The Law of Mind" must see that synechism[10] calls for.
>
> (Peirce, 1994: 6.289)

In Peirce's philosophy, the production of meaning is brought into what mechanicism sees as "dead" nature by the concepts of Firstness and Synechism combined with hylozoism and the development of the universe through the combination of the three different kinds of evolution: Evolution by fortuitous variation (tychasm), or evolution by mechanical necessity (anancasm), or evolution by creative love (agapism). But it is with Peirce as it is with St. John, of those true love is the greatest and the most profound. He writes:

> Evolution by sporting and evolution by mechanical necessity are conceptions warring against one another. Lamarckian evolution is thus evolution by the force of habit …. Thus, habit plays a double part; it serves to establish the new features, and also to bring them into harmony with the general morphology and function of the animals and plants to which they belong. But if the reader will now kindly give himself the trouble of turning back a page or two, he will see that this account of Lamarckian evolution coincides with the general description of the action of love, to which, I suppose, he yielded his assent.
>
> (Peirce, 1994: 6.301)

Further we must keep in mind that matter is "effete mind". The three categories are connected through the "pure feeling" of Firstness. Thus "the Law of Mind" also breaks up habits of matter.

> Remembering that all matter is really mind, remembering, too, the continuity of mind, let us ask what aspect Lamarckian evolution takes on within the domain of consciousness … the deeper workings of the spirit take place in their own slow way, without our connivance … Besides this inward process, there is the operation of the environment, which goes to break up habits destined to be broken up and so to render the mind lively. Everybody knows that the long continuance of a routine of habit makes us lethargic, while a succession of surprises wonderfully brightens the ideas …. A portion of mind, abundantly commissured to other portions, works almost mechanically. It sinks to a condition of a railway junction. But a portion of mind almost isolated, a spiritual peninsula, or cul-de-sac, is like a railway terminus. Now mental commissures are habits. Where they abound, originality is not needed and is not found; but where they are in defect spontaneity is set free. Thus, the first

[10] Peirce held that the continuity of space, time, ideation, feeling, and perception is an irreducible (philosophical ontological) foundation of science, and that an adequate conception of the continuous is an extremely important part of all the sciences. This doctrine he called "synechism," a word deriving from the Greek preposition that means "together with". Peirce was least one of the first scientific thinkers, to argue in favor of the actual existence of infinite sets. Not only did Peirce defend infinite magnitudes, but also he defended infinitesimal magnitudes. See http://plato.stanford.edu/entries/peirce/#syn.

> step in the Lamarckian evolution of mind is the putting of sundry thoughts into situations in which they are free to play.
>
> (Peirce, 1994: 6.302)

This, of course, relates back to his epistemology of Abduction founded in "Pure Play". It is the "Lamarckian" development of mind that makes science as a collective enquiry possible at all. Thus in Peirce's philosophy, the categories work according to the "law of mind" and there is an inner aspect of Firstness (pure feeling) in matter. But one has to be aware of Peirce's special conception of mind and consciousness. He writes:

> Far less has any notion of mind been established and generally acknowledged which can compare for an instant in distinctness to the dynamical conception of matter. Almost all the psychologists still tell us that mind is consciousness. But … unconscious mind exists. What is meant by consciousness is really in itself nothing but feeling.… there may be, and probably is, something of the general nature of feeling almost everywhere, yet feeling in any ascertainable degree is a mere property of protoplasm, perhaps only of nerve matter. Now it so happens that biological organisms, and especially a nervous system are favorably conditioned for exhibiting the phenomena of mind also; and therefore it is not surprising that mind and feeling should be confounded.… that feeling is nothing but the inward aspect of things, while mind on the contrary is essentially an external phenomenon.
>
> (Peirce, 1994: 7.364)

Thus, the essence of consciousness is feeling and an important aspect of Firstness is pure feeling. You may then reinterpret the mystical theory of the possibility of being aware on other levels in a Peircean framework as the possibility of being aware of the basic Firstness uniting all manifest things. The universe is permeated with Firstness as Mind, but that is not the same thing as human awareness. Though a consistent theory of evolution has to point to it, as the origin of human consciousness, Peirce writes.

> What the psychologists study is mind, not consciousness exclusively …. consciousness is a very simple thing …. not … Self-consciousness … consciousness is nothing but Feeling, in general, – not feeling in the German sense, but more generally, the immediate element of experience generalized to its utmost. Mind, on the contrary is a very difficult thing to analyze. I am not speaking of Soul, the metaphysical substratum of Mind (if it has any), but of Mind phenomenally understood. To get such a conception of Mind, or mental phenomena, as the science of Dynamics affords of Matter, or material events, is a business which can only be accomplished by resolute scientific investigation.
>
> (Peirce, 1994: 7.365)

Peirce is not speaking of human self-consciousness but of the essence of consciousness as a phenomenon that develops in nature to emerge in new and more structured forms in living beings, nervous systems and language-based culture. He wants western science to study it, to take phenomenology seriously, and also the phenomenology lying within Eastern philosophies, of which he had studied Buddhism the most. Being an objective idealist, Peirce argues for a scientific study of mind seen as a foundational aspect of reality. This is not possible for the mechanistic science that starts off with fixed and dead laws that cannot develop and cannot encompass either emotions or free will as causal powers. Peirce writes about this concept of thought, understood as a function of mind and semiosis:

> 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. But as there cannot be a General without Instances embodying it, so there cannot be thought without Signs. We must here give "Sign" a very wide sense, no doubt, but not too wide a sense to come within our definition.
>
> (Peirce, 1994: 4.551)

Here Peirce is widening the semiosis concept to include chemical pattern-creating processes as nature's thinking. I would prefer to call these proto- or quasi-semiotic processes to avoid a too broad sense of the concept leading into a pan-semiotic metaphysics. But, nevertheless, Peirce's metaphysics operates with the "inside" of material nature. He writes:

> Wherever chance-spontaneity is found, there in the same proportion feeling exists. In fact, chance is but the outward aspect of that which within itself is feeling.
>
> (Peirce, 1994: 6.265)

I find it compatible with an interpretation of Peirce's theory and in accordance with Perennial Philosophy's mysticism (Stace 1960) to see the living systems, most of all, the human, as the way in which the universe is becoming aware of itself. Evolution is the development of self-organization of systems until they become closed and thereby individuals with own intentions. One needs a body and a nervous system to become (self)-conscious! As Peirce writes:

> Since God, in His essential character of Ens necessarium, is a disembodied spirit, and since there is strong reason to hold that what we call consciousness is either merely the general sensation of the brain or some part of it, or at all events some visceral or bodily sensation, God probably has no consciousness.
>
> (Peirce 1994: 6.489)

Thus, Peirce's concept of God is first and most basic an abstract transcendental origin and continuity "behind it all". God does not appear as a manifest person, as is the basis for much personal worship in so many religions including Christianity. God in Peirce's philosophy is a state of "utter nothingness" like the Godhead of Meister Eckhart (Eckhart 1941) and the emptiness of the Buddhists, as it manifests as an immanent order and "drive" in evolution. It reminds us somewhat of Hegel's "spirit", but again in a different metaphysical framework, where evolution and scientific thinking is integrated in a model that deviates from the Greek Logos thinking and has a triadic semiotic turn to the dialectics of evolution. In trying to give some hints about what pragmaticism[11] is and how it can be used on the highest metaphysical principles, Peirce sums up his general view of cosmic evolution in the following way:

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[11] Pragmaticism is Peirce's special term to defend his original idea of pragmatism, which he found that both William James and John Dewey had misconstrued and which Richard Rorty's later development and – even more anti-foundational and anti-metaphysical and some would also say anti-rational – development of American pragmatism runs contrary to (Haack, S. 2000). The rest of the paper lays out some of the metaphysics of Peirce's pragmaticism.

> A disembodied spirit, or pure mind, has its being out of time, since all that it is destined to think is fully in its being at any and every previous time. But in endless time it is destined to think all that it is capable of thinking. Order is simply thought embodied in arrangement; and thought embodied in any other way appears objectively as a character that is a generalization of order, and that, in the lack of any word for it, we may call for the nounce, "Super-order." It is something like uniformity. Pure mind, as creative of thought, must, so far as it is manifested in time, appear as having a character related to the habit-taking capacity, just as super-order is related to uniformity .... perfect cosmology must ... show that the whole history of the three universes, as it has been and is to be, would follow from a premiss which would not suppose them to exist at all .... But that premiss must represent a state of things in which the three universes were completely nil. Consequently, whether in time or not, the three universes must actually be absolutely necessary results of a state of utter nothingness. We cannot ourselves conceive of such a state of nility; but we can easily conceive that there should be a mind that could conceive it, since, after all, no contradiction can be involved in mere non-existence.
>
> (Peirce, 1994: 6.490)

In the last quote Peirce also touches upon the necessity of a generalization of order as the drive behind the evolutionary processes of the three basic categories. This "pull" towards a super order seems to be the final causation of the evolution of the universe. It "urges" to embody its thoughts in manifest creation. Or as Plato puts it in Timeios: The One's desire to share its love and perfection with the imperfect. It "flows over" from the transcendent into the relative and manifest in time and space creating matter as "effete" mind. The last is a Peircean formulation.

The paradox is that such a transcendent order cannot be formulated in any human language. David Bohm (1983) discusses the same consequences of his own ideas of Wholeness and the Implicate Order; which is the title of his famous book where he works with the idea of an immanent order in nature that produces the "holomovement". This is his conception of evolution. Subsequently, in an interview, he talks about the "super implicate order", which seems very similar to Peirce's "disembodied spirit" that has its existence out of time (Weber 1972). Like the Buddhists, Peirce sees this order as nothing, an emptiness.

Peirce writes that the three worlds, Firstness (qualia and potentialities), Secondness (resistance, will and brute force) and Thirdness (mediation, understanding and habit-taking) must evolve from this transcendental basis in an evolutionary metaphysics. There is a transcendental reality beyond time and space that cannot be spoken of but, still, it is somehow the source of everything. Why is it necessary? Peirce explains:

> For all Being involves some kind of super-order. For example, to suppose a thing to have any particular character is to suppose a conditional proposition to be true of it, which proposition would express some kind of super-order, as any formulation of a general fact does. To suppose it to have elasticity of volume is to suppose that if it were subjected to pressure its volume would diminish until at a certain point the full pressure was attained within and without its periphery. This is a super-order, a law expressible by a differential equation. Any such super-order would be a super-habit. Any general state of things whatsoever would be a super-order and a super-habit.
>
> (Peirce, 1994: 6.490)

Thus logic of the idea of things having universal properties demands a logos as universal foundation. The big question is then, how does evolution start from there?

Plato writes in Timeios that the ‘One’ overflows by love to create something that can contain at least some love in an imperfect way, as it is not jealous. In the Vedas it is desire that makes Brahman create the world through his Shakti (female force of creation). Brahman is in itself the unmovable foundation. In Christianity it is the Holy Ghost that acts in creation on behalf of “The Father”. Peirce’s solution is close to these, but formulated within his own metaphysics and, therefore, much closer to a view and a wording acceptable from a scientific viewpoint of, for instance, quantum field theory:

> In that state of absolute nility, in or out of time, that is, before or after the evolution of time, there must then have been a tohu bohu of which nothing whatever affirmative or negative was true universally. There must have been, therefore, a little of everything conceivable. There must have been here and there a little undifferentiated tendency to take super-habits. But such a state must tend to increase itself. For a tendency to act in any way, combined with a tendency to take habits, must increase the tendency to act in that way. But there are some habits that carried beyond a certain point eliminate their subjects from the universe …. Thus a tendency to lose mass will end in a total loss of mass. A tendency to lose energy will end in removing its subject from perceptible existence.
>
> (Peirce, 1994: 6.490)

Clearly, we move over into Firstness as soon as the tendency to take habits has some differences to work on that will not self-destruct. Thus the Big Bang theory does not tell us how the world was created. It is an attempt to tell us about the physical development of time, space and energy. Transcendence[12] breeds immanence[13] and immanence makes the distinction to transcendence “before” time and “outside” space in an ever ongoing process of being

To return to the beginning of this article, it is possible to understand Peirce’s “neglected argument for God” through the “musing” of “pure play” in the light of his philosophy. Peirce is a synechist – as Michael Raposa (1989) points out – since he considers the Divine as both immanent and as well as transcendent and to be connected in a continuum; whereas others either denies the transcendent – as Bateson or Deleuze – or has assert an absolute dualism like Descartes, so that interaction between the two world becomes a mystery.

For Peirce, to make valuable abductions, the scientist must in a positive way open his mind to the basic creative dynamics of both mind and matter. Many mystics speak of “emptying” the mind, “being simple”, “going beyond the ego” and “letting God in”. But this is not to be understood as divine and intentional messages from a personal God or the perception of some ready made and exact transcendental ideas. It is rather a listening to the hum of creation or the general or basic vibration of the Godhead, flowing “into” time, space, life and mind and back again into its own

[12] Transcendent – a philosophical and theological concept – is that, which is beyond our senses and experience; existing apart from matter. “It” is beyond and outside the ordinary range of human experience or understanding. In theology, the concept transcendent is, pertaining to God as exalted above the universe.

[13] Immanence is a theological and philosophical concept. It is derived from the Latin words, ‘in’ and ‘manere’, the original meaning being “to exist or remain within”.

"nothingness" in that fundamental vibration that upholds our reality (according to much mystical theory). This is a version of the philosophy called panentheism.[14] As Suzuki (2002: 9) points out, God in this conception is not only pantheistic or transcendental, but both, and thereby the concept covers infinitely more.

This theory lifts theories of knowledge and nature out of determinism. We cannot give a final deterministic description of nature, culture, or the knowledge process. Thus knowing is much more than knowledge. Human knowing is a processual flow. It is only by giving yourself up into this sporting of musement, as Peirce calls it, by leaving behind any limits imposed by previous knowledge and skeptical attitudes that you can hope to abduct basic and universal knowledge.

Although Peirce did have a mystical experience (Brent 1998), his major path to the divine insight was clearly through science (as he understood it). Where Plato and Descartes believed in transcendental ideas that our mind could contemplate in the highest and most divine status of mind, Peirce's abductions, with a basis in Musing, gives an evolutionary view on the basic source of fallible human ideas and intuition, to be tested, or falsified as Karl Popper called it much later. The basic ideas and qualia in Firstness are vague and can only be manifested through the collective dynamic processes of science. This is the collective effect of being logical and permitting further empirical testing the ideas or hypothesis through induction and deduction.

Our understanding is not ready made and fixed but fallible and has to be tested and developed through human scientific practice. Thus, although Peirce's musing can be seen as a technique of mystical revelation, it is not about forgetting real life in the ultimate divine existentiality, but a rich inspiration in building a common cultural understanding of reality.

Peirce says that Firstness is vague. It is only being; not existence in the same way as Secondness is "existence". Qualisigns need signs of Secondness to be manifest. Peircean philosophy thus has a mystical metaphysical foundation. Like Aristotle develops a philosophy of science on a mystical metaphysical foundation. But Peirce's "logos" is vague; it is evolutionary, taking habits and thus creating Thirdness. With his theory of abduction, Peirce's places himself between Plato and Aristotle. It is our access to the divine that inspires our understanding of the material world through abduction. Contrary to Aristotle, Peirce sees that induction is fallible because the ideas are vague and the laws of nature not exact. We have to deduct tests from our abductivily created theories and then make inductions from these tests to make our beliefs firm. Nevertheless Peirce does not doubt that we

[14] Panentheism is the belief that the divine is in all things and unifies all things, but is ultimately greater than all things. It is an understanding of all creation as existing in God, yet without negating the transcendence of God. A version of it, which is close to Peirce's philosophy, is holding that the world and God are mutually dependent upon one another for their fulfillment. Peirce points out that God cannot be conscious the same way as humans as it/he/she does not have a body. It is then through the development of structures and processes in time and space that God can become conscious. See Clayton and Peacocke (2004) for one of the latest and most interesting reflections on Panentheism in a scientific world.

advance in thinking all the time, and that everything about the world can be known given time enough, given dedicated groups of people searching for the right way of thinking, and through developing the logic of semiotics towards the summum bonum of all.

Thus in spite of what most scientist and philosophers would think we still end up with fallible science as the most important road to knowledge and evolving towards truth. This in spite of Peirce having a world view opening to mind, consciousness and the Divine as part of reality – an interesting perspective in these times where science, religion and democracy clashed again threatening world peace. Let us sum up the positions, the conflict and Peirce's solution.

## Cybernetic Ecologism versus Semiotic Panentheism

For Bateson, mind cannot exist without matter while matter without mind can exist but is inaccessible. To him mind is recursive patterns of information and logical types in a dynamic hierarchy of Chinese boxes. His worldview is a mind-ecology based on differences that makes a difference (information). The framework is Norbert Wiener's cybernetic statistical thermodynamically concept of information as neg-entropy and therefore order. Wiener builds on Gibbs probabilistic paradigm of thermodynamics (developed from Boltzmann) and complicated phase-space mathematical models. In a Gibbs world view order is the mystery: The pattern that connects. Chaos is instable and collapses into order. What cybernetics adds to the scientific world of force, energy and mass is the virtual world of information-dynamics, which Bateson struggles to find a way to integrate with the classical view of science and its realistic and materialistic view of the world. Bateson called the old physical aspect of the world Pleroma. To keep us "From Single Vision and Newton's Sleep," as William Blake said, he developed Wiener's virtual informational aspect calling it Creatura. Creatura is an aspect of Pleroma, like the process of drawing a map, i.e., extracting features holding the same relations as features of the territory, but without ever producing the exact equivalent of the relations pertaining to the territory mapped.

Therefore Bateson insisted on the possibility and desirability of a science of epistemology and a scientific aesthetics! Cybernetic science, which is also a science of codes, is seen as the key to such a deep non-mystical knowledge of the relation between us, mind, ecology and evolution! This is the pattern that connects. This pattern of order is in the virtual world of Creatura within Pleroma. It is a dynamic order of logical types, which he saw as the basic grammar in a kind of cybernetic language. This dynamics is cybernetic mind, which is the pattern that connects all living systems. Mind is in all of nature from the brain to the ecosystem, from the species to the whole biosphere. The combination of differences, from chaos and structures with the energy flow plus the auto-catalytically recursive tendency of 'cybernetic mind', is what drives evolution. Against mysticism and spiritualism Bateson puts his 'Lonely Skeleton of Truth' as he calls it, which is this cybernetic thermodynamic, evolutionary and ecological mind of recursively dynamic logical types. Here is Bateson's poem he wrote after completion of Mind and Nature (Bateson and Bateson 2005/1987:6):

**The manuscript**

So there it is in words
Precise
And if you read between the lines
You will find nothing there
For that is the discipline I ask
Not more, not less
Not the world as it is
Not ought to be –
Only the precision
The skeleton of truth
I do not dabble in emotions
Hint at implications
Evoke the ghosts of old forgotten creeds.
All that is for the preacher
The hypnotist, therapist and missionary
They will come after me
And use the little that I said
To bait more traps
For those who cannot bear
The lonely
Skeleton
of Truth

This cybernetic mind[15] also rules our emotions as a relational logic. It shows up in our perception as aesthetics. It is the learning pattern in evolution. Wisdom is to know and live the pattern of evolutionary and ecological wholeness in cultures as well as in individual awareness. The pattern that connects can be understood as a metaphor for what many nature-religions or spiritual types of ecologism, or Gaia-thinking, sees as the sacred or the divine. But this non-manifest dynamic pattern is an immanent deity. This is the sacred. The Creatural deep code aspect of reality! But there is no transcendence! Mind is in nature – nature is in mind – mind is in culture and therefore our cultural thinking is deeply connected to nature. What we think about nature is vital for our survival! With a wrong theory of nature and the pattern that connects our cultures chance of survival is like a snowball in hell.

[15] Based on M. C. Batesons introduction to *Angels Fear*, where she quotes the poem. I interpret that 'The Lonely Skeleton of Truth' is a metaphor for his cybernetic steps to an ecology of mind, which I also see as his answer to what is 'the pattern that connects'. On p. 12 G. Bateson writes about the rules of his work: "…, in scientific explanation, there should be no use of mind or deity, and there should be no appeal to final causes. All causality should flow with the flow of time, with no effect of the future upon the present or the past. No deity, no teleology, and no mind should be postulated in the universe that was to be explained."

Thus immanence and pantheism unites Peirce and Bateson although their concepts of the divine are very different. Both place mind as immanent in nature and humans as well as in all living systems. Both see it as important for evolution and the development of cognition and learning. The underlying immanent pattern and dynamics of the mind is seen as the sacred. But it is The Lonely (logical) Skeleton of Truth versus The law of Mind and Evolutionary love, which is very central to modern discussion about what the role of science is in society and in relation to philosophy and religion. In Peirce's theory there is an experiencing inside aspect of the law of mind. Peirce writes about this:

> But all mind is directly or indirectly connected with all matter, and acts in a more or less regular way; so that all mind more or less partake of the nature of matter …. Viewing a thing from the outside; considering its relations of action and reaction with other things, it appears as matter, Viewing it from the inside, looking at its immediate character as feeling; it appears as consciousness.
>
> … a general idea is a certain modification of consciousness, which accompanies any regularity or general relation between chance actions.
>
> The consciousness of a general idea has a certain 'unity of the ego,' in it, which is identical when it passes from one mind to another. It is, therefore, quite analogous to a person; and indeed, a person is only a particular kind of general idea …. a person is nothing but a symbol involving a general idea; … every general idea has the unified living feeling of a person.
>
> (Peirce 1923, Chance, Love and Logic, 253,260–65 here after Brent 1998:214)

From this reflection springs his famous theory of the person as a sign, primarily a symbol in the greater scheme of mind and general ideas. To understand this, one has to remember the philosophical framework from which the concepts derive their meaning. Peirce is a panentheist. The divine or the suprasensible – as Brent (1998:214) calls it – is represented in the sensible. This is an aspect of the metaphysical framework, which most scientific oriented system science and cybernetics avoids in the tradition of avoiding explicit metaphysics beyond science.[16] But the price is, in my opinion, that they lack a theory of meaning, person/subject and first person experience, and qualia.

It is important to note that Peirce does not talk of religion as faith or as a sociological phenomenon and institution: "Religion per se seems to me a barbaric superstition" he wrote in a letter to William James (Brent 1998:261), which also reveals that he has thought critically about both Christianity as well as Buddhism.

In the same year in one of his famous Monist articles The Law of Mind. Peirce writes some important remarks to explain the inspiration and new conception of this classical transcendentalism and mysticism:

> I have begun by showing that tychism must give birth to an evolutionary cosmology, in which all the regularities of nature and mind are regarded as products of growth, and

[16] Brent (1998:209) mentions how Peirce had had a mystical experience on April 24, 1892, in St. Thomas Episcopal Church in New York. Brent found this letter after having written the first edition of the biography, and it made him change the interpretations in the second version considerably.

> to a Schelling-fashioned idealism which holds matter to be mere specialized and partially deadened mind …. I was born and reared in the neighborhood of Concord, – I mean in Cambridge, – at the time when Emerson, Hedge, and their friends were disseminating the ideas they had caught from Schelling, and Schelling from Plotinus, from Boehm(e), or from God knows what minds stricken with the monstrous mysticism of the East. But the atmosphere of Cambridge held many an antiseptic against Concord transcendentalism; and I am not conscious of having contracted any of that virus. Nevertheless, it is probable that some cultured Bacilli, some benignant form of the disease was implanted in my soul, unawares, and that now, after long incubation, it comes to the surface, modified by mathematical conceptions and by training in physical investigations.
>
> (Peirce, 1994: 6.102–6.163)

Thus his vision has a different conceptualization. The essence of consciousness to Peirce is feeling and an important aspect of Firstness is pure feeling. From a Peircian framework, with its synechism, you have to admit that the universe is permeated with Firstness, but that is not the same thing as human awareness (though it is the origin of it). Peirce writes.

> What the psychologists study is mind, not consciousness exclusively …. consciousness is a very simple thing …. not … Self-consciousness … consciousness is nothing but Feeling, in general, – not feeling in the German sense, but more generally, the immediate element of experience generalized to its utmost. Mind, on the contrary is a very difficult thing to analyze. I am not speaking of Soul, the metaphysical substratum of Mind (if it has any), but of Mind phenomenally understood. To get such a conception of Mind, or mental phenomena, as the science of Dynamics affords of Matter, or material events, is a business which can only be accomplished by resolute scientific investigation.
>
> (Peirce, 1994: 7.365)

Peirce is not speaking of human self-consciousness but of the essence of consciousness as a phenomenon that develops in nature to emerge in new and more structured forms in living beings, nervous systems, and language-based culture. Peirce developed his special understanding of the relation between science and religion as mutually dependent and in mutual fruitful evolutionary interaction, what Raposa calls his "scientific Theism". He writes:

> He clung to "the essence of religion", to it's "deep mystery", but not to any particular expression or articulation of it. While also adhering "so far as possible to the church." At the same time, his perspective was informed by and adapted to his ideals as a scientist. Thus he sought to develop and to advocate for persons of faith a distinctive vision and set of attitudes, rooted in his double optimism that "God's truth" is one and that it is indeed accessible to a community of open and inquiring minds.
>
> Raposa (1989:7–13)

This is the unique position of Peirce. In his writing can be found traces of Schelling, Hegel, but the evolution of the spirit is formulated much closer to the scientific view of his time, which is no wonder as he was so well trained and versed in that. Abduction, deduction and induction in triadic semiotic reasoning were substituted for Hegel's (and later Marx, Engels and Lenin's) dialectical thinking process. As in dialectical materialism, Peirce's concept of matter includes but goes beyond the scientific definition at the time. His way of combining matter and mind places him in position either between or – I would prefer to see it – beyond Hegel and Marx.[17] Peirce explains this "religion of science" in the following quote:

> Such a state of mind may properly called a religion of science …. it is a religion, so true to itself, that it becomes animated by the scientific spirit, confident that all the conquests of science will be triumphs of its own, and accepting all the results of science as scientific men themselves accepts them, as steps toward the truth, which may for a time appear to be in conflict with other truths, but which in such cases merely await adjustments which time is sure to effect.
>
> (CP 6.433)

We know that truth for Peirce is what the unlimited community of inquiries will discover to be the case in the long run. A good idea is one that will eventually get itself thought and then keep living and thereby exerting a gentle influence in exchange with others interested in exploring the same kinds of insight (Raposa 1989:154).

Thus for Peirce true science and true religion – if being consistent with their own claim of devoted search for and surrendering to truth and meaning – must work side by side exchanging arguments and developing each other towards that singularity in which truth and meaning through the universe's dialogue and argument with itself converge and meet in a single point. Peirce writes:

> The Universe as an argument is necessary a great work of art, a great poem – for every fine argument is a poem and a symphony – just as every true poem is a sound augment. But let us compare it rather with a painting – with an impressionistic seashore piece – then every Quality in a Premiss is one of the elementary colored particles of the Painting; them are all meant to go together to make up the intended Quality that belongs tot the whole as whole. The total effect is beyond our ken: but we can appreciate in some measure the resultant Quality of parts of the whole.
>
> (Peirce, 1994: 5.119)

To sum up then, the relation between science and Christianity in the West has been somewhat hostile. But so has the relation between the Church and the mystics ever since Meister Eckhart was excommunicated after his death in the medieval times. Peirce's philosophy can be interpreted as an integration of mysticism and science. In Peirce's philosophy mind is feeling on the inside, and on the outside spontaneity, chance, and chaos, with a tendency to take habits. This is the law of mind; with love as Agape being the sole reason for his three types of evolution. Peirce sees the processes and habits of the universe as thoughts and writes that mind manifests best in protoplasm and the nervous system. In some of Peirce's manuscripts he further writes of an emptiness beyond the three worlds of reality (his Categories), which is the source from where the categories spring.

Through this foundation for semiosis, a theory of meaning and interpretation including mind as immanent inside nature, it is possible that the proto-semiotic cybernetic views of information can be combined with pragmatic theories of

[17] If Marx and Hegel's philosophies are viewed as thesis and anti-thesis, then his (Peirce) theory is the synthesis, 'Aufhebung,' of the opposites to be integrated at a new level. The same view can be argued with regard to Plato and Aristotle's philosophies of nature, God and knowledge. Peirce is a mystic evolutionary idealist like Plato (without reincarnation theory), but also a realist and believer in empirical research like Aristotle, but he enlarges their concept of logic with his semiotics plus abductive knowledge process and adds an evolutionary theory of both mind and matter.

language in the biosemiotic perspective. Combining this with a systems theory of emergence, self-organization, and closure/autopoiesis, it can become an explicit theory of how the inner world of organism is constituted in evolution and therefore how first person views and the establishment of interpretants is possible. A triadic aspect-monism with a relational semiotic coding, driven by the law of mind and evolutionary love is the dynamics of the semiotic web underling all reality ultimately arising from the non-conscious transcendental infinite speaker to which science can only have access through intuition and Peircean musing. His main route to intuitive insights seems to have been his method of free musing. His road to enlightenment is based on musement or free association combined with abduction, deduction and induction in the collective ethical process of science in the search for truth.

Peirce was a mystic whose road to enlightenment was pragmaticism, science and the development of semiotic rationality in society. This radical new view of nature, mind and meaning is what is behind Peircean biosemiotics, which I have developed further into a Cybersemiotics.

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# Chapter 14
# Bateson, Peirce, and the Sign of the Sacred

**Deborah Eicher-Catt**

**Abstract** I argue that Gregory Bateson and Charles Sanders Peirce, although holding different beliefs about God and religion, share much in common concerning how the body and mind operate as an integrative, recursive communication system. Regardless of their different points of departure on the topic of communication, their philosophic paths necessarily cross at an "interface" that constitutes an epistemological matrix between them. Herein, I explore this matrix and argue that Bateson's epistemology of the sacred is best understood within a triadic frame of relations offered by semiotician, Charles Sanders Peirce. Specifically, Bateson's triadic relations of aesthetics, consciousness (mental process), and the sacred are understood by way of Peirce's existential semiotic categories of Firstness, Secondness, and Thirdness. Hence, we come to know sacred existence as a phenomenological sign action of human semiosis. As a result, Bateson's epistemology of the sacred becomes more accessible as a philosophy of human existence. We see that his epistemology fosters pragmatic insight concerning the relations between aesthetic perceiving and mental process that supports the characteriological growth of human beings in particular and scientific inquiry in general.

**Keywords** Gregory Bateson, Charles S. Peirce, semiotics, communication, sacred

## Introduction

In his evolving epistemological project concerning the necessary unity between mind and nature, Gregory Bateson makes the issue of *the sacred*, or the mental "pattern which connects" a central problematic, especially during his later years (Bateson & Bateson, 1987). He is convinced that by investigating the "interwoven regularities … and necessities of communication and logic …," we open up new meanings for words like "god" and the "sacred" (Bateson & Bateson, 1987, p. 142)

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that can be epistemologically heuristic. As his work progresses, Bateson becomes more confident than other theorists of his time are willing to admit that the texture of *the sacred* is deeply entwined within both "nature" and culture. Furthermore, he is sure that studying information and communicative processes of all organisms hold the key to understanding *the sacred*. He goes so far as to say "… that the communicative fabric of the living world is ordered, pervasive, and determinant even to the point where one might say of it, that is what men [sic] have meant by God" (Bateson & Bateson, 1987, p. 151). As a theorist of human communication and a Communicologist,[1] I am convinced that, on many of these accounts, he is correct. Unfortunately, the full impact of his ideas have been largely ignored.

Given Bateson's ontological framework known as the *ecology of mind*, how should we understand his notion of the *epistemology of the sacred*, especially within the current context of postmodern thought and human relations? More specifically, how, we must ask, is the process of *knowing* a sacred act between self, other, and world? And, how is *the sacred* tied to knowing, if we theoretically frame knowing as essentially a *communicative* process and event? Furthermore, how are both *knowing* and *sacrality* connected to *mind* and *nature*; connected, in other words, to both the mental and physical realms of human existence as we experience them within everyday life? All of these questions are, foremost, problematics of human communication; i.e., questions about *how relationships* between mind and nature are created, sustained, and transformed through linguistic and non-linguistic structures and processes. Specifically, the above questions call for a philosophy of communication, like Communicology, that will acknowledge the salient relationships interpersonally negotiated between cultural and corporeal aspects inherent within all human knowing and understanding (Eicher-Catt, 2005a). Put simply, it calls for an approach that reflects an integrative application of semiotics and phenomenology (Lanigan, 1992) to Bateson's work.

Exploring these problematics within the framework of Communicology, we begin to understand that human communication is best conceived as *both* a structure *and* a process that entails information exchange but is not sufficiently created, sustained, or transformed by it. Such a theoretical position is not contrary to Bateson's work in cybernetics, nor is it opposed to his later work on the *epistemology of the sacred*. Indeed, Bateson acknowledges that communication, at the human level of a system/environment interchange, requires interlocutors that not only succeed at exchanging "news of difference" or information (Bateson, 1972), but also are capable of together creating an identical message-to-code relationship that is mutually perceived or embodied (Ruesch and Bateson, 1987). Unlike many in my discipline in the United States who think they have reaped plenty from Bateson's initial forays into cybernetics and information theory, i.e., the study of message

[1] Communicology is a coherent theory and methodology recognized in the United States and Europe which explores the existential or phenomenological ground from which subjectivity and intersubjectivity emerge among human interlocutors as a semiotic (Peirce, 1955) process. Communicology's historical roots lie within the *Geisteswissenschaft* (human science) tradition. See, for examples, Lanigan, 1988, 1992, 2000; Eicher-Catt, 2001, 2005a, Catt 2000, 2002.

production and exchange, I contend there is much more in Bateson's writings, especially in terms of *the epistemology of the sacred*, that can contribute to our understanding of the accomplishment (or lack thereof) of human communication, as defined above. My discussion herein thus focuses upon the following research question: How are we to understand *the sacred* as a way of *knowing* in the context of self, other, and world relationships?

Theoretically, I synthesize a semiotic perspective on language and discourse (Peirce, 1955) with an existential phenomenological (Merleau-Ponty, 1962) approach. The former engages questions of human, corporeal experience of signs and sign systems at the cultural level of existence (referred to by both Bateson and Peirce as simply "mind"). The latter perspective engages questions of human consciousness as a sign process at the level of physical/corporeal embodiment (akin, in this context, to Bateson's concept of "nature"). While Bateson theorizes his "Science of Mind" as a structural and processual *ecology of ideas*, based upon the interactions between an aesthetic conception of human agency and consciousness, semiotician and pragmatist Charles Sanders Peirce conceives the workings of mind to be comprised from another triadic relation. Peirce's science is, of course, based primarily in semiotics, i.e., the study of sign processes as a communicational logic, whose phenomenological (bodily) elements he identifies as sign, object and interpretant.[2] These elements or categories of being, according to Peirce, constitute the semiotic process by which we come to grasp and know the world around us as a phenomenology.[3] In terms of our topic of *the sacred* and its relationship to *knowing*, both theorists have something to say. Bateson appreciates an ineffable "power" or sacrality that operates integratively, he believes, at a human "interface" as part of a larger matrix of mental process. *The sacred*, after all, provides the very "staff of life" (Bateson, 1991, p. 270) of which we are only a part. Although more implicit, Peirce (1955) also recognizes the same ineffable power, by acknowledging that any boundary conditions imposed by cultural signs are "… the very definition of thought" (Deledalle, 2000, p. 14) from which all life and knowledge about life spring. Read alongside one another, we come to appreciate that their philosophic paths "interface" (Bateson & Bateson, 1987). This interface constitutes, I suggest, a heuristic philosophic matrix that advances our understanding of *the sacred* or "the pattern which connects" as essentially a communicative phenomenon that is open to scientific interrogation. Exploring them together, we find that both philosophers recognize the possibilities that exist for the human condition if we honor any interface between mind and nature as a site of potential communicative accomplishment. As a result, such a synthesis allows us to explore how we might theoretically frame *the sacred* as a way of *knowing* about self, other, and world within a highly complex context of information networks and multi-layered systems of human signification and meaning in which we live as human beings.

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[2] See Gerard Deledalle (2000) for an insightful discussion of Peirce's categories.
[3] See specifically chapter six in the J. Buchler's (1955) *Philosophical Writings of Peirce* for a discussion of Peircian phenomenology.

## The Interface of Theoretical Foundations

Elsewhere (Eicher-Catt, 2003), I thoroughly interrogate their interface at the level of theory by employing an abductive logic as espoused by both Bateson and Peirce. Because this epistemological interface forms the foundation for my argument herein, I briefly summarize its main tenets.

I begin by providing some context for the theories they both pursue on the essential integration of mind and body as a *communicative logic*. I compare Bateson's ecology of mind with Peirce's theory of sign actions. We find that one of the driving questions of scientific inquiry for both theorists is: what are "patterns," (in Bateson's case) or "signs," (in Peirce's case) for? In other words, both are concerned with what do signs/patterns of experience teach us about the world from which an existential pragmatics of mental process "naturally" evolves? I contend that both philosophers are troubled with the notion of human agency (at both the mental and biological level) and the pragmatics of existence as displayed within a multi-leveled, existential relatedness between self, other, and world. Most important, we find that both also construct their developing epistemologies within a triadic frame of relational understanding that successfully accounts for how the integration of body and mind is accomplished in everyday discursive and non-discursive practices.

In my comparison as Figure 14.1 suggests, I read Bateson's interpretation of the "readiness to receive" information function of organisms akin to Peirce's semiotic phenomenological category of Firstness. I see Bateson's notion of consciousness/awareness (understood as primary consciousness) as Peirce's semiotic phenomenological category of Secondness.[4] I interpret Bateson's pursuit of the "pattern which connects," or *the sacred*, as recognizing what Peirce describes as the semiotic phenomenological category of Thirdness. See Figure 14.1 for an account of these comparisons and their interrelationships at multiple levels of abstraction.

While Peirce and Bateson explicitly frame their scientific inquiries of mind in terms of these triadic relations, they are also aware that the very constitution of relations, in and of themselves, is a boundary-spanning activity. As humans we

[4] Bateson, in particular, is careful to distinguish between what he means by consciousness and what he means by "mental process" or mind, although he stipulates that consciousness is an aspect of mind (Harries-Jones, 1995). For Bateson, consciousness is an awareness of how information moves in a communication system (Bateson & Bateson, 1997, p. 100). Typically, he separates consciousness into several levels to mark distinctions between those that are readily "accessible" to an organism's awareness and those that are not. Eventually in his epistemology, the term consciousness is reserved to represent the actions of living organisms promoted by conscious intent or purpose. He often spoke of this as a "secondary process" of mind or "prose" consciousness (Bateson, 1979, 1991). On the other hand, it does appear that Bateson's notions of the "unconscious" realm, "primary process," the "non-purposive components of mind," or what he deems "poetic/metaphoric consciousness," however, begin to speak to what phenomenologists call the primordial, pre-logical, or pre-objective aspect of consciousness (Merleau-Ponty, 1962). At this level of his theory, moreover, Bateson does adequately account for an "active" consciousness (conceived as a phenomenological intentionality), even though its actions are typically inaccessible to human review.

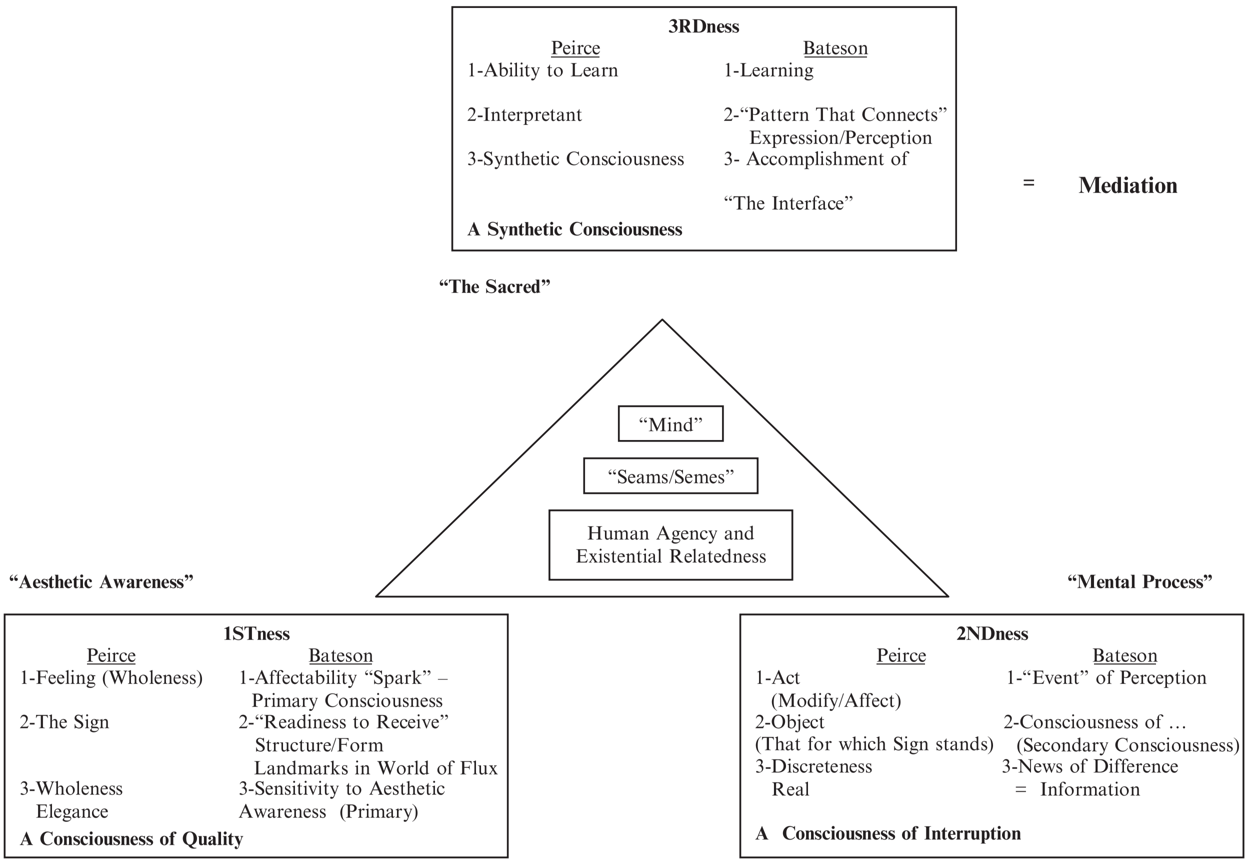


**Fig. 14.1** Comparison of Semiosis (sign action) and the ecology of mind

bring some "thing" into relation with another "thing" precisely because there is a perceived *gap*, a discontinuity between the two that necessarily entails a *boundary* between them. Peirce thinks that the very nature of any sign's appearance (its Firstness) automatically forms such a boundary condition for us from which we begin the existential process of semiosis or sign perception/interpretation. That is for Peirce, any sign, as an artifact of experience, sets up inclusionary and exclusionary rules by its "natural" history within a semiotic web that both possibilizes and constrains its subsequent signification and meaning constitution (as an aspect of Thirdness). Bateson, as a system's theorist, is also well aware that the form/structure of any system/ environment within his ecological framework exists because of the inclusionary and exclusionary function of the necessary boundary that mediates the two. He writes extensively about the interface and later about "scanning the interface" as an essential route to accomplish this perception (Bateson & Bateson, 1987; Bateson, 1991).

However, to fully understand the communication dynamics of boundaries within both of their theories of mind and, consequently, to illuminate how we come to understand *the sacred* as a communicative phenomenon, we must "shift" to a higher level of awareness in our discussion. This brings me to my exploration herein: Bateson's triadic relation of aesthetics, consciousness (mental process) and *the sacred* explicated through a semiotic and phenomenological lens. We discover within this triadic layer of theoretical thought, Bateson's way of exposing how these three relations set in motion a new epistemology that any *sacred unity* (Bateson, 1991) entails.[5] According to Bateson, the recognition and preservation of this unity of relations is indicative of any organism's survival worthiness. I begin with Bateson's focus on aesthetics.

## Aesthetic Experience as Epistemology

Bateson theorizes that to recapture a productive sense of the "eternal verities of life and environment" that together weave the "pattern which connects," scientific inquiry has to reclaim, from organized religions, some of the qualitative sensibilities about how to perceive the world that substantiates a recursive unity between mind and nature. Therefore, he proposes an attitude or sentiment towards inquiry

[5] Now, as I begin this theoretical juxtaposition, I am fully aware of Bateson's suspicion of our capacity to "symbolize," or our capacity to use language and discourse to represent the world. The irony of my argument in this paper, reading Bateson through Peircian semiotics, will not go unnoticed, therefore, by those most familiar with Bateson's work. Although Bateson refutes our capacity to symbolize because of its power to "cut things up" (Harries-Jones, 1995, p. 302) in acts of representation, I hope to show that, while symbolic language certainly accomplishes this feat, a contrary "language of relationships" (Bateson, 1979) that Bateson promotes is inherent within Peirce's triadic relations of Firstness, Secondness, and Thirdness. In my analysis, semiosis, understood as embodied relations of signs, becomes sacramental to Bateson's epistemology, rather than counter to it.

that espouses an aesthetic, i.e., a "perceiving for perceiving's sake" (Hospers, 1967, p. 36) in which life's structures and processes can be recognized as aesthetic performances and accomplishments. This way of perceiving the world is not to be confused with a cognitive focus that merely reduces objects (signs) to self-serving frames of reference. Aesthetic appreciation, for Bateson, is at once an unconscious and unaware experience fueled by primary not secondary consciousness, as he defines them. That is, it is an awareness that is non-purposive. Thus, he understands that "Aesthetic attention [toward the world] is always to the phenomenal object, not to the physical object" (Hospers, 1967, p. 38). The aesthetic experience is constituted by an appreciation for the internal/external, structure/process amalgamation of the object (sign) perceived that gleans its originary "neatness, elegance, and economy of means" (Hospers, 1967, p. 38). He recognizes, especially in all religious doctrines and sacramental activities, an ability to evoke in participants this broader appreciation for a perception of the world's aesthetic beauty. (As a phenomenological semiotician, Peirce, of course, categorizes this state of appreciation and beingness as Firstness.) Moreover, Bateson is convinced that we, as a species, do not endorse an aesthetic attitude enough when it comes to our own ways of knowing about or understanding the world. Such a perspective, he thinks, would enhance our abilities to appreciate *the sacred* unity of mind and nature. It also would increase our survival worthiness.

Above all, Bateson understands that to invoke the aesthetic within an evolving epistemology means that science needs a degree of "humbleness," i.e., an ability to submit itself to the process of recursive questioning which should subsequently stir, move, or pull itself out of typical modes of thinking to this new level of awareness. To use Peirce, we are able to aesthetically appreciate or value life, Bateson thinks, because of those aspects of originary Firstness which problematize the immanence and transcendence of experience *simultaneously*. Any*thing* deemed *sacred* is, after all, that which we hold dear (immanent) because it is that which is untouchable or unspeakable (transcendent). This mental process entails, of course, an implicit appreciation (as an aspect of primary process) of the *boundary* or *interface* that necessarily exists between the two. Bateson, I believe, is fully aware of this paradoxical division and unity of perception and experience when he claims that such an aesthetic experience of inquiry requires a degree of detachment from the natural attitude of science and propagated by life's sense of everydayness. He also understands that the drawing of the boundary is an axiological event framed by our own perceptual/expressive processes since, "the boundaries we draw are also criteria of our own taste and aesthetics" (Harries-Jones, 1995, p. 226). To respond to life through aesthetic perception means it is necessary, according to Bateson, not only to recognize, non-purposively, that a boundary between system and environment exists, but to appreciate the existence of the boundary for the potentiality of information exchange and communication it provides. After all, it is the discontinuity or *gap*, as Bateson says, that is necessary in order to prevent "… recursive systems [from] dissolv[ing] into tangles of interconnectedness" (Harries-Jones, 1995, p. 223). Boundaries, as Harries-Jones (1995, p. 223, my italics) explains, and their corresponding "*Gaps* are necessary in order that perceptual processes can mark distinctions and differences in system integration. Recursiveness certainly proposes patterns of continuity. Yet gaps and discontinuities are a condition of grasping such continuities of form." This primary "conscious" experience of the boundary invokes an aesthetic. It is "wonder in face of the world," as phenomenologists contend.[6]

## Mental Process (Consciousness) as Epistemology

Although Bateson does not, of course, define mind or mental process explicitly as a function of semiosis, as Peirce does, we have seen how his ideas about the nature of mind run parallel with Peirce's, especially in regard to mind's essential relational components. Fundamental to Peirce's "law of Mind" is his premise that the study of sign actions offers "an account of how the mind functions, develops, and decays …" (Colapietro, 1989, p. 54) within a "semiotic web" constituted inter-relationally. To Peirce, mind is both form and function (Bateson's notions of structure and process) and is not merely cognitive in scope. Instead, mind is mediated by a consciousness that exceeds Bateson's concept of "secondary process." Peirce theorizes that "ideas" or mental processes tend to spread through affectability so that all mental phenomena exhibit an inherent dynamic quality that is captured phenomenologically. This matches closely with Bateson's notion of mental process as an "aesthetic sensibility" (Bateson, 1979). Peirce also qualifies his three modes of being as "categories of consciousness" (1955, p. 95) where Firstness is a consciousness of quality, Secondness as consciousness of an interruption into the field of consciousness, and Thirdness as synthetic consciousness, binding all together.

With his ideas of the ecology of mind, Bateson, like Peirce, is trying to explicate mental process as a systematic account of informational and communicational checks and balances, self-corrections, growth and decay at any system/environment interface (Ruesch & Bateson, 1987). Bateson's notion of the mind thus displays a rich texture or "matrix," as he says, that seeks to account for all the "communication regularities of the biosphere" (Bateson & Bateson, 1979, p. 142) that comprise systems of thought. Bateson's theories of mind, in other words, seek to explore what Peirce calls "psychical truths," or the workings of the mind in general" (Colapietro, 1989, p. 51). Thus, for Bateson, mind or mental process is of a higher logical type or level of abstraction than his other notions of consciousness framed as conscious intent or secondary process. Peirce theorizes similarly. As Peirce remarks, "… the action of thought is all the time going on, not merely in that part of consciousness which thrusts itself on the attention … but also in the deeply shaded [or hidden] parts" (cited in Colapietro, 1989, p. 40). To Bateson's way of thinking, mind, as a complex matrix of ideas and ideas about ideas, illuminates how ideas (news of difference) move within the system/environment interface to allow for the formation of pattern, purpose, and organization within every living organism. (Bringing these

[6] This phrase is credited to phenomenologist Eugene Fink.

elements into contiguous relation does, of course, constitute Secondness according to Peirce's categories of existence.) Thus Peirce also allows for the accomplishment of Secondness from both secondary conscious purpose and "unconscious" primary consciousness.

The meeting place or *interface* at which scientific inquiry or human relations encounter "news of difference," i.e., information, or Secondness, is best understood as yet another existential boundary condition exposed by the unique relationship established between aesthetic experience (Firstness) and mental process (Secondness). Especially at this level of thinking, Bateson is quick to emphasize that the "lines" or boundaries that are drawn are a direct result of any science or human's operating premises and subsequent criteria for judgment—its operating ontology and axiology. Thus, developing mental processes as an evolving epistemology requires a scientist or an ordinary human being to appreciate comparison and metaphorical thinking that bring into contiguity two differing positions in hopes that, through their juxtaposition, new insights about the "patterns which connect" are produced.[7]

As Harries-Jones describes, it is at this juncture of Bateson's thinking that he corrects or improves his model of mental process as advanced in *Mind and Nature* (1979). Bateson's new concern lies in the relation between process and structure that he previously outlined on the basis of Russell's hierarchy of logical typing. That is, his previous proposal of process and structure as a "dialectical zig-zag" relation was primarily "… a cognitive reordering of relations (i.e., reordering from the 'inside,' or 'the form side'), as Harries-Jones (1995, p. 261) explains. Instead, Bateson subsequently realizes that he needs a new model that " … [will] more clearly emphasize an ability to grasp percepts of 'the process side' in addition to 'the form side,' and their patterns of interconnection" (Harries-Jones, 1995, p. 261). To solve this, Bateson develops his idea of "scanning" at the interface which "… requires as a minimum *a triad of relations* … [because] … the model of 'scanning' had to account for the way that the whole system – ecology, environment, and mind – is able to re-enter an organism's perception, enabling observation in a recursive manner, without splitting organism from environment" (Harries-Jones, 1995, p. 261, my underlining). Thus, he devises a structural and processual model similar to Peirce's triadic relation of sign, object, and interpretant in that his new model acknowledges, like Peirce's, a pattern of "… reflexive communication that [is] *intransitive* in its processual orientation – and one which include[s] patterns of loops within loops as a mark of its continuity" (Harries-Jones, 1995, p. 262). His model includes, therefore, a double articulation at the interface between continuities and discontinuities. His objective is to not only account for a "creative subjectivity" within humans in general and scientific inquiry more specifically, but also to account for how such "self-referencing systems" conjoin and couple at the interface to produce new ideas or insights. As Bateson now asserts, the coupling aspect at the boundary (its aspect of discreteness/Secondness) recognizes its recursive capabilities,

[7] This constitutes, of course, Peirce's notion of an abductive logic.

i.e., “boundaries of any interface are scanned as we meet them and are themselves changed as we alter our relations to them” (Harries-Jones, 1995, p. 264). Above all, Bateson’s evolving epistemology as mental process acknowledges the necessary unity of primary and secondary consciousness or mental process as well as the boundary conditions from which that unity is ultimately derived. Therefore, Peirce and Bateson theorize mind as both immanent and transcendent experiences of consciousness. Peirce thinks mind produces mental “habits” or regularities of affect by focusing upon the cultural elements of language as they are articulated and circulated in discourse. Bateson thinks mind achieves “pattern” within an evolving matrix of communicative patterns, also embedded within discursive and non-discursive frames. Both assign to mind an imaginative or creative function by recognizing its reflexive and recursive capabilities. They are simultaneously idealistic and materialistic concerning the characteristics of mind. That is, they are idealistic because they think “… matter is a species of mind” and materialistic because they think “… mind must be embodied” (Colapietro, 1989, p. 113) to move, to shape, to affect within self, other, and world relations.

Given the above, we see that Bateson’s mental process and Peirce’s concept of mind align closely with a phenomenological and semiotic understanding of human relations. The relationships between the two reveal their *mind-in-action* as it exists to enliven everyday cultural experiences, including scientific investigations. Bateson’s foci upon communication systems and with the mutual causal chains activated by “news of differences” are concerns, I contend, with the phenomenological semiotic conditions of lived experience. Although Bateson is careful not to jump onto a phenomenological bandwagon, it is not because he does not share some basic ideas about what mind or consciousness of the world entails. Rather, he misinterprets, I believe, the phenomenologists’ concept of perception by accepting the mistaken belief that phenomenologists do not recognize distinction/difference but only generalizing gestalts within the perceptual process (May, 1977, p. 80). To the contrary, existential phenomenologist Merleau-Ponty (1962, 1964) and many others clearly articulate the primacy of perception as an accomplishment of the very distinction and difference that Bateson recognizes as the relational key to knowing anything. Our final perceptual experience of the gestalt is, however, an irreducible accomplishment of Firstness, Secondness, and Thirdness, as a *sacred* unity.

## Bateson’s Epistemology of the Sacred

As Bateson’s exploration of science and human communicative action reveals, the recursive and reflexive elements of the relations between aesthetic awareness (Firstness) and mental process (Secondness) are mediated by “the pattern which connects,” what Bateson comes to call *the sacred* (Thirdness). Essential to this overall communication process (identified by Peirce as both phenomenological and semiotic) is an understanding of structure or forms (signs to Peirce’s way of thinking) that, by their very nature, instantiate boundary conditions between the relations, i.e., the conditions of human perception/expression that engender these relations. As Harries-Jones indicates, in Bateson's posthumous publication *Angels Fear*, written with his daughter, Mary Catherine Bateson, he identifies how boundaries are essential for setting the "outer limits" between living systems and non-living systems, acknowledging Jung's distinctions between *creatura* and *pleroma* in his, Seven Sermons of the Dead (1965). Bateson is also well aware that "… wherever a distinction is drawn which separates a unity, as with the figure of *creatura* on the ground of *pleroma*, the distinction will always require a *'third position'* from which the separation of figure from ground can be contemplated" (Harries-Jones, 1995, p. 97, my italics). At this level of thought, Bateson identifies this third position as *the sacred*. Boundaries are, of course, the very means by which any "ordering of relations" abides at any level of human existence or scientific inquiry in general. Peirce also recognizes the existence of these implicit boundaries when he identifies his three categories of mind and the distinctions between them.

Now, Bateson envisions boundaries as Harries-Jones describes (1995, p. 99, my italics), as creating "… gap[s] in a continuum which is otherwise perceptually undifferentiated. The 'gap' then becomes a locus for contrast, this is for perceiving a difference and creating a distinction between figure and ground. *Once the boundary is perceived*, the distinctions in its levels and the characteristics of the 'gap' can be spoken about." Bateson contends, therefore, that these gaps are needed in order to maintain the possibility of *the sacred*. Moreover, Bateson theorizes these gaps within his multi-leveled communicative matrix as primarily the absence of communication or "noncommunication" (Bateson & Bateson, 1987, p. 80). We have to conclude, at this point, that he is referencing noncommunication as the absence of any system/environment information interchange. In this specific context, however, Bateson is erroneously equating the act of *communication* with conscious purpose or intent to send a message that, by its very intrusion within the system/environment relation, may disrupt the aesthetic experience of mental process or "… alter the nature of the ideas" (1987, p. 80).[8] Because he wants to eliminate this intrusion, he advocates an avoidance of "communication" as a way to preserve the "secrecy" that typically surrounds anything we deem *sacred*. To Bateson, the avoidance of communication (defined, in this context, as intent to send a message or *information*), is, of course, an act of non-connection that sustains the *gaps* between patterns of thought that he thinks possibilizes *the sacred*. Hence, he subsequently admits that "silence is golden" (1987, p. 81) when it comes to understanding *the sacred*. As such, however, he defines silence as an accomplishment of conscious purpose to *not* "communicate." This act of silence would ironically, however, constitute silence arrived at through what Bateson identifies as a "self-consciousness" (1987, p. 86).

In order to correct this mis-interpretation of equating communication with conscious intent to send a message, as Bateson does in this passage, we need to accurately

[8] This is not unlike many who superficially equate the sending of a message with communication. Instead, the act and process of communication needs to be understood at a different level—it is an accomplishment of mutual understanding that entails information or message exchange but is not sufficiently determined by it.

view human *communication* as an accomplishment where mutuality of signification and meaning is derived, as detailed above in my previous discussions. Accordingly, we can then view this experience of the gap as silence, as Bateson acknowledges, but it is a silence that *marks* the very accomplishment of communication between interlocutors as the establishment of mutual meaning (Thayer, 1997). If we accept the premise that information exchange is motivated by a need to reduce uncertainty (Berger & Calabrese, 1975), as is popular within the literature of communication studies, then silence, in this sense, signals its accomplishment. It is the moment, in other words, when mutual signification is phenomenologically achieved between interlocutors within the sign to object to interpretant relationship. But, it is a mutuality that lacks any self-consciousness. Or, in Bateson's terminology, this structure and process signals the achievement of "balance" between system and its environment which emphasizes the boundary or unity between the two. Further on in this passage, Bateson does admit that silence, understood in the sense I am now using it, marks the experience of "approaching holy ground" (Bateson & Bateson, 1987, p. 81) and that "… a *lack of self-consciousness* is right in the center of this business of noncommunication" (1987, p. 86, my italics). Silence, understood in this corrected way, thus manifests the gaps that in turn engenders unevenly distributed information among the interacting parts (1987, p. 85). On a human level, the result of this experience of uneven distribution of information takes the phenomenological forms of an "unknowing," "secrecy," and/or "mystery" that *the sacred* portends.

So far, we have explored the existential and semiotic relations of both Bateson and Peirce in terms of how we should appreciate human experience as an accomplishment of Firstness, Secondness, and Thirdness as a *sacred unity*. In order to answer fully my research question: how are we to understand *the sacred* as a way of *knowing* in the context of self, other, and world relationships, requires, however, another recursive "shift" in perspective. It requires "double vision," as Bateson contends. It requires a recursive move, in other words, from Thirdness back to Firstness in our attempt to fully explore (and perceive) *the sacred*. In doing so, we begin to expose how we existentially weave insights about *the sacred* into a typical fabric of everyday life that clearly displays *the sacrality* of human existence in its function and form.

## Weaving Sacrality into Human Existence

If we conceptualize these relations of unity and difference metaphorically as various pieces of cloth or fabric, as Bateson often does in his writing (Bateson & Bateson, 1987), then we can visualize these essential gaps as spaces that mark the distinctions between the woof (aesthetic awareness) and warp (mental process) of any fabric's weave. When successfully combined (*sacred unity*) they accomplish patterned existence. As a reminder, Bateson envisions that these interfaces, boundaries, or gaps are *essential* and thus contribute to the fabric's (organism's) integrity because they allow the fabric or necessary unity to "… permit change to occur without disruption of the whole system, or, alternatively, without the whole system being required to adapt constantly to minor variations" (Harries-Jones, 1995, p. 101). Again using the power of metaphor, these essential gaps within a piece of cloth allow, in other words, for a fabric of human existence to remain flexible and less likely to shred under normal conditions of wear and tear. As Bateson acknowledges, "It is this *loss of flexibility* that would be lethal to the total process" (Bateson & Bateson, 1987, p. 92). This idea explains why in his later writings he contends that "continuity at the interface of the recursive must be offset by discontinuity" (Harries-Jones, 1995, p. 223). And, while "… recursiveness certainly proposes patterns of continuity … gaps and discontinuities are a condition of grasping such continuities of form" (Harries-Jones, 1995, p. 223). Unfortunately for us, we do not recognize these typical gaps in regular pieces of fabric because they are the *ground*; their purpose is to focus our attention on the *figure*, i.e., the originary wholeness of the cloth (or discourse) as a work of art (or communication). Therefore, it is in our recognition of the distinctions between continuity and discontinuity in human existence that enables us continually to weave any fabric of patterned thought, whether personal or scientific. Indeed, any fabric of life is both form and process, as Bateson acknowledges.

When we finish our weave of knowledge (or patterned thought), we often bind the edges with what a fiber artist calls a *seam*. Now, the kinship between the word *seam* and the Greek word for sign, *semeion*, or in its shortened derivative, *seme* (pronounced *seam*) is not coincidental. *Seme* is translated in a number of ways, the most relevant being as a sign, *boundary*, or divine message, as in the 'signs and tokens' of the God of the Old Testament, such as the rainbow (Wilden, 1987, pp. 142–143). Hence, a *seam/seme* or presence of a sign acknowledges a *divine boundary* that exists between continuity and discontinuity, between mind and nature, between aesthetic awareness and mental process. To Bateson's way of thinking, unfortunately every discipline within the academy is busy weaving its own pieces of knowledge and binding them with *seams/semes* or signs which, above all, keep them appearing separate and distinct from one another. This process of producing multi-layered, distinct pieces of *seamed/semed* fabric, whether in the scientific realm or the realm of human relations, runs the risk of producing too many fragments of knowledge which remain disjointed. The overall aesthetic "pattern which connects" is under-appreciated and thereby lost, especially in Western societies where the grand narrative of progress requires replacement of the old with the new. In the case of scientific inquiry, even if epistemological investigations eventually expand our ontological base at greater levels of abstraction, we do so at the risk of instituting new boundaries or seams/semes, where edges of cloth have been sewn together in a confusing patchwork way. For Bateson, it is better or "healthier" if we initially recognize the gaps (engendered by these signs of inquiry) produced by these fragments as already part of a greater matrix or necessary unity that exists between an epistemology of aesthetics and mental process. Understanding this process of boundary recognition, through sign instantiation, I argue is the very process and ultimate structure of what Bateson describes metaphorically as *the* *sacred*. Ironically, we must come to understand that the actual establishment of these boundary conditions or *gaps* is the *necessary condition* that creates any system's relationship to its environment. Without the gaps, there are only "tangles of interconnectedness" (Harries-Jones, 1995, p. 223), as Bateson reminds us.

A fuller appreciation of *the sacred* is not achieved, however, through conscious purpose or an awareness of the boundary that is, in any sense, goal directed. To the contrary, such self-conscious boundary awareness possibilizes only secular discourse, as Bateson understands it, or discourse at the everyday level of existence. Rather, it is in the silent *process* of stitching across the gaps and creating the structural element of a seam/seme that, for Bateson, begins to expose the possibilities inherent within *the sacred*. It is, in other words, recognizing within an aesthetic awareness discontinuity as a possible continuity and vice versa. Thus, the "pattern which connects" is mediated by the relationships between *form* (pattern/sign/seme) and *process* (action/stitching/expression/perception) as a phenomenological semiosis of the speaking/perceiving person. According to Bateson, all living organisms participate in this sacred triadic process although, in the case of human interaction, its accomplishment is typically repressed. Fundamentally, what *is sacred* in life is to know aesthetically, as Bateson suggests, the potentiality of "ideas" or the experience of "differences which make a difference" and the contextual cues that shape the success or failure of interactions. In an everyday sense, these ideas or epistemologies can be revelations; however, they are only produced when we effectively participate in our own determination and evolution at the existential boundary condition presented by a given sign(s). Bateson contends that this accomplishment induces both positive "pure and holy" and negative consequences "impure and unholy" seams/semes depending upon our level of awareness and responses at the boundary. In discussing this process as a sequencing of steps, Bateson and Bateson (1987, p. 159) contends that "… the outcome of the sequence will depend upon the sequence of steps, and if the sequence is in wrong order or some steps are omitted, the outcome will be changed and may be disastrous." Accordingly, in contributing to our own determination and evolution every human and scientific system has the capacity to participate and create positive sign actions or negative ones. Using Bateson, we can understand that the outcome of any sign action is signified as positive when it supports the characterological growth of our being as an integral component within a wider network of social relations. When the systemic balance is disrupted or stymied, characterological disintegration occurs and the outcome is signified as negative (Bateson, 1991).

Now, in his later writings on how this process of accomplishment applies specifically to human agency, Bateson emphasizes the importance of understanding *how* we perceive or "scan" our stitching process at this boundary/sign interface. The interface is characterized, according to Bateson, by differences of kind or qualitative differences between what is one side and the other (1987, p. 123). Accordingly, in our process of "scanning the interface" (Bateson & Bateson, 1987), if we do not, in other words, problematize or sufficiently grasp the system/environment boundary as a moment that possibilizes a sacred *aesthetic connection* between mind/body, then our interactions within the world become merely re-productions of already thematized or existing cultural signs and embodied codes. The world becomes full of "things," distorting the awareness of relations among things. Our overall fabric of inquiry or life may be torn, but we do not notice that we are at the mercy of signs and patterned sign systems. In such cases, all our sign actions (products of phenomenological semiosis) appear to follow the same general rule; our interactions with the world are determined, colonized, and/or naturalized by the very "nature" of cultural sedimentations of meaning (ideologies) posed by these patterned sign systems. Life, in general, and epistemology in particular, become mere duplication of culturally accepted sign processes and interpretations that separate us from future, differing interpretants that might provide other possibilities for meaning and scientific investigation. These dominant cultural codes have "reset the bias," as Bateson says (1987, p. 134); such codes change the structure's (or organism's) calibration in the way it typically receives information. Bateson (1987, p. 138) argues that under such conditions the potential for pathology runs high. These dominant cultural codes "… clot together to create aggregates which become the embodiment of themes of which the individuals themselves are or may be unconscious." Unfortunately, there is comfort at this unproblematized boundary for those who reject ambiguity, mystery, and the questioning that typically follows.

When we eclipse boundary recognitions, either at the level of primary or secondary consciousness, therefore, we merely develop "habits" and pre-"dispositions" toward the world that certainly serve to frame our existence and the questions we ask about it (Peirce, 1955). Life, in general, and scientific inquiry in particular, become pre-ordained or "ordinary." Ironically, Peirce describes philosophic inquiry from this point of view as "seminary" (Colapietro, 1989, p. xvii), using its religious connotation. He believes it to be a sub-standard way to think. It is thinking, according to Peirce, within a pattern of ideas that is not of one's own making. It is adopting a doctrine or pattern of signs and sign systems instead of questioning them. Again speaking metaphorically, we see how such a state of non-recognition of the boundary is produced by mistaking seams/semes at the edges of various pieces of cloth for seams/semes that unify instead of further divide. Such a perceptual process engenders various bound or seamed pieces of cloth that appear self-contained and, therefore, legitimate. In such cases, the sign or sign systems do, indeed, reign dominant and unquestioned. We mistake our part of epistemological thinking for the whole. As a result, we produce fragments of knowledge or meaning that are only familiar, i.e., fit within a logical frame of language and discourse that seeks only to represent itself. Bateson classifies such sign interpretations as "secular" experiences of the world. Such occasions only honor, appreciate, and consequently, preserve mundane existence. De-personalized, life takes on a superficiality that renders it unrewarding (Eicher-Catt, 1996). Likewise, he says this is indicative of the manifestation of the "impure" aspect of the "pattern which connects," the other side of the coin of *the sacred* (Bateson, 1991). Furthermore, he indicates that such mis-recognitions at the boundary foster a host of pathologies, based upon essential confusions about meanings, both their type and level. Thus, not recognizing or not adequately problematizing the boundary or sign at the interface, at either the primary, aesthetic or secondary level creates pathological thinking that spins what can become profane recursive webs of future distortion and misrecognition at both the personal and societal levels.

Thus, in order to fully appreciate *the sacred* and connect the aesthetics of experience with the consciousness of mental process as Bateson conceives them, the boundary or gaps between the system/environment interchange must be phenomenologically perceived and semiotically problematized; i.e., the gaps must be *aesthetically appreciated*. Bateson describes this process of aesthetic recognition as the perceptual "scanning the interface" (Bateson & Bateson, 1989). With this claim, he wants primarily to accentuate the very fact that the system environment relationship has an interchange that possibilizes its unity when its structure and process is fully appreciated. With this notion of scanning, Bateson is also trying to account for a process of "double vision" of the organism that transpires at the interface. As Harries-Jones (1995, p. 263) points out, with his concept of double vision Bateson proposed "… that difference must interface twice into the process of perception. In the first case, the interface is in the form of perceiving a pattern of continuities; and in the second interface, differences that make a difference are recognized in order to enable classification to take place." I contend that Bateson's notion of double vision describes the existential yet reciprocal movements of perception as we move from Peirce's semiotic category of Thirdness (continuity from within the system) back through Firstness to Secondness (differences of pattern imposed from the environment) within a repetitive pattern that a phenomenological semiosis always entails. Bateson is acknowledging that there is a recursive movement (such as demonstrated by my "stitching" metaphor) that occurs along the boundary that creates new perceptual seams/semes of conscious and "unconscious" experience. Bateson is convinced, after all, that "It is at the crossing of these [semiotic categories] that creativity abides" (Harries-Jones, 1995, p. 264). Thus, a problematized sign or sign system (a difference that triggers a response) provide the opportunity for a "release" from ordinary taken-for-granted discourse and perception as described above. It also highlights the fact that we are ultimately the decision makers that control this release (Bateson, 1979, p. 102). This is the very *vitality* of existence that we so often seek to experience. This is, I believe, the actualization of the "pure" sense of *the sacred*. Under such conditions, the experiences that follow appear extra-ordinary as we momentarily sense a clear, felt boundary between ourselves (the system) and our environment and that "boundary is good," because it is of our own making. It is an evocative experience that moves us to keep traversing the boundary, to keep stitching, although it is a practice that is difficult to sustain because of life's constant interruptions.

Therefore, from a Communicological perspective coming to *know* and understand *the sacred* is a momentary aesthetic acknowledgment of the experiential gaps between semiotic relations and the phenomenological experience of those relations as a "pattern which connects." After all, we must come to know that gaps exist before we can attempt to sew them. Coming to *know the sacred* is, in other words, the aesthetic experience of actually phenomenologically traversing the existential boundary by stitching semiotic seams through the gaps. This stitching is done metaphorically in expressive/perceptive silence however; a silence engendered by an aesthetic appreciation that boundaries, systems and environments, are vital accomplishments of a discursive and non-discursive, communicative whole. Coming to *know* and understand *the sacred* is aesthetically perceiving the boundary as a sign or sign system (Peirce, 1955) for "perceiving's sake;" in other words, recognizing the fact that the gap and the instantiation of the sign that follows is beautiful because it *possibilizes* any system/environment interchange. In the case of institutions in general and scientific inquiry in particular, it behooves us not "… to treat institutions as things, as places for the transmission of information. Institutions must be imagined as boundaries from which we move, not enclosures into which we have moved" (Catt, 2000, p. 202).

The momentary experience of feeling the problematized boundary is, ironically, a sense of one-ness, of being part of a greater whole, tapping into a creative power that surpasses what any one individual agency can contrive. It is the simultaneous experience of immanence and transcendence, of feeling at one while also feeling only a part of something greater. We are "empty" while being full. It is the experience of mystery when we realize that we are able to grasp only one small piece of the larger fabric of existence that will remain unknown. The momentary experience of acting or re-acting upon the boundary is vital to our subsequent survival. After all, our interchanges can produce re-actions that are embedded within semiotic systems that deny any phenomenological integrity. As Bateson claims, *the sacred unity* has the "… potential to determine actions, thinking – [where] language and discourse can desecrate *the sacred*" (Harries-Jones, 1995). In such cases as detailed above, we wear a fabric of meanings and existence not of our own making. On the other hand, we can act to sew seams/semes that create new patterns that prove to be more "survival worthy." The momentary experience of learning how to recognize and problematize the boundary (understood as sign), therefore, is *learning how to learn* about *the sacred unity* inherent in signs and systems. We experience *the sacred* as both momentary presence and a process of perceiving/expressing. It is something we comprehend only in its semiotic and phenomenological transformation. All of these experiences testify why the aesthetic recognition of the gap is, indeed, considered a holy act.

Allowing oneself to experience and problematize the boundary at whatever level involves, of course, a certain degree of risk and it is this risk that prevents us from lingering in its sensuousness too often and for too long. Above all, stitching a new pattern of existence means "jumping" across the gaps and this involves calibration and change. It means exposing ourselves to different ways of being that will automatically impact our lives and those within our intricate web of meanings. This is why faith is an integral part of sacred existence. Faith is the process of producing links between ideas that sustain our ability to jump. "We are defended from doubt," Bateson contends, "by an *unawareness* of the gaps" (1987, p. 95), by a temporary alignment with faith. Sacred stitching across the gaps, above all, requires a faith that we can maintain a delicate balance between system and environment in order to create a seam/seme that is worthy. It requires faith that we can make the necessary seam/seme when needed, when the existential conjunction of continuity and discontinuity is apparent. We have to convince ourselves, through our exercise of faith, that we have the proper thread and the necessary know how to complete the stitching process and the seams/semes of aesthetic experience we hope to create. This realization of faith is intricately bound up with the actualization of *the sacred*, as Bateson well understands.

In addition, to manifest a more "pure" aspect of *the sacred*, we must respond in ways that negate the negative. As communication theorist Frank Millar contends, Bateson's concept of *the sacred* speaks to the "… idea of the negation of the negative" or what Burke described as the "perfect" (1990, p. 33). As he goes on to say, "the 'perfect'… is that imaginary, utopian condition … the 'perfect' is what we humans postulate as sacred – e.g., God, objectivity, fidelity… the unspeakable territory that is hinted at, pointed toward, and imaginatively constructed by some community of map-makers" (pp. 33–35). *The sacred* "pattern which connects" as the aesthetic recognition of the boundary or gap becomes, then, a higher order of abstraction and thinking that illuminates our "… ability to grasp percepts of 'the process side' in addition to 'the form side,' and their patterns of interconnection" (Harries-Jones, 1995, p. 261). Only through communicative events are the boundaries sufficiently problematized semiotically and made ready for aesthetic, phenomenological appreciation.

With this new perspective, we come to realize that what *is sacred* in human life and epistemological inquiry is our existential ability to appreciate the beauty and elegance of mental process, i.e., to discriminate among signs and signifying systems and to hold "perfect" the ideation of phenomenological sign action. This ability is our very "staff of life," as Bateson defines it (Bateson, 1991, p. 270). This uncanny, dual nature of *the sacred* is, therefore, conceptualized as *necessarily* a binary, analogue logic of communication (Lanigan, 1988) that overall produces a positive ambiguity of existence (Eicher-Catt, 2005b). Our activation of *the sacred* always potentially exists within this lived ambiguity.

## Conclusion

Another look at Bateson's later work, and especially his *epistemology of the sacred*, proves timely, I believe, at this juncture in postmodern thought. In a theoretical climate that appears in many ways to have all but dismissed an aesthetic for life and scientific inquiry, it behooves researchers to take a closer look at his attempts to cover new epistemological ground. Nowhere is an adequate understanding of a system's need and ability to respond in healthy productive ways, more useful than in today's climate of legitimate ideological suspicion and, in the case of the United States, the proclaimed "war on terror." The need to fully explicate what makes a system/environment interchange "survival-worthy," or the ability to successfully negotiate particular relations of domination and physical force, is all the more necessary in postmodern existence. With the fragmentation of traditional systems of thought and the resultant array of conflicting and contradictory messages endemic to postmodern life, we have, unfortunately, created societies of "saturated," fragmented, and confused selves (Gergen, 1991). As mental health practitioners Reiber and Green (1989) document, Bateson's epistemology seeks to account for the psychopathology of everyday life and helps to explain the frequent occurrence of anti-social behavior and incidents of social distress. Bateson's *epistemology of the sacred* reveals the very fragmentation and disjointedness of postmodern life as an inevitable process and product of ecological recursion, especially when we tear the fabric of existence by ignoring or mis-recognizing the semiotic and phenomenological boundary conditions from which we operate. Although some researchers may contend otherwise, Bateson is not representative of modernist notions. He is, instead, a critical, experientialist (Lanigan, 1992). He successfully combines, in other words, eidetic exploration (mental) with empirical reality (nature) in a semiotic phenomenology of the embodied organism. He moves us closer, as human beings, to understanding the important existential nexus point, where person and cultural experience intersect.

Bateson's triadic conceptualization of existential relations mirrors Peirce's, and thus exposes how we come to *know* and understand *the sacred* as recursive, phenomenological semiotic relations between Firstness, Secondness, and Thirdness exercised within all human existence. Bateson is right to accentuate the interface or gap, because it is the seam/sign of "holy ground." The sign, however, does not construct *the sacred* as something to which we can preserve (Bateson & Bateson, 1987, p. 149) once and for all. Rather, the boundary and the subsequent engendering of signs and sign systems constitute the necessary communicative *relationships* from which *the sacred* might emerge. Accordingly, we see that the boundary and its conditions of activation, constitution, and transformation, semiotically and phenomenologically produce the human mental process of repetitious sign actions (semiosis to Peirce, 1955) that Bateson sought so earnestly to expose as his "ecology of mind." And, as an ecology, this form and process must be continually attended to. Reading Bateson alongside Peirce, we understand that Bateson's notion of *sacred unity* is a call for us to establish new boundaries for personal and scientific thought that necessarily expose the apposition of experience, consciousness, and communication that conditions the very possibility of difference. To be survival worthy means phenomenologically attending to the signs – of discovering new and ever-evolving information and knowledge that will create new threads to be woven into the fabric constituted by the nessesary apposition of mind *and* nature.

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