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The patterns which connect: Gregory Bateson and Terrence Deacon as healers of the great divide between natural and human science.²

An introductory summary and motivation for the paper

An important proportion of scholars within the social sciences and the humanities, from here on called human sciences, see the great divide between “the two cultures” as a natural consequence of an equally great divide between humans and the rest of nature.

Many of them will accept Darwin’s theory of natural selection as a kind of bridge across the great divide. But even if they explicitly refuse God or Intelligent Design as an explanation for human uniqueness, many cling to some implicit assumption of miraculously improbable mutations, which in practice amounts to the same as the intervention of God or Intelligent design. This view on human uniqueness is for many the prime justification for not accepting perspectives from evolutionary biology as an integrated and legitimate part of human science.

The anthropologist and multidisciplinary scholar Gregory Bateson (1904-1980) and the almost equally multidisciplinary biological anthropologist and neuroscientist Terrence Deacon (1950-) are examples of researchers that have dedicated much effort to the development of concepts and insights describing fundamental processes that operate across the great divide. That is, they try to identify patterns that are operative on several levels, from the most basic level of physics and chemistry, across the advent of life, multi-cellularity, social behavior, symbolic abstraction, to the complex technologies of modern life. In the words of Bateson: the patterns which connect.

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Their contribution consists among other things in some significant shifts in perspective or emphasis: One is to look for the basic operations of mind, not in the human brain but in the dynamics of life itself. Hence, they claimed that the important solutions to the mystery of the mind were not primarily to be looked for in the divide between humans and pre-humans, but in the divide between life and inanimate matter. Another shift was to regard relations and dynamics/processes as in many respects more foundational than things and structures (Hoffmeyer 2008).

To achieve this, they draw on a multitude of research and examples from different disciplines. Their method is often to dive into and look closely at some elaborate examples in one domain (for example cybernetics or thermodynamics), and then move on to some quite different domain (e.g. the symmetries of body shapes, patterns in neuronal activities or religious world views) and use what they just have looked at as lenses or perspectives to look with. They may sometimes stretch the analogies across domains and disciplines to a point where these analogies literally appear far-fetched.

In the hands of less talented scholars, this method might be hazardous. But quite a few of us regard the kind of visionary and creative spirit of Bateson and Deacon as badly needed in an academic world that to an increasing degree becomes disciplinary streamlined and more or less predictable through narrow specialization. [Note for possible follow up: Can the ideal of anthropological relativism studying primitive cultures be applied to the study of evolutionary distant organisms?]

Globalization and its three major crises – the environmental, the economic and the cultural – are to an increasing degree the cumulative result of increased efficiency from a multitude of separate, science based technical innovations. Efforts to understand how the three crises of globalization are interconnected are hampered by the fact that research grants to understand fundamental patterns across the great divide are rare or non-existent. So-called quality research is to an increasing degree identical to highly specialized research. Multidisciplinary visionaries like Bateson and Deacon are frequently frowned upon. This paper argues for the need in academia of a certain percentage of this kind of talented “enfants terribles”. Candidates exist, but they are to an increasing degree outcompeted or “disciplined” at an early stage in our current university regime.

The paper will also explore some of Bateson and Deacon’s contributions in light of this quest for radical interdisciplinarity.
From the divide between humans and prehumans to the divide between life and matter

The abyss between C. P. Snow’s “two cultures” (1959) may look quite different from each side of the divide. From the natural science point of view, the cleavage is often seen as primarily a difference in methods, where the most scientistic proponents accuse much of human science of a complete lack of scientific method. From the humanist side, the cleavage is primarily seen as a difference in the object of study. The human science camp sees humans, and in particular their more subtle, cognitive and cultural activities, as being so fundamentally different from the activities of other animals that they cannot be understood with the methods of natural science. Hence, in the human science view, the depth of the difference between “the two cultures” follows directly from the naturally given difference between humans and animals. There are also other kinds of differences that are used to justify the academic cleavage, but many of these can be derived from this fundamental claim of a natural difference in the objects of study. Here, I will only address the purported natural difference and in particular the two researchers’, Gregory Bateson and Terrence Deacon’s, efforts to bridge the gap.

The gap between humans and the rest of living nature has been challenged on several occasions throughout the history of science with Darwin’s theory of natural selection as probably the most important blow to human uniqueness. Darwin was the first to spell out a basic mechanism that could explain the evolutionary transitions from one species to the next. And he saw no reason why in principle this process of natural selection could not also explain the transition from other species to humans. Neither Darwin nor his successors in evolutionary biology claim that science has uncovered all the steps of this transition, only that we know the basic mechanism that can explain the fundamental continuity between humans and the rest of nature.

Darwin’s argument for a fundamental, unbroken continuity has met objections from it was launched to this day, and the arguments for a radical discontinuity can be grouped into two clusters: One that turns around a set of more or less religiously motivated questions of morality and free will, and the other that turns around the superiority of human skills. With the first set of arguments, wild animals are seen as mechanical “victims” of their instincts and drives, incapable of controlling their impulses and taking reason and moral standards into considerations. Hence, they cannot be held morally responsible, and thus belong to a radically different realm of nature than humans. Among the skill arguments, it is especially the human capacities for language, technology and complex cooperation that are seen to be radically discontinuous with the rest of nature. Both human moral and cognitive skills are related to the mind. So, the human mind becomes the crucial mystery of the discontinuity,
and the origin of this mystery is by most scholars from “both cultures” thought to be found somewhere in the transition from animals to humans. This transition is seen by many humanists as simply too great to be explained only by the “Darwinist” mechanism of random, heritable variation combined with ecological selection pressures. There are also a growing number of biologists and philosophers that share a discontent with what they see as a fundamentalist or simplistic Darwinism even though they don’t embrace any kind of Intelligent design or morally motivated arguments for the radical discontinuity. Both Bateson and Deacon express a wish to heal important aspects of the great divide. And to do that, they identify a need to create a new understanding of both the continuity and discontinuity across the divide. And both of them attach particular importance to a new understanding of the role of levels, types of levels (logical levels versus complex, dynamic levels), and how interactions between levels can be the source of both creative and destructive paradoxes. But there are also important differences between the two. While Bateson started building the bridge from the shores of anthropology, Deacon started from the shores of biology.

**Bateson, Deacon, interdisciplinarity, and paradox**

Gregory Bateson was born near the University of Cambridge, England in 1904 and died in San Francisco, California in 1980 as a naturalized US citizen. On the back cover of his most well known book *Steps to an ecology of mind* (1972), he is described as a fieldwork anthropologist, psychiatrist and zoologist. Wikipedia adds linguist, visual anthropologist, semiotician and cybernetician. Several more could have been added. I think it will be hard to find a researcher who deserves the label interdisciplinary or multidisciplinary more profoundly than Bateson. However, in the opening pages of his last book *Mind and Nature: a necessary unity* (1979 p. 8), he states: “I have been a biologist all my life.” This is somewhat puzzling if you look at his bibliography which contains very few items that would count as biological research papers, and also, if you consider the fact that most biologists ignore his contributions to biology.

Although Bateson started his university studies in zoology, his first completed degree and disciplinary affiliation was in anthropology, and many anthropologists like to reckon him as basically an anthropologist who later moved into other fields. But Bateson’s upbringing was very much in a milieu of biology under the guidance of his famous father, the geneticist William Bateson. William even named his son after the founder of genetics, Gregor Mendel. So Gregory became a kind of “native” biologist before turning to the study of cultures. The tension between biology and anthropology came to dominate much of Bateson’s thinking, and this may also explain his intense preoccupation
with a whole range of dichotomies with profound and related “tensions”: Mind versus Nature, the world of the living versus the world of the nonliving, circularity versus linearity, epistemology versus ontology. Many of these dichotomies have a potential for being a source of contradictions or paradoxes. A paradox may be approached like a problem to be solved for someone obsessed by making order and structure. For Bateson, paradoxes were not necessarily a threat to order. Rather, paradoxes were closer to being the very source of order. Paradoxes may be a threat to logic and logically designed machines, but not to life since Bateson placed paradoxes at the foundation of living systems.

Bateson’s taste for paradoxes is shared by the professor and recent chair of the anthropology department at the University of California at Berkeley, Terrence William Deacon born in 1950, about half a century after Bateson. Deacon’s kind of multidisciplinarity may be more limited in scope than Bateson’s. But in many respects Deacon’s is even more impressive as he manages to pursue his interdisciplinarity at the center of established academia where Bateson more operated in its margins. Deacon has produced appraised research contributions within evolutionary anthropology, cognitive neuroscience and linguistics just to mention a few of his disciplines highlighted by Wikipedia. His latest book *Incomplete Nature: How mind emerged from matter* could in some respects be regarded as a more biologically focused update of Bateson’s book *Mind and Nature: a necessary unity*. Deacon never hides his indebtedness to Bateson not least when it comes to Bateson’s ambivalence towards the omnipotence of logic and formalisms in the traditional scientific approach to the study of life and mind. Deacon includes several quotes from Bateson, among them the following from *Mind and Nature*:

> In a computer, which works by cause and effect, with one transistor triggering another, the sequences of cause and effect are used to simulate logic. Thirty years ago, we used to ask: Can a computer simulate all the processes of logic? The answer was “yes,” but the question was surely wrong. We should have asked: Can logic simulate all sequences of cause and effect? The answer would have been: “no.” (Bateson 1979: 58 cited in Deacon 2011: 91)

I reckon one of Bateson’s most important scientific contributions to be a deeper appreciation of the power and pervasiveness of paradoxes and the related limits to the power of formalisms.

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3 Publication year printed in the book is 2012, but officially released November 2011.
In the history of science, there have been many cases where what seemed like a paradox at one moment, became free from contradictions through a change in perspective. A classic example is the observation of stops and reversed movement of planets in a pre-Copernican, geocentric universe that became smooth, elliptic circles in a post-Kepplerian, heliocentric universe. Systematic observation coupled with models based on logic and mathematics had proved to be so immensely powerful that many scientists became seduced to believe that one day every aspect of nature would be explained with the same degree of precision as the movements of planets. This unlimited optimism on behalf of reductionist and formalist science has been fuelled by both new empirical discoveries and new developments within mathematics and related formalisms. Bateson worked from the end of the 1940s close to the founders of cybernetics, and he was thrilled by how the introduction of recursions (feedback loops) into formal theory to an increasing degree made it possible to create formal models of complex dynamic systems. Models like these would have collapsed under the burden of destructive paradoxes with the use of older and more traditional mathematical modeling tools.

The temporal recursion of the feedback loops in cybernetic systems has a parallel in the recursion of space in the patterns of fractal geometry. Developments in several other formal modeling tools (like network theory) increase the temptation to think that behind every observed paradox in nature, there must be some complex structure or subtle formalisms that are not yet discovered, but that eventually will “solve” the paradox within a larger, logical framework.

However, this optimism on behalf of formalisms may also be a trap. One of Deacon’s main messages is to show how deeply paradoxical the nature of living systems is, and that these paradoxes are of a categorically different kind from those governing the life-like behavior of even the most advanced computer-based robots. Deacon even criticizes Bateson of having been too seduced by the power of cybernetics, and rightly so. For example, Bateson’s theory of paradoxical communication as a cause of schizophrenia has proven to be simply wrong. But Bateson’s general fascination for paradoxes in animal and human play behavior, humor, addiction, and arms race continue to inspire Deacon as well as other researchers.

Bateson’s ambivalent fascination for logic also translated into an ambivalence towards academic disciplines. He felt that anthropology lacked in rigor and traditional biology in imagination. Bateson needed both, not as a compromise or middle ground between two extremes, but rather as a combination of strict rigor with audacious imagination. The result was at times a kind of oscillation.
In the documentary film "An ecology of mind" (2011) by Nora Bateson about her father, there is footage of him from 1978 where he says to a friend:

I’m endlessly fighting a battle with people, you know, who want to throw the intellect out and think of nothing but the heart. And when you fight that battle, you sound like an intellectual. But when I meet intellectuals, I find myself fighting the opposite battle.

**Collaborative versus radical or existential interdisciplinarity**

The concept “interdisciplinarity” may be used in many senses. In this context, I wish to distinguish only two: 1) the dialogue and possible confrontation between collaborating scientists from different academic disciplines, and 2) the dialogue and possible confrontation between different academic “disciplines” within a single scientist. Collaborative interdisciplinarity is to some extent the normal way of science as it is practiced outside specialized university departments. Typically, it may be a research project where separate “chunks of reality” are analyzed by different, more or less complementary academic specialists. This kind of collaborative or jigsaw puzzle interdisciplinarity may have its difficulties and challenges, often due to differences in methods and terminology. There may be fierce competition about resources, and disciplinary differences may be accentuated for the sake of this competition. But in general, and as long as the aim of the research is empirical and pragmatic, this kind of interdisciplinarity does not necessarily challenge the basic world view or disciplinary identity of the participants. The researchers can, when the project is over, return to their university departments more or less unchanged.

But on some occasions interdisciplinarity may be more radical, even to the point of becoming personally and existentially threatening. This often seems to be the case when it comes to interdisciplinarity across the great divide between biology and human science. Ever since Darwin, it seems that evolutionary biology, more than any other issues, has a particular ability to raise the temperature in interdisciplinary debates. The Norwegian TV-series *Hjernevask* (“Brain Wash”) (NRK1 2010) on humanist scientists’ ignorance and/or denial of findings from evolutionary psychology provoked the largest national public debate of science issues in several decades.

I assume most academics have experienced that there exists some correlation between a researcher’s personality and his or her choice of academic discipline. Without being able to present empirical data on the strength and cause of this correlation, I hypothesize that what separates a prototype natural scientist from a prototype scholar from the humanities is related to differences in
how they appreciate logic and paradoxes in their academic work. I think radically interdisciplinary researchers will often experience a split or cognitive dissonance between two tendencies within themselves not unlike what Bateson expressed about “intellectuals” in the citation above: One inclination towards structure and logic, where every paradox is seen as a challenge to be resolved, and where the ultimate beauty and satisfaction is to be found in a perfectly coherent and logical system. And another, where paradoxes are an attractive source of satisfaction and beauty in their unresolved state. A recent example of the first kind of research is the quest for Higg’s particle, the piece of missing evidence that many say would complete and unify a simple theory of “everything”. Any paradox within such a framework would be a disturbance, a nuisance that cannot be brought to silence before a theory is found that makes previous paradoxes appear logical within a more comprehensive framework.

The prototypical humanist’s approach to paradox may be quite different. In the study of art, religion and complex cultural expressions there will often be an unresolvable paradox at the heart of what is most beautiful and attractive, as in the idea of Christ that is both dead and living, human and divine. And in the humanities, this central paradox is often not treated as an enigma to be logically resolved, but as something to be aesthetically consumed through “analytic” concepts that are as paradoxical and ambiguous as the phenomenon they were meant to explain. Within natural science, much effort is invested in making analytic concepts precise and unambiguous. Within the humanities and social sciences, there are many concepts very far from this ideal although they are often presented as if they were precise and explicit. The concept of “culture” is still central to anthropology even though its definition has not been more unanimously agreed upon since Kroeber and Kluckhohn in 1952, in a famous essay, identified 156 current definitions of culture. One reason for this lack of precision is that “culture” as well as many other concepts used within human science are also operative concepts in everyday language where their ambiguity and lack of precision may be an asset. Every summer, Norwegian newspapers, for lack of other news, ask politicians and lay people “What is Norwegian culture?”. And every year someone is lured to give a relatively precise and explicit definition which in turn triggers an endless and generally fruitless debate. Seemingly, we desperately need paradoxical and imprecise concepts in our day-to-day living, and we may also to a certain extent need them in current human science. But will we need them in a future science of humans? The future solution may neither simply be to straighten up all the concepts of human science with the precision level of mathematics, nor may the solution lie in accepting everyday vagueness and lack of precision. Maybe the solution lies more in the direction of concepts and insights, where the logic and precision of the hard sciences are preserved at the same time as the paradoxes and ambiguities of human life (and life in general) are given a different and more prominent role. I see both Bateson and Deacon as
scholars that have tried to provide us with such concepts and insights. One example that I will return to is Deacon’s concept “absential phenomena”.

One of Bateson’s most cited phrases is his “definition” of information: “A difference that makes a difference.” Here, the concept of difference is used in two different senses. The first sense alludes to some structural or static difference that can be perceived. The next sense relates to the impact this difference makes on some process. His definition is difficult to translate into Norwegian because this language does not have a direct equivalent to the English idiom “to make a difference”. Usually it is awkwardly translated word by word into a Norwegian “anglicism”. However, this does not communicate as powerfully as Bateson’s own, native version where the double meaning of “difference” is more deeply embedded in the wording. In any case, the somewhat paradoxical use of the double meaning is appropriate because the phenomenon of information is indeed deeply paradoxical. In Deacon’s terminology, information is a prime example of an absential phenomenon; a phenomenon whose existence depends on something absent or missing – notably the alternative sign that is not there, but that could have been.

Also Deacon’s book Incomplete Nature contains numerous small, catchy phrases where he sums up his insights in seemingly paradoxical statements, not particularly to be witty, but to highlight the paradoxical foundations of life. Already the title “Incomplete Nature” has a paradoxical twist in that something (Nature) should be characterized by its incompleteness. The image on the dust jacket is of a bronze sculpture entitled Revelation by Il-Ho Lee from South Korea “modified with inner iterations by Terrence W. Deacon”. Its symbolism is as far as I can see clear. Aspects of what we see as patterns on the surface level are recognizable on several deeper or inner levels, but not ad infinitum. There is a deepest level, and in the midst of that one, there is a hole, an absence, or a zero. The book has 18 chapters numbered from 0 to 17. Chapter number 0 has the title ABSENCE and the next chapter, number 1, is titled (W)HOLES.
The complexity of life is not possible without a hierarchy of levels. Also a computer contains a hierarchy of levels. But what makes a computer work (and to some degree to seem “alive”) is the absence of true paradoxes. True paradoxes are what make computers stop. An organism will also contain processes in a hierarchy of levels that can be threatened by paradoxical operations. But not in the same way as computers, because at the center of life there is a paradox. The miracle of negentropy, life’s ability to create order out of chaos, is based on the second law of thermodynamics used against itself (Deacon 2011: ?).

Understanding paradox amounts to almost the same as understanding levels, and understanding levels in the world of Bateson and Deacon amounts not least to understanding the relations between parts and wholes, or “compositional relationships and their related hierarchical properties” (Deacon 2011: 550).

Bateson was particularly interested in levels of communication, where one level could classify the other level, in his terms as “a metacommunication”. Logical paradoxes emerge when an element inside a statement classifies the totality (including itself) as in “Everything I say is a lie (including this statement)”.

Deacon finds an analogy to this logical paradox in the physical structures and processes of an organism. The statement “Everything in this organism is determined by its DNA (including this DNA)” represent in some aspects a real parallel to the paradox from logic. But the parallel is not total because the nature of the levels is different.
Logical paradoxes appear in a purely representational and digital world, whereas a living organism consists of physical parts with other kind of properties than words in a sentence. The analogue movements of a myriad of physical molecules in an organism may translate into a “digital conclusion” at a higher, aggregate level, as when an action potential is released in nerve cell\(^4\). But both this and other examples of threshold based (digital) effects of analogues, buildup-processes in an organism are different from the pure, representational logic of a computer. I read Deacon’s project as an attempt to create a unified theory of levels and paradoxes that will work for both parts and wholes of complex, physical aggregates as well as for paradoxes of a representational kind. Such a theory could be an important pillar for the bridge across “the two cultures”.

Bateson studied different cultures’ rituals and religion, animals’ and children’s play behavior, addiction problems among alcoholics, and communication problems in families with schizophrenia. All of these domains of life are particularly rich in levels and potential paradoxes. And they are domains where the ability or failure to manage levels is critical to health and wellbeing (ref. ?). But Bateson’s main interest was not in any of these empirical fields per se. His main interest lied in the general patterns that connected all of them. And it is these deeper patterns that Deacon continues to dig for. But Deacon thinks that we will not understand the more advanced processes of human cognition before we understand the more basic processes of life in general. Human cognition is an evolutionary latecomer, and the basics of cognition have to be sought out in the most primitive of organisms and not least in the protobiological dynamics leading up to the advent of life.

Deacon clearly regards the evolutionary transition to humans as in many ways unique, but not in all ways. There are similarities to be found between the transition to humans and certain other evolutionary transitions. Therefore, even if humans are a unique product of evolution, the kind of transition needs not be unique. This implies that Darwin’s version of natural selection is not the only kind of transition in evolution. We are beginning to discern a typology of kinds of evolutionary transitions that may operate simultaneously on different temporal and spatial scales. There is a special category of transition that could be called an emergent transition where radically new channels of information and integration appear. An early example is the transition from unicellular to multicellular organisms that together with a handful of other transitions have been called The major transitions in evolution (Maynard Smith and Szathmáry 1995). These transitions are not an alternative to natural selection that operates in the same way in “major” as in “ordinary”

\(^4\) An action potential is a kind of electro-chemical domino effect in the nerve cells that make signals travel along the nerves of the nervous system.
transitions. But in addition to basic natural selection, new levels or layers of organization emerge due to special forms of synergy and other processes.

I see a connection between what Maynard Smith and Szathmáry called *The major transitions in evolution*, and what Deacon explains as transitions to new levels of *teleodynamics*. But before I shall try to explain some of Deacon’s rather complex ideas on the transition to teleodynamics, it could be helpful to reflect a bit on the growing interest in dynamics in general. [Some paragraphs are to be included here].

The idea of major or emergent transitions in evolution is by Deacon generalized into the more abstract idea of teleodynamic transitions with applicability to a broader range of events in phylogenetic evolution (the creation of new species), ontogenesis (the creation of new individuals), and the genesis of partially autonomous processes of neuronal activity (the creation of new thoughts and actions). There is a constant interplay between morphodynamic and teleodynamic transitions. And probably, what is ordinarily termed major transitions in evolution will contain myriads of both morphodynamic and teledynamic emergences of different magnitudes. In general, teleodynamic transitions are rare in evolution, but they seem to appear with an accelerated frequency after cultural evolution took off among humans. The advent of culture is linked to the emergence of multiple new layers of teleodynamic autonomy in the brain.

One of Deacon’s important contributions is his insisting on the intimate link between the emergence of new levels of complexity within the evolution of life and the transition from inanimate matter to living organisms, that is, the origins of life. In his book, *Incomplete Nature: How Mind Emerged from Nature*, Deacon is obviously interested in the emergence of human cognition. But as he admits in lectures on Youtube, presenting *Incomplete Nature*, the book turned out to be only the preface to the originally planned book on how mind emerged from matter. The book’s main theme has become the emergence of teleodynamics, a much more general phenomenon.

Deacon sees a major obstacle to a true understanding of teleodynamics in the temptation to think of genetic processes as basically a form of advanced computation. In the larger picture of life, genes represent a kind of freedom, not a kind of determinism in the physico-mathematical sense. DNA can look like a computer program, but taken too literally, this largely ends up in a misleading analogy. Not because the DNA-string in itself has no analogy to a string of bits and bytes in a computer

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5 I will elaborate on the distinction between these two terms below.
program, but because it implies that the rest of the cell is analogous to a computer. And that is where Deacon sees that the analogy breaks down.

**The immateriality of matter and the materiality of mind**

An important take in Deacon’s strategy to create a bridge from matter to mind is to question both the immateriality of the mind and the materiality of matter. This is not done in the sense that matter should obey some new or other “laws” than those described by ordinary physics. Deacon is a traditional materialist in the sense that he sees every living being, including the most spiritual among humans, as consisting solely of material molecules in the most traditional sense of matter. No supernatural or extra-material substance of any kind is added in the transitions from neither lifeless matter to life nor from “mindless” creatures to self-conscious, human beings. But that does not imply that all there is to life and mind can ultimately be explained by physics. Still, surprisingly many aspects of both life and mind can according to Deacon be understood through physics and not least through his generalized vision of thermodynamics applied to dynamical systems with increasing levels of complexity.

Deacon’s version of life and mind is exposed in considerable detail over the 602 pages of *Incomplete Nature*, and it will obviously be impossible to compress this tour de force of a book into this presentation. But I will try to go somewhat deeper into a few of his central distinctions. This is partly done with direct reference to his texts, partly as my own interpretation of Deacon’s ideas.

**Two types of form generating processes**

To make a form, there must be something that can be formed. And to keep that form stable over any period of time, that something must somehow be able to resist deformation in face of the “chaotic forces” (or entropic tendencies) described by the second law of thermodynamics. Physical matter in the form of atoms and molecules is an obvious candidate for making building blocks of this something. But matter is not the only candidate.

Physical elements, like atoms and molecules, can interact in processes and create new, transient forms on a complex, aggregate level (e.g. whirlpools and metabolic cycles). Some of these aggregate, processual forms can interact in ways to make them so stable that they themselves can play the role as elements of a substrate for new forms of higher complexity levels.
But the generation of form is not only influenced by differences in spatial and temporal levels. To understand how form is generated, Deacon makes a distinction between two fundamentally different types of form generating processes:

1) **Morphodynamics** is characterized by processes where form is generated spontaneously by the interacting elements themselves. The form is generated from below, from within or intrinsically, with the energy and structure contained in each element or with energy acted upon all elements in a global, uniform way like the force of gravity. [check Deacon 2011:238]

2) **Teleodynamics** is characterized by processes where form is generated by synergistically interacting morphodynamic processes but also from historical templates whose form or pattern were created from a level above, from without, spatially extrinsic and temporally prior to the actual, spontaneous interaction of the present elements (ref Deacon 2011: 238). This second kind of form generation needs to be fuelled with collateral energy, that is, energy available for work by means of other elements than those making up the form or the structure, elements that got their energy from morphodynamic processes that were more distant in time and space than the immediate adjacent levels that may provide “work” in morphodynamic form generation.

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6 The distinction between the two is sometimes difficult to grasp because they are sometimes seen as mutually exclusive alternatives and sometimes as nested with teleodynamics encompassing morphodynamics. There is some truth to both of these views. Teleodynamics is a complex phenomenon and cannot be distinguished from other phenomena with one overarching criterion. Here I start with some criterion related to form generation. Later I will come back to the “telos”- part of teleodynamics, the properties related to goal directed self-conservation or “survival”.

7 In fact, Deacon distinguishes between three basic dynamics. Below morphodynamics, where form is generated, there is homeodynamics where form is disentangled, dissipated or destroyed. Homeodynamics is a generalized version of thermodynamics. The form obtained in morphodynamics may often be described as an attractor in the terminology of complexity theory or dynamical systems theory (Deacon 2011: 230). Since the equilibrium state of a homodynamic or thermodynamic system can be understood as an attractor with minimal or no form, then both morphodynamics and homeodynamics belong to a kind of attractor-based dynamics that set them apart from teleodynamics. Therefore I believe that the transition to teleodynamics is the really radical transition, and that the two other dynamics could be grouped together on the side of the non-living.

8 In Mind in Nature (1979, p. 92) Bateson identified six criteria of a mental process, a list that has some similarities with Deacon’s criteria of a teledynamic process. Bateson’s criterion no. 3 was: “Mental process requires collateral energy”. Bateson used this list to identify the critical differences between the living and the non-living processes in the world, in his terms, between Creatura from Pleroma. Deacon does not draw the line exactly in the same way, but the overall strategy and ambition is similar.
Examples of a spontaneous, intrinsic form generating process may be a tornado or a hurricane. The twister of a tornado or the huge vortex formed by the clouds of a hurricane is a spontaneously generated form by a set of atmospheric molecules that contain specific differences in temperature, air pressure, humidity and other meteorological conditions. The energy driving the process comes ultimately from the sun, but is transferred to the atmospheric molecules before they form the spiral. Energy transfers from the sun to the seawater and from the water to the air, always across levels with immediate contiguity to each other.

An example of the second kind of process, the extrinsically guided form generation, may be the synthesis of a sequence of amino acids in a protein guided by a nucleotide sequence in the DNA molecule in a cell. Still another example may be the generation of thoughts in your head by reading this text. These historical template based examples (DNA-sequences and texts) are complex in a different way than the formation of whirls in tornados and hurricanes. Historical template based form generation can only exist as part of an entirely different type of dynamics; the dynamics of life which Deacon has termed teleodynamics in contrast to the spontaneous form generating processes of non-living matter that Deacon has called morphodynamics. An example of collateral energy is the “battery molecule” of our cells, ATP. The “batteries” are charged in a morphodynamic, metabolic process and the energy is chemically stored in ATP-molecules in a way that makes the energy available for work in other processes of the cell, “far” removed from their sites of production. The human extraction and use of fossil fuel could be seen as a comparable case of collateral energy, more extreme than ATP, but still a case of separation between the sites of production and consumption of energy.

A template based form generation may also exist within morphodynamic processes, and that is crystallization. Crystals get their basic form and symmetry from the structure of the initial and subsequent molecules of the growing crystal. And the parallel between genes and crystals was already acknowledged before the discovery of DNA. Erwin Schrödinger meant that genes had to be something like an “aperiodic crystal” (Deacon 2011: 282). But the “template” molecules in crystal growth do not reflect any previous processes of form generation. This is in contrast to the templates in teleodynamic processes that reflect a history. In that sense, the advent of teleodynamics, where traces from past sequences of morphodynamic processes become the templates for future sequences of morphodynamic processes, represent the birth of evolutionary history. The generation of form in morphodynamics is fundamentally ahistorical in the sense that each hurricane gets its form for the “first time”, unaffected by the form of any previous hurricane. This may be a bit confusing, because both morphodynamic and teledynamic processes do have a kind of history
within its “own lifetime”. Apart from the hexagonal symmetry, each snow crystal has a unique form that reflects the history of its way through the atmosphere, where shifting conditions of temperature and humidity caused its branches to crystallize or melt in a unique way. The micro-environment for a growing snow crystal is constantly influenced by both the new atmospheric conditions that the falling snowflake encounters and the form of the previous crystallization. Because there are so many variables involved, the likelihood of two snowflakes being identical is practically zero. This could be compared to a river that gets its form from both the original riverbed and from the sediments it breaks loose and deposits on the river banks. When humans, some million years later, look at these sediments in a petrified, sedimentary rock, we look at patterns or forms that are generated in some of the same ways as that of a snow crystal. The form reflects a history of interaction between morphodynamic processes. But this history never influences the form of subsequent sedimentary rocks or subsequent snow crystals. The form became *traces* of history but never *templates* for the future. The new coupling of past and future through historical template based form generation represents a crucial feature that separates teleodynamics from morphodynamics.

However, the form generating process described as extrinsic and template based was not always identical to teleodynamics. But today, it is usually an essential part of it, at least in all the life forms that currently exist on earth. But it there is more to teleodynamic organization than form generated by templates.

Teleodynamics, as the prefix *teleo*- suggests, is a dynamical organization with a purpose, a “telos”. The ultimate telos of any teleodynamic process is to sustain itself, or in more colloquial terms “to stay alive” as an individuality or by producing reproducing descendants. The fundamental purpose of staying alive implies that every teleodynamic process must somehow take into account the possibility of death, deformation, or dissolution and try to counteract these possibilities. This “awareness” of threats to its continuity constitutes the rudimentary kernel of a self. But this self doesn’t need to be of a self-conscious kind as in the case of humans. However, some kind of self and self-preservation must per definition be present. A process with no behavior to actively protect or secure its continuity is per definition not a teleodynamic process. Phenomena like intention, purpose, function, reference, and value would be inconceivable if they were not related to a self-sustaining process where some aspects of possible futures (beneficial or harmful) were taken into consideration. Deacon coins the word *ententional* as a generic term for all these phenomena characterized and influenced by something missing or not yet present. In every ententional phenomenon, something related to the future must be relevant for something in the present.
But such phenomena represent a real conundrum for traditional science since the future should not be able to have a causal influence on the present (i.e. “the future’s past”). This kind of backward causality should in principle be incompatible with the basic laws of physics.

Deacon sees ententional phenomena as part of a wider category which he calls *absential phenomena*, because alternative, not yet realized possibilities of the future are absent from the present in a different and causal way within living (or teleodynamic) systems than within any non-living (e.g. morphodynamic) systems. And it is the role of these absential phenomena that separates life from non-life. It is this incompleteness of living processes that define all intentional processes, or, to use his neologism, all “ententional phenomena”.

To understand what Deacon means by *absential* one has to start with his concept of “*constraint*”\(^9\). Constraint implies the elimination of possibilities that *could have been*. A constraint is therefore not a substance or a thing in itself. It is only a role in a process that limits the range of possible states of a dynamic system (Deacon 2012: 548). Humans seem to have more problems with thinking in negative than in positive terms. Thinking in terms of absent possibilities is somewhat counterintuitive. This

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\(^9\) Deacon may be difficult to read for two seemingly opposite tendencies: 1) he creates a series of new concepts, like *absential, ententional, morphodynamic* and *teleodynamic*, and 2) he gives several ordinary, established concepts a new and often more precise and thereby a more abstract, generalizable meaning, notably the concepts of *constraint, work, and information*. However, it would be unfair to say that Deacon adds difficulties to the subject by his use of neologisms. The main difficulties stem from the paradoxical nature of the subject itself, *teleodynamics*. The book chapters are organized to create a seemingly traditional, scientific narrative of complexity from the most basic physics to the most advanced consciousness. But this structure contradicts the message that in teleodynamics, important aspects of the parts and the totality create each other. Teleodynamic emergence is in many ways not something *on top of* other processes. It is more of a mid-level phenomenon, a kind of inserted, complex detour of matter and energy dissipation that simultaneously creates both a new totality and new elements. The problem with the simpler, mainstream, gene-centric story of biology, is that it tries to impose a linear narrative on a dynamics that in reality has no obvious beginning or end. I think it is this ambition, to present a deeply non-linear reality in a linear book that accounts for many of the difficulties in reading and understanding both Bateson and Deacon. [Idea for possible follow up: Link the above to Bateson’s idea of the limits of unilateral control.]
may also be the reason for the appeal of Lamarckism which allows looking at evolution as an active strife for obtaining a specific form. This resonates more with our everyday strife for form and order compared to Darwin’s natural selection where form is just what is left from a passive elimination process. That is also why it took so long to accept the number zero in mathematics. Deacon sees a parallel between his focus on absential phenomena in biology and the discovery of zero in mathematics.

Several of Deacon’s critics have questioned his need for many of his neologisms. For example teleodynamics. Does this neologism characterize anything that could not simply be covered by the concept of life, the autonomous aspects of life or the living aspect of an organism? Deacon’s need for a new concept is that a living organism on today’s earth is just a special case of a teleodynamic process which he sees as a much more general phenomenon. Any collection of entities or elements that is organized in a way to spontaneously and purposefully sustain and perpetuate its own organization will be a teleodynamic system. To just call it a “living or vital system” would tie it too closely to an existing, individual organism. An organism will also contain many morphodynamic processes that are part of life but not “living”. Although Deacon finds no independent teleodynamic organization in nature that is less complex than the simplest living organism, he finds several instances of more complex teleodynamics. These higher order teleodynamics can emerge from collaborating colonies of lower order teleodynamic systems, like multicellular organisms, colony forming organisms, and socially or culturally integrated human institutions. But teleodynamic properties may also be identified in layers of neural activities within the brain or as other teleodynamic subsystems within a larger system (i.e. economic firms and institutions, self-sustaining neural processes or layers in our cognitive architecture).

The more established concepts of self-organization and autopoiesis do not correspond exactly to teleodynamics because they are not clearly distinct from morphodynamic processes.

A source of confusion could be that it may be difficult to distinguish morphodynamics and teleodynamics by just looking at the form generated by the two dynamics. Both the direction of the process and the end result may look identical while the process behind is quite different. An example is the so-called Chinese room thought experiment by John Searl.\(^\text{10}\) The task is to interpret a computer’s performance and decide whether there is a living person behind the answers or just programs and computer hardware. In Deacon’s terminology the task could be described as

\(^{10}\) Cf http://en.wikipedia.org/wiki/Chinese_room
determining whether the form of the output was the result of a very complex morphodynamic process or a teleodynamic process.

Without access to its historical relationship with its environment, that could be undecidable.

The fact that we can be confused or fooled by the dynamics we are confronting can have huge consequences. Even the big question of whether climate change is “natural” or anthropogenic does to some extent translate into a question of whether we are confronted with a morphodynamic or a teledynamic process. James Lovelock’s theory of Gaia hypothesizes that the entire biosphere is basically teleodynamic. Whether that is true or not will have huge political consequences. Adam Smith’s idea of the invisible hand of the market may be interpreted as the result of morphodynamics or teleodynamics. The difference between the two may have important political consequences. In the case of teleodynamics, the tendency towards deep-rooted self-repair and sustainability should be inherent in the market system. In the case of morphodynamics, there are no comparable barriers against collapse and death.

**Immateriality as substrate independence**

The vortex of a tornado may last for minutes, the huge whirlwinds of a hurricane for days, and the gigantic, circular flow patterns of ocean currents for millions of years. However, there is nothing within these morphodynamic processes that actively tries to counteract their “death”. Still, meteorologists find it useful and natural to give hurricanes of a certain size and impact a personal name. According to Wikipedia, hurricane Katrina formed as a tropical depression over the Bahamas on August 23 2005 and named Katrina the day after, gained strength over the Gulf of Mexico and hit New Orleans on August 29. But few or none of the actual air molecules that formed the original whirlwinds hit New Orleans. Katrina as an “individual” was not a physical substance but a special kind of organization that propagated its identity through the atmosphere in spite of the fact that the swirling collection of air molecules might be entirely replaced from one week to the next. This is also the case for the majority of the molecules of our own body. Both morphodynamic and teleodynamic systems are immaterial in the sense that they are not attached to some particular material substance. They represent a temporary set of constraints or organizational form of some process where all of the material substance can be replaced without compromising its identity. The form of human bodies as well as the form of hurricanes depends on a steady material and energetic input that could be seen as resources. And for both human bodies and hurricanes, this input in the form of material and energetic resources must leave the processes in a form of “waste material” and “waste energy”, notably “heat”.
In this sense, the life of our bodies could be regarded as a complex swirl of molecules and energy from birth to death, of course, magnitudes more complex than a hurricane, but still comparable when it comes to the need for a constant material and energetic input and the elimination of waste. The metabolic processes in our body are basically morphodynamic in their organization even though they may represent and contain elements and modules of larger teleodynamic processes.

Teleodynamic processes emerge from morphodynamic processes. But the change from a morpho- to a teleo-level of dynamical organization is not a simple change from morphodynamic elements to aggregates of the same elements. Something quite special happens that Deacon calls “synergistic emergence”. This implies that two or more (in the case of living organisms very many more) morphodynamic processes interact in the way that the output (or “waste”) from one process becomes the input (or “resources”) for the other and vice versa in a way that reinforce the synergy. This does not in practice happen to hurricanes or any other morphodynamic processes outside living beings. But to illustrate the principle, let us imagine that it really did happen.

Let us imagine that hurricane Katrina did not get all of its energy and humidity from the Gulf of Mexico but some of this from the outputs of a neighboring hurricane Rita that “fed” on some other part of the Gulf and that they combined forces in a long term relationship. The analogy halts because the synergy would be poor if they were not more different and more complementary than two identical hurricanes. Still, the analogy may help us to imagine how powerful and interdependant two processes may become through this principle of reciprocal use of each other’s output as input. If we add the possibility of an operational closure (a membrane) that can halt the morphodynamic process until the combined unit has reached a more favorable environment and a mechanism that can keep record of different, favorable environments, then we start to approach the minimal definition of a teleodynamic entity or a living individual.

The impossibility of radical interdisciplinarity

The reviewers of Deacon’s *Incomplete Nature* are clearly divided. The average number of stars among 21 customer’s reviews on Amazon (August 2012) was 4 out of maximum 5. Many with a panegyric text. On the opposite end of the scale, the philosophy professor Colin McGinn’s wrote in New York Review of Books:

The whole idea of “incomplete nature” is confused and unhelpful; the only sliver of truth to it is that physics is incomplete as a description of full reality, so that many realities are absent from it. Despite his aspirations to producing a new metaphysics, Deacon is clearly no
metaphysician (he is a biologist and brain scientist, not a philosopher). (McGinn, NYRB June 7, 2012)

I read McGinn’s review as a kind of disciplinary policing. The citation above seems to be based on two underlying assumptions: 1) Deacon’s aspiration is to produce new metaphysics, and 2) you have to be a philosopher and metaphysician to produce new metaphysics.

I read Deacon’s aspirations as primarily being a contribution to biology and natural science, but at the same time conscious of the fact that if his hypotheses are correct, they will have profound consequences for philosophy, metaphysics and the human sciences in general. He is fully aware of the fact that all of his hypotheses are not confirmed. Deacon is inspired by a variety of disciplinary sources, including philosophers, and his book contains elaborate thought experiments and may in that sense look more like the work of a philosopher than a biologist. But his aspirations are always directed towards making hypotheses about the world that would be possible to verify empirically. Nevertheless, I can see why Deacon’s style of thinking and writing may be seen as heretical from both the standpoint of biology and philosophy. Deacon pushes his theoretical speculations and use of analogies further than what is normally accepted in a strictly empirical and experimental conception of biology. And Deacon is grounding his metaphysical implications more profoundly in physics and chemistry than what is normally accepted in philosophy. But it is exactly this lack of respect for academic demarcations that makes this project possible and interesting.

The career and intellectual achievements of both Bateson and Deacon presuppose some rare combination of cognitive talents. That in itself is often enough to provoke specialists who find comfort within the boundaries of their traditional disciplines that they think should be accessible through a more normal scope of talents and hard work. Many look with suspicion on realms of knowledge inaccessible to a dedicated, clever scientist and hard work.

In the late 1940s Bateson found a soul mate in the mathematician Norbert Wiener whom he met at the Macy conferences. These ten conferences may be among the most extraordinary interdisciplinary events in academic history, and they are wonderfully described and analyzed by Steve Joshua Heims in his book from 1991 Constructing a Social Science for Postwar America. The Cybernetics Group, 1946-1953. Heims writes:

“Wiener and Bateson were both willing to translate exact theorems of communication engineering, physics, and formal logic into relatively loose verbal, formal statements – which
they would then extend and apply in a heuristic way to other areas of science, although most scientists frowned on such practices. Having accepted the legitimacy of the human endeavor to understand the world in a more than piecemeal, “departementalized” way, they had necessarily to take into the bargain paradoxes, incompleteness, vagueness, and tentativeness. Narrow specialization had been sine qua non of science for generations; consequently, Wiener’s and Bateson’s efforts to describe the world and ourselves in a comprehensive, holistic way and yet function as scientists were not taken seriously by colleagues and tended to isolate them.” (Heims 1993:107)

As an apropos to this, how Bateson left anthropology is noteworthy. He wanted to continue his visiting professorship in anthropology at Harvard in 1956 but was refused renewal (Heims 1993: 147), and a more “disciplined” anthropologist got his position. He never returned to work in an anthropology department.

I reckon Bateson’s willingness and ability to swift changes between ontological questions (“what he is looking at”) and epistemological questions (“what he is looking with”) as both his greatest strength and his greatest weakness. Strength because he, through his multiple descriptions, forces the reader to live and experience some very abstract and otherwise quite inaccessible ideas - weakness because his restless style allows him to jump away from sometimes difficult and unsettled questions that would have become prominent had he rested for a longer time within one perspective.

Deacon may be accused of something of the same, but he is more stringent than Bateson. The academic world needs a certain amount of these “enfants terribles”, but they become increasingly rare thanks to the increasing identification of academic quality with narrow specialization.

As mentioned in the introduction, the world’s major challenges today could be summarized in three crises: 1) an environmental crisis with global warming and loss of biodiversity as its prime symptoms, 2) an economic crisis with extreme inequality and the threat of breakdown of major financial systems as important symptoms, and 3) the cultural crisis with culturally and religiously motivated violence as an important symptom.

All of these crises may be deeply interconnected, but very few researchers try to investigate the connections between them because such an endeavor would presuppose a kind of interdisciplinarity that is actively discouraged, not least by the Norwegian Research Council. But luckily, the European Research Council has provided a grant (cf. www.uio.no/overheating) that both directly and indirectly has made the Second Bateson Symposium in Oslo possible.
Together with some colleagues at the University of Oslo, I have organized a colloquium called Beyond dualism where we meet irregularly to discuss deep patterns that connect the “the two cultures”. It consists for the time being of two anthropologists, a linguist, two biologists, an archeologist, an economist, and a cognitive neuropsychologist, most of them leading scholars in their fields. But it is difficult to find funding for this kind of radical interdisciplinarity. Interdisciplinarity is typically praised with big letters and words in the opening statements of official, Norwegian research policy documents. But towards the end of the same documents, in the text with small letters specifying how the grants actually are going to be distributed, then the buzz-word of interdisciplinarity have generally been replaced by “quality” which in practice translates to disciplinary specialization, or pragmatic, jigsaw-puzzel, complementary interdisciplinarity far from the visionary thinking of Bateson and Deacon.

I will conclude this article with an extract from a transcript of dr. Ginger Campbell’s interview with Terrence Deacon as www.booksandideas.com. It reports some biographical facts about Deacon with relevance for this articles focus on the conditions for radical interdisciplinarity.

“Dr. Campbell: OK. So, we look at your CV, and we see that you’re the head of a department of anthropology. So, I erroneously—it sounds like—jumped to the conclusion that you would be an anthropologist. But that’s just the closest thing to describe what you do, which is kind of a very broad attempt to integrate a lot of different disciplines.

Dr. Deacon: Well, my links to anthropology are two: The first one is that one of the people who influenced me a lot when I was younger was a man named Gregory Bateson. My interaction with him was mostly at a distance, and mostly through one of his later students. Nevertheless, he made clear to me that the things I’m interested in are general enough to not fall easily into any particular field. And he, as an anthropologist said, Look, all of the stuff that I have been doing—studying communication, cybernetics, information, things like that—I’ve been able to do as an anthropologist; in part because anthropology has this kind of breadth of possibility. Now what I would say is I think that the field has actually narrowed since that time, and that its acceptance of the kind of things that I do has probably narrowed. I think that will change, but probably not easily.

The second reason that I got into the field is I was interested in what’s unique about human beings—human cognition, and particularly human language. And the evolution of human language does not,
itself, fall easily into linguistics, into biology, into neuroscience, but it does fall into anthropology. It has, historically.

So, this joint focus on the nervous system and how it works and how it evolved, and language and what’s unique about language (what Charles Sanders Peirce, my original source of insights, called semiotic processes; that is, all processes that have referential and significant relationships), those were things that he was trying to get a general understanding of. And I think until we actually had an understanding of those kinds of processes in general—not just language, but language in its larger context as a means of referring and communicating—this was really an anthropological problem also.

And so, in many ways I saw anthropology as just a place where I could do the work I wanted to do, without too many interferences. And my mentors at Harvard, when I was there—particularly a man named Melvin Konner—appreciated that interest of mine, and the breadth, and let it flower, so to speak, and let me do what amounts to a very rare neuroscience PhD, but in a department of anthropology.”

I share Deacon’s mixed feelings on anthropology departments as a possible site for radical transdisciplinarity. However, they once were, and I think the possibilities are still there. I take it as a good sign that the Department of Social Anthropology at the University of Oslo is the main sponsor of the Bateson-symposium 2013.

References:

Spektrum