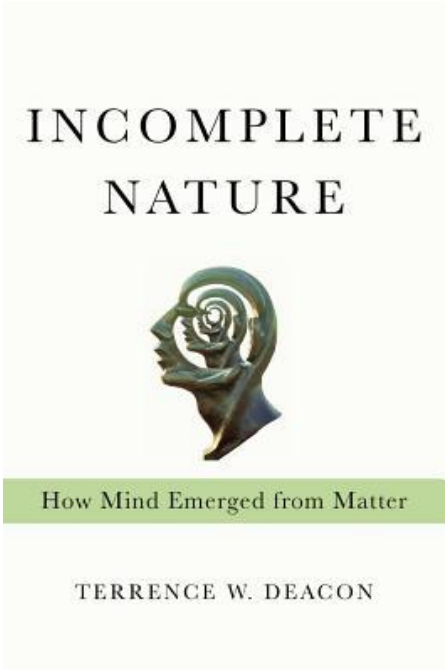

Incomplete Nature: How Mind Emerged from Matter

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As physicists work toward completing a theory of the universe and biologists unravel the molecular complexity of life, a glaring incompleteness in this scientific vision becomes apparent. The "Theory of Everything" that appears to be emerging includes everything but us: the feelings, meanings, consciousness, and purposes that make us (and many of our animal cousins) what we are. These most immediate and incontrovertible phenomena are left unexplained by the natural sciences because they lack the physical properties—such as mass, momentum, charge, and location—that are assumed to be necessary for something to have physical consequences in the world. This is an unacceptable omission. We need a "theory of everything" that does not leave it absurd that we exist.

Incomplete Nature begins by accepting what other theories try to deny: that, although mental contents do indeed lack these material-energetic properties, they are still entirely products of physical processes and have an unprecedented kind of causal power that is unlike anything that physics and chemistry alone have so far explained. Paradoxically, it is the intrinsic incompleteness of these semiotic and teleological phenomena that is the source of their unique form of physical influence in the world. *Incomplete Nature* meticulously traces the emergence of this special causal capacity from simple thermodynamics to self-organizing dynamics to living and mental dynamics, and it demonstrates how specific absences (or constraints) play the critical causal role in the organization of physical processes that generate these properties.

The book's radically challenging conclusion is that we are made of these specific absenses—such stuff as dreams are made on—and that what is not immediately present can be as physically potent as that which is. It offers a figure/background shift that shows how even meanings and values can be understood as legitimate components of the physical world.

Incomplete Nature: How Mind Emerged from Matter Details

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From Reader Review Incomplete Nature: How Mind Emerged from Matter for online ebook

Bob Nichols says

In a thick, complex argument, Deacon makes the case for absence as the critical factor in the transition from inorganic matter to life and from life to mind. To best illustrate this notion, ideas have no physical attribute yet they have casual power. This "absence" he argues is a central factor in the evolution of life.

Deacon's thesis is embedded in physics and specifically in the second law of thermodynamics. Matter's natural course is the dissipation of energy to an equilibrium state. Life is an exception to this movement toward entropy. Life goes the opposite direction by building up order and complexity, in an incessant battle against the forces of entropy that ultimately prevail with death.

Deacon draws on Aristotle's theory of causality and resurrects final cause. There are two forms of change within nature, Deacon states. One is the non-spontaneous change typical of Newtonian physics (is caused by extrinsic forces). The other is spontaneous, an intrinsic disposition within matter (and energy) to dissipate until it reaches a (thermo) equilibrium state. This spontaneous tendency of matter and energy to "even out" and "eliminate itself" is the key challenge faced by life.

How life surmounts the challenge of entropy is the main thrust of Deacon's argument and his concept of constraint is key. As entropy is movement toward an equilibrium state, "constraint" is the opposite. Constraint is order. Order is organization. Organization is a self-bounded system that protects its integrity against the forces of entropy. "Constraint" is the absence of those factors that are not neccesary for or are hostile to the organization's integrity.

Deacon divides his discussion of self-organizing systems into three stages. Each stage builds on the other through the emergence of new properties in a ratchet effect that moves life-like, system properties (self-boundedness, whole-part integration, repair and replication) further down the road and protecting against retreat. The discussion is quite technical and not easy to follow. The Goodreads review by Steffes (January 21, 2012) has a good description of these self-organizing, emergent stages (and is an excellent review overall).

The third stage, referred to as teleodynamic, is life as we think of it. Here again, the notion of constraint is central to Deacon's argument in the sense that life excludes those factors that are least helpful. This elimination promotes the ratchet effect that allows the organism to build on what has gone before without the noise and baggage that is not conducive to its integrity. Cells join with other cells. Each gives up something so that they can co-function with each other. Parts work together to form new wholes. Multicell bodies become "teleogens" that are part autonomous and part dependent.

In this stage, life is goal directed and expresses the full self-organizational properties that allow life to be both open (energy needs - "the capture and management of energy" - to counter the forces of entropy) yet separate from (protective) the environment. For Deacon, this is the "self" in the sense of a distinction from the other. While all life expresses identity of this sort, humans add to this with the capacity for reflection. With consciousness come ideas and with ideas come the power of non-material causality that Deacon argues are "absential" and as another example of "constraint" in the sense that physical attributes are absent. "Nothing" in the physical sense nevertheless has the power to transform action in the material world.

I don't know how close this is to being an accurate account of Deacon's argument. There are many technical words and discussions. Many times I lost his trail and was able only to pick up a faint scent here and there. This is a book that can be read again to more fully absorb what he's presenting. Nevertheless, from what I did pick up, Deacon lays out many interesting ideas that help to see the life, non-life distinction from a newer perspective, particularly his attempt to frame his argument in terms of (consistency with) the second law of thermodynamics.

As far as "take aways" from this book, there are a few that stood out. First, Deacon questions whether DNA is the central factor in evolution or is DNA itself an evolved capacity that was preceded by something more fundamental. Second, he sees this more fundamental capacity present in protolife forms ("autogens") that exhibit self-contained, self-reproducing properties. Unfortunately, his argument here is technical, leaving me unclear about how this basic self-organizing property originated in the first place. Deacon does say that his discussion is not about the origin of life per se, but rather about the "general principles" that make the origin of life possible. It could be, that the homunculus that he attempts to dismiss nevertheless remains, although a better understanding of his theory of self-organizing systems might sufficiently address that question. Third, it's clear that life exhibits "end-directed" behavior, but it's not clear what that general term means exactly. In self-organizing properties, is there something about the "whole" that directs the development of the parts to preserve the organism's integrity? At times, Deacon's argument seems to suggest this. He refers repeatedly to telos and end-directed behavior, even though the thrust of his argument comes down on the side of "emergent" wholes coming from parts functioning well collectively because the "interest" of each is served as a result. In this case, the "whole" is not the cause, but is a by-product of the parts of the organism that function well together. By anology, two plus two necessarily results in four (four emerges from two added to two); four does not "pull" these numbers together to create four). Yet, even this analogy is reductionist, whereas a whole is greater than its parts.

Fourth, boiled down to its essence, life's self-organization interacts with the world in two fundamental ways: Life seeks what it needs from the world to survive (which is why self-organization is open) and reacts to the negative stuff (defend against) the world sends its way. Both seeking and defending also seem to be essential properties of self-organization as they require the organism to modify itself so that it can survive. Fifth, Deacon's argument suggests that freedom as an embedded life property. The organism needs to be free to seek (and defend) in order to live. Most of the theories don't see life in that way. Action is determined largely by instinct. But that action serves a deeper purpose which is the need to be free to seek. This line of thought is clear when it comes to human freedom. We, most perhaps would argue, are free to chose how we engage the world, but that freedom serves our goals of survival and well being. In a way, with these fixed goals we are not free at all. That's what Deacon seems to be arguing when he says a self-organized system is constrained. It is bounded to ward off that which it doesn't need or which is harmful.

Sixth, Deacon's argument seems to be that "constraints" - the elimination of what was not useful - is the primary factor in evolutionary development, but he also argues that life processes are creators of order. Organization is not nothing. Organization is the retention of an entity that very much has physical properties. It is not clear to me why "absence" is more critical than "presence." Both of these work together. One eliminates and one creates. In a way, it seems that the more accurate statement is that elimination allows order, the physicality of an organism, to operate. Deacon's treatment of this issue is less than clear at times, although he does say that we organize "around an invariant telos: the self-creating constraints that make the work of this self-creation possible."

Seventh, Deacon begins his book by discussing the absence of physical attributes ("nothing") of ideas. Yet his theme is that the brain is not a general intelligence organ. Brains develop to support the body's goal, and they do this by predicting consequences for the body's various choices. The brain, via mind, thus reflects on

the lessons of the past and projects these lessons into the future. This is the realm of abstraction, but that abstraction represents realities that have implications for the self. As abstraction, ideas are nothing (physically). But they are very much something as well because abstraction translates into the body's welfare.

Eighth, in arguing about the role of constraint, Deacon states that consciousness is not a material thing but a product of what is not. "We are what we are not," he writes. "Continually, intrinsically, necessarily" we are "incomplete in our very nature." The self is literally sui generis, emerging each moment from what is not there." Here Deacon seems to be referencing our openess to the outside world and our internal adjustments to that world, but is he overstating his case? He also talks about a permanent self and telos that governs our interactions with that world. That self, that telos, is invariant. The self seems to have both unchanging as well as changing properties. While we might emerge each moment sui generis, that emergence nevertheless pushes off from a fundamental and unchanging core (the body's welfare).

As a final point, if we are continually developing our nature, what drives as to do so and for what purpose? Without an invariant core, transformation becomes random and pointless from an evolutionary point of view. That core is the ultimate standard of value (good and bad) and the ultimate principle that regulates our interaction with the world. Deacon laments that the most tragic feature of our age is that science has no place for value. Deacon's book brings value - the central role of biological well-being and the subsidiary values that derive from this - back into view. That is a good thing.

Juan says

Este es uno de esos casos en los que no sé qué hacemos en Goodreads. ¿Cómo califico yo esto igual que una novela de terror? ¿Acaso he comprendido siquiera la mitad de lo que propone el autor? La respuesta es *no*.

Pero no es tanto por su ambición, asintótica (hay un límite que no se ve capaz de traspasar en sus explicaciones) en su intento de juntar casi todas las ciencias naturales y deducir desde ellas la emergencia de la consciencia desde los estados inanimados y pantagruélica al estilo de las abordadas en Gödel, Escher, Bach: An Eternal Golden Braid o La Física de la Inmortalidad, sino porque jamás leí un libro con tantos polisílabos, sobreesdrújulos, términos inventados, citas aleatorias de todos los campos del conocimiento y construcciones subordinadas dentro de otras construcciones subordinadas, todas colocadas en orden psicológico. El fondo es una locura muy interesante, la forma se queda solo en locura; la persona que me aguanta en la vida, avezada en la lectura de textos complejos, no dejaba de sorprenderse de que estuviera abordando semejante ida de olla. De verdad, podría citar cualquier párrafo al azar y la probabilidad de que sea incomprensible es elevada.

Le doy cuatro estrellas porque es un tema interesantísimo y un ejercicio intelectual soberbio; la quinta se pierde porque no logra transmitir lo que pretende (o a mí me falta una base enorme). También le doy cuatro estrellas como epitafio, porque llevaba muchos días deseoso de sacarlo de mi vida, solo por saber si puedo volver a disfrutar con el ejercicio de la lectura. Dolor, mucho dolor.

Michael says

I can't see myself recommending this book to anyone.

Part of this is because I'm a physicist. Deacon spends quite a bit of time discussing thermodynamics, but he doesn't understand it as thoroughly as he perhaps thinks he does. The second law doesn't exist in a vacuum. It is a part of thermodynamics that works in concert with other pieces. I would point him to the Helmholtz free energy and Boltzman's formula for entropy. Combining them, his concept of constraint and its subsequent implications becomes scientific and predictable instead of gedanken and vague.

Another reason is that his writing style is abusive to the reader. His average sentence has to be around thirty-five words long and spans over five lines. And many are filled with words he literally made up. It's painful and leaves you with the constant question, "What the hell did I just read?" Better editing would have made this work vastly more accessible. I asked myself if he got paid by the word over and over again...

Other frustrations. He finds homunculi under every rock and behind every tree in the early chapters, but fails to even raise the concept when it came to his discussion of interpretation. Who is doing the interpreting?

And honestly, what he's doing in this work is offering up a suggestion for how things *might* be, but it is presented authoritatively, as if it was the result of research. But it isn't the result of research. So definitive statements of, for example, how specific teleodynamic system properties are results of certain morphodynamical interactions are misleading at best. He doesn't know because this research hasn't been done. And if it has been done, it isn't cited. So why present it this way? Yes, occasionally he mentions that he's trying to create a framework for research. But his presentation is such that he gives the impression that the work has already been done and these are the results. I find that to be somewhat dishonest.

To be fair, I find his concept of constraints and the possible implications of their interactions to be brilliant. I just don't think they're appropriately presented.

Kunal Sen says

This is one of the most difficult books I have read, but the gain easily paid for the effort. In fact I would strongly suggest that anyone who is curious about the deepest problems of life – intelligence, emotions, self, consciousness, etc., and is looking for answers that do not involve any mysticism or magic, must pick up this book. It is a beautiful example of how to build up an argument and a point of view from the absolute basics and gradually form an explanation for some of the most complex ideas. It is a great example of 21st century scientific thinking, which does not try to avoid certain hard problems by pretending they do not exist, or that they are just illusions, but rather tries to develop a theory that tries to explain mysterious phenomenon such as human consciousness purely from a rational framework. The author is not claiming that this is the ultimate theory of the mind, but is creating a rigorous framework of thought that opens the door for rational and demonstrable explanation of these complex mental phenomena. We are lucky to live in a time when we are finally opening up those doors that were, until recently, only the domain of philosophy, metaphysics and spiritualism.

Eric says

In "Incomplete Nature: How Mind Emerged from Matter," Terrence W. Deacon attacks a deep and serious problem: if we reject a non-physical spirit, how can we explain the mind.
My first complaint about this book is that it is too long. Deacon's editor should have pared the book down to

a third of its present size to keep Deacon's argument focused. Instead Deacon goes off on tangents which meander too far from the declared topic. For instance, he feels compelled to try to explain how life could have started on the primitive Earth. (Admittedly he then tries to connect this to the emergence of mind, but it seems to be a stretch.) Deacon also includes descriptions of how lasers work, of the Lorenz attractor, and Rayleigh-Bénard convection, among others, all of which are corralled, somewhat unconvincingly, into his argument by analogy.

My second complaint is that Deacon finds it necessary to coin new words and phrases without explaining why they are necessary. Examples include orthograde, contragrade, autogeneses, homeodynamic and morphodynamic. Why must new words be introduced for these ideas? My suspicion is that they help conceal sloppy thinking: "This capacity of constraints on dynamical change to propagate new constraints to other linked dynamical systems is the capacity for morphodynamic work." (p. 348) This sentence is italicized by Deacon so apparently he feels that it is especially meaningful. Nowhere does he provide an example which gives this sentence actual meaning.

Addressing Deacon's main argument, he seems especially enamored of entropy, documenting its introduction by Clausius, its explication by Boltzmann in terms of statistics, and its extension to the theory of information by Shannon. Entropy is undoubtedly an important aspect of the story, but Deacon's thinking seems muddled. On page 108, Deacon states the classical second law of thermodynamics for a closed system (Clausius): "The second law of thermodynamics tells us that, all other things being equal and without outside interference or loss (or more specifically, in a hypothetically isolated physical system in which energy neither enters or leaves), entropy will inevitably tend to increase until it reaches [a] maximum."

He then (p. 109) appears to argue that life violates the second law and proceeds to explain how life is possible by invoking Boltzmann, noting that "[t]he second law of thermodynamics is only a probabilistic tendency, not a necessity, and that offers some wiggle room." No; this line of argument is just totally wrong. He neglects to point out that a thermodynamically closed system cannot exchange matter with its environment either. This is relevant, if an organism cannot eat or breathe, or dispose of waste, of course life is not possible. Life requires an open thermodynamic system, as organisms continually process low entropy material from the environment (food) and convert it into high entropy material (waste) which is returned to the environment. In this way the decrease in entropy (increase in order) in the organism is more than offset by the increase in entropy (decrease in order) in the environment. Deacon actually adopts this argument later in the book. (Editor, where are you?)

Deacon himself admits that his line of thinking needs fleshing out in order to be convincing: "Obviously, as there are innumerable molecular details in the autogen story that I have merely assumed to be plausible without actually investigating the chemistry involved, ..." (p.447) Fundamentally his argument is by analogy, not by science, and he offers no proof that his hypothetical stories are true.

I must conclude that, although he makes some interesting points, Deacon fails in his task of explaining how mind could arise from inanimate matter without invoking a non-physical essence. More damning however is that he failed to produce a compelling and entertaining book; it is a forced march to finish this book.

Theo Armour says

Absence makes the brain go ponder...

Ed says

I believe this book has the potential to change--and perhaps revolutionize--scientific thinking in a great many

areas. Deacon presents a theory of "emergent dynamics" to explain how the emergence of higher-level processes from simpler physical processes changes causal dynamics in surprising and dramatic ways. His main objective is to show that "ententional" phenomena (function, information, meaning, reference, representation, agency, purpose, sentience, and value) have a legitimate place in scientific explanation once they are properly understood. Accomplishing that would overcome an enormous divide in modern thought since Descartes, with physical scientists tending to eliminate or marginalize these phenomena because they can't fit them into their mechanistic models, and more phenomenological thinkers insisting on them as essential aspects of our human experience, although not being able to explain how they can exist in a material world. In the course of presenting his solution to that problem, Deacon makes major contributions to the understanding of causality, emergence, organisms, evolution, work, information, emotion, and consciousness.

Fundamental to Deacon's argument is a distinction between "orthograde" changes, which occur spontaneously without external interference, and "contragrade" changes, which must be extrinsically forced. Contragrade changes correspond to Aristotle's efficient causality, the usual causality assumed in mechanistic explanation. Such explanation tends to overlook orthograde change and the more subtle formal and/or final causality it involves. Deacon understands form as a constraint on the possible states of a system, a definition that avoids both extreme realism (general forms existing prior to particulars, as in Platonism) and extreme nominalism (forms existing only in the minds of observers). Defined as constraint, form refers in a way to what isn't physically present, and yet what has definite causal consequences. Final causality is the ability of a synergistic system of forms to become its own cause by perpetuating itself.

Deacon distinguishes three levels of dynamic process, each with its own orthograde tendency. A "homeodynamic" process spontaneously reduces a system's constraints to their minimum, as exemplified by the increase in entropy described by the second law of thermodynamics. Although a large number of objects interacting in a system exert efficient causality on one another, an increase in entropy arises from the statistical form of the system as a whole, in which disordered macro-states far outnumber ordered states; in that sense the homeodynamic process exhibits formal causality.

When systems in different thermodynamic states encounter each other, they exert a contragrade influence, as when a hotter system encounters a colder one, so that each is moved away from the equilibrium it otherwise would have had. The second level of dynamic process, "morphodynamic," emerges when the flow of "energy" across such a gradient is constrained so as to generate order; it is a process of form generating more form. The crystalline form of a falling snowflake places constraint on where additional molecules will form when it freezes some of the water molecules it encounters in the air, so its form generates more form over its unique interactional history. Surprisingly then, a higher-level order-building process emerges out of the lower-level tendency toward thermodynamic equilibrium, one illustration of how emergence transforms causal dynamics. Morphodynamic processes occur only rarely and fleetingly in the inorganic world, but they are essential to the organic world. They rely on the thermodynamic foundation of radiation from the Sun to the Earth, constrained and put to the work of building bodies.

Organisms depend on a number of morphodynamic, order-building processes, each inducing contragrade changes in others, but in a synergistic way. One process creates a condition favorable to another, so that it can continue rather than wind down by destroying the conditions that gave rise to it. A self-assembly process similar to crystal formation can build a cellular wall, providing a protected space for an autocatalytic process that creates many molecules of the same kind, providing a continued supply of material for self-assembly. This kind of synergy generates Deacon's third level of dynamic process, called "teleodynamic" or end-directed, in which the system's orthograde tendency is to perpetuate itself by sustaining its closely coordinated morphodynamic processes. This gives organisms a kind of closure from external processes,

creating a distinct self, able to act on its own behalf in its environment in order to sustain itself.

Purely bottom-up explanation, trying to find the causes of the organism's behavior at lower levels, will be insufficient here. The lower-level physiological details can vary greatly, as long as the macro-level constraints are perpetuated. And the component processes are affected by the synergistic relationships in which they participate, so they can't be understood simply as independent causes. This is also relevant to the understanding of genetic information, whose meaning is not intrinsic but dependent on the teleodynamic context in which it is used. That's part of the problem of seeing the organism as a machine running a genetic "program."

In animals with brains, a second-order self can emerge, which we call "consciousness". This is a more specialized teleodynamic process contributing to the more general teleodynamics of the organism. Like any teleodynamic process, it is thermodynamically driven (it takes energy to feel and think) and emergent from morphodynamic synergies (interdependencies among order-generating processes within the vast neural network of the brain). And like any teleodynamic process, it is inherently self-sustaining. But what does it do for the body? Deacon describes it as a representational process that interprets the organisms's own teleodynamic tendency. I take that to mean that this process maintains a normative model of what the animal is trying to do, allowing it to anticipate opportunities and threats rather than just reacting to them. At the risk of putting words in Deacon's mouth, I would conclude that it is purposive in a double sense, having its own purpose of sustaining itself so that it can give purpose (direction) to the organism as it tries to sustain itself. Like any teleodynamic process, it performs work on what is "other" to itself, but in this case what is other includes other processes within the same body. Deacon makes the intriguing suggestion that the work done to mobilize the body to respond to favorable or unfavorable contingencies is experienced as emotion.

This perspective leads more naturally than any other I'm aware of to an understanding of human beings as thinking, feeling, and active free agents. But as Deacon says, freedom has to be understood not as freedom from causality, but freedom to exercise causal power, including some power over ourselves!

Obviously Deacon takes a dim view of cognitive science and neuroscience models that reduce thought to mechanical computation or relegate consciousness to the role of passive spectator to the brain's bottom-up causal activity. Mind isn't a ghostly immaterial entity existing beyond causality, but neither is it causally epiphenomenal (inconsequential). It is a dynamic process that evolved because of its function in sustaining and coordinating bodily activity in a very subtle way, through the perpetuation of constraint. Since mechanistic models only consider the extrinsic force exerted on one part by another in a deterministic system, they overlook the spontaneous propagation and self-persistence of constraints that organize our world while leaving it open to further organization.

I do have one reservation about Deacon's position, and that is that I'm not as sure as he is that teleodynamic process was absent for most of the universe's history. His description of teleodynamics reminded me of physicist David Bohm's concept of reciprocal causation, which he intends as a universal principle. I understand why Deacon wants to limit the discussion to living things, and I find his account of teleodynamics there persuasive, but perhaps he closes the door a little too firmly against the possibility of a self-sustaining process on a deeper level. I wonder what Aristotle would make of that.

Overall, I recommend this book very highly and hope that it will be widely read. Anyone who wants to think about human beings scientifically without reducing them to robots (or "golems") will benefit from it. In the Machine Age, we modeled our relationship to nature as a relationship of "man to machine," which ultimately forced us to regard ourselves as machines in order to include ourselves in nature. So the model became machinery controlled by machinery, with no place for consciousness, purpose, feeling or value. Now it's time

to recover our respect for nature's purposes, as well as our own self-respect. As Deacon ends the book, "Even as our scientific tools have given us mastery over so much of the physical world around and within us, they have at the same time alienated us from these same realms. It is time to find our way home."

Brian Tracz says

This book contained one of the most unique, rigorously scientific, and inventive accounts of the mind in nature that I have read recently. The basic gist of the book is that "absential" constraints are as important as the present physical properties in explaining self-organising systems like the mind. In other words, reductive physicalism overlooks the way that phenomena *not present in the system (e.g., brain)* but nevertheless *constraining* it might have played a role in shaping evolution, the mind, and the universe.

Terrence Deacon's story is a welcome alternative narrative to the now worn metaphors of Neo-Darwinism, which often involve the invocation of adaptationism as an explanation for all major changes in biological (and, strangely, cosmological) history. Deacon suggests that organised systems of all stripes are indeed selected for in accordance with environmental constraints. However, the picture he paints is one of a *non-reductive* adaptational science in which new entities, with new causal capacities and homeostatic capacities, emerge from lower-level absential constraints and physical properties. The shape and "morphology" of things, says Deacon (in line with Aristotle), are just as important as the physical laws that apply to the matter composing those things.

I could certainly go on, but I think the reader will be rewarded by this book. It is also a welcome fact that a biological anthropologist (as opposed to a laboratory neuroscientist or geneticist) undertook an effort to explain his viewpoint on these matters. Recently, I think the viewpoints of geneticists and neuroscientists have been over-emphasised--especially when they were speaking about metaphysical as opposed to physical matters. Of course, I have enormous respect for these researchers, but objectivity about our understanding of what it means to be "physical" will only be obtained when we know with full force what all the explananda of the universe are. This book is a wonderful piece of that project. Additionally, the book is *very* clear (much more so than this review) and engaging. Highly recommended.

G.R. says

(I have a friend who *did* throw War and Peace across a room, upon realizing, 95% done, that they didn't *care* what happened to the characters.)

I 'spose academics are free, outside the classroom, to spout nonsense about science that they have no understanding of. But even so, can you do neuroscience and misunderstand completely what the 2nd Law is about?

Otto Lehto says

Terrence Deacon's ambitious tome can be intimidating, as it is occasionally difficult, but it is worth reading, since it opens up a new paradigm. The book is beautifully written and the jargon is - amazingly - kept at a minimum. I consider it one of the most important books I have ever read.

It strives to unify the sciences, and produce an integrated vision of how life, mind and meaning can, without magic, emerge from the seemingly inorganic, insentient and meaningless material world. The question is not whether it succeeds in all the details - of course not - but whether it opens up a whole new way of looking at seemingly disconnected and strangely opaque phenomena - yes, yes, it does. In fact, I would say the power of its analysis is unparalleled. The lucidity it evokes is not only refreshing, it is also exciting for natural sciences, and vital for our humanities.

Ideally, the book should be read by the masses, since it contains a powerful new vision of the world. But realistically this book is too difficult for public consumption. So what we need are intrepid philosophers, scientists and free-spirited individuals to take on the challenge of reading this book, interpreting its message, and taking head-on the new paradigm that it proposes. Thus, just like books like "The Origin of Species" or "The Wealth of Nations" have never been read by the masses, they can BECOME tools of paradigm shift in the public consciousness. And I fully expect Deacon's book to have the same circuitous effect. If it doesn't, it's to the detriment of the public imagination.
So, brave warriors of the mind, come forth, you have a job to do, a "telos" to fulfill!

I will not attempt a summary of the book's arguments, since that would take a long while. But the basic premise is simple and powerful: that the laws of physics and chemistry can give rise to "emergent" levels of "dynamics", through the creation of self-amplifying and self-reinforcing constraints, which, in turn, can give rise to ever-higher forms of self-amplifying and self-reinforcing constraints. The end result of this process is a three-level nested hierarchy of dynamical processes - from thermodynamics to morphodynamics to teleodynamics - which constitutes the basic building blocks of inorganic and organic chemistry. This leads, in turn, to biological organization, evolutionary development, the complexification of life-forms and the capacity of "non-spontaneous" and highly "unlikely" events to appear in the world - including butterflies, human beings and (as a result of the emergence of human minds with the capacity to facilitate evolution) artificial products like computers and iPhones. The step-by-step emergence of these various dynamical processes, through the pitting of constraints against one another, and through the creation of self-referential loops that locally negate the dissipative effects of entropy, can be used to make sense of the seeming complexity and absurdity of biological and mental life.

It is the great achievement of the book that through the invention of only a handful of conceptual tools (the concepts of the three levels of dynamics and a few other things), Prof. Deacon has managed to construct a beautifully logical and painstakingly argued hypothesis that seems to elucidate many heretofore muddy conceptual issues within evolutionary accounts of cognition.

The book is at its weakest when it tries to explain the origin of conscious experience. This is not surprising, since the brute fact of conscious experience is one of the hardest problems that can be asked (I hesitate to say "answered"). And despite Prof. Deacon's valiant efforts, I believe there is still an explanatory gap between saying that the self-emergence of brain and mind can give rise to informational self-reference, and the precise birth of subjective experience. One does not seem to be a necessary consequence of the other. They seem to be brute biological facts. And he himself would probably agree that lots more would need to be said about the matter before we can cry "heureuka!" (And he DOES, in fact, emphasize that he is content to provide new paradigms of research, rather than final answers to specific questions.)

Despite its ambition, the book is surprisingly and refreshingly humble about its achievements. The stated goals of the book are explored with intrepid curiosity and penetrating vision, but many open questions must remain. And this is good, since it means that science is a never-ending project - as "incomplete" as the human nature that "teleodynamically" (to use Deacon's word) emerges from matter in the course of evolution. But all further research in this area must start from where Prof. Deacon has charted the course

anew. And even the weaknesses in his analysis are illuminating.

The goal posts have shifted, as has our understanding of our own limitations. The explanatory gap remains - the gap of our "incomplete nature" - between our current understanding and a complete understanding of everything there is to know; but instead of a foreboding Grand Canyon, we are now faced with a bridgeable gulf. We are ready to face the abyss of the unknown, guided by our unified, synergistic vision of evolutionary science. As human beings, as material creatures, as dynamical processes that "are not there" but yet "are there", as real causative agents, as functional features of the world, we have a duty to understand ourselves, and to understand ourselves as incomplete.

Tyler Guillen says

This book somehow found itself on one of my Amazon wish lists, so in a fit of curiosity, I ordered it. The description seemed to implicitly promise some spooky mystical solution to the problems it presents (sometimes a sane-sounding book will bait-and-switch you at the very end with some stupid new-agey *deus ex machina*--I've read enough Terence McKenna to be able to see that coming), but I went ahead with it for the sake of discovery. The depth and scope of the work, I found, was pleasantly fulfilling.

Deacon presents the same premise that just about any modern philosopher would use when discussing these topics: the moment you reject any weird Cartesian dualism in terms of the mind/brain problem, you concede to the fact that our conscious experience is in some way related to physical processes. From there, he presents a very up-to-date survey of biology, thermodynamics, complexity theory, and the cognitive sciences and redefines them (mind, without forfeiting any of their present integrity) in general terms. The key to his argument is the awareness of negative space.

With those terms in mind, Deacon gives us an extremely satisfying new perspective on life and mind, brimming with insight and future promise. With the theories he presents, we need not abandon our current efforts in neuroscience and biochemistry; instead, we should be inspired to frame the bleeding edge in new terms. Though he humbly admits to not giving us a complete theory, we're left with what I think is the most important intuition pump for today's theorists.

Indeed, the book's long. And difficult. However, I'm convinced that anybody who is curious about the bigger picture of current scientific process, especially that which is in any way related to the mind, owes it to him-/herself to get through it.

Elena says

The title, “Incomplete Nature,” bears a dual sense. It refers, first of all, to the incomplete pictures of nature so far yielded by materialism and idealism alike. In this guise, the work proposes itself as a third alternative, a prolegomena to a complete explanation of mind that formulates the criteria by which we can recognize when we've reached explanatory completeness. Deacon shows the kind of painstaking metaphysical reconstruction that is required to bridge the gap that still remains between mind and matter, as conceptualized according to the current paradigm, framed as it is between the extreme positions of idealist phenomenology and eliminative materialism. There are no quick and easy fixes here. Anything short of a total metaphysical reconstruction will at best be a hack-job, a pseudo-explanation, and his analysis exposes

the many such that are in fashion today. Deacon shows that so long as we fail to redefine in emergent dynamic systems terms our paradigm's core regulative notions, such as information, function, cause, form, structure, pattern, and identity, we will be left with an “incomplete nature.” That is, we will be left with a picture that leaves it absurd that we, with the values, experiences and meanings that we live by, should exist in the physical world as we know it.

“Incomplete Nature” also refers to the paradoxical insight that “something missing is missing” from all explanatory paradigms currently on offer. That is, the current paradigm is incomplete for failing to recognize the fundamental incompleteness of our nature. Deacon makes the intriguing claim that it is not so much lack of relevant scientific evidence that has bogged us down in our attempts to provide a physical explanation of mind. Rather, we have all the empirical data we need to close the gap. The issue is that said data has been systematically ordered and interpreted in terms of a bankrupt substance metaphysics. Instead, the clue to understanding the structure of end-directed (or as he calls them, “ententional”) processes such as mind and life is to be found in their counterintuitive “absential” character. That is, only if we can conceive how absence can be causally efficacious can we hope to explain the paradoxical, goal-directed organization of living and mental systems. Our scientific methodology flounders when it seeks to characterize their structure in positive terms, that is, in terms of the part/whole, aggregative relation of physical constitution. Classical emergence theories would hold that reductionism fails because the structure of organic and cognitive wholes is “something more” than the sum of their parts. Deacon, intriguingly suggests that their structure is actually “something less” than that sum. The concept of constraint proves to be the key to this rethinking of physical structure.

As Deacon puts it, the conceptual challenge absential phenomena presents us with is akin to the struggle of medieval mathematics to learn to compute with zero. We too must learn to compute physical structure with the null quantity of physical absence if we are to understand the structure of functional, informational phenomena. In particular, our working paradigm must be altered to recognize the causal role played by possibilities not realized. Deacon undertakes a logical analysis of the concept of efficacious absence which shows both the commonality of mind and life with the physico-chemical continuum, as well as their specific difference, which is to be found in their identity as emergent, dynamical systems that autonomously organize themselves around “constitutive absences.” This is much like the pattern in lace is held in place as much by the structure of the material fabric, as it is by the specific location of gaps.

On the way to such prolegomena, Deacon provides an unusually sober and systematic analysis of our current conceptual tools in order to show just where both extremes of materialism and idealism fail. Idealism, even in its current revamping as phenomenology, provides a pattern of explanation which Deacon aptly calls a “homunculus.“ This mode of explanation proceeds by insisting on the logical irreducibility of the teleological properties of mind and life (implicit in concepts such as information, function, reference, meaning, value, purposive behaviour, as well as centralized organization around a core locus of perspective, i.e. self) while failing to show how such properties relate to physical properties, and thus are effective members in the larger causal fabric of the physical world. Homunculi fail as explanations because, while they give a place to these properties in our accounts, they nonetheless do so by positing them as unanalyzable black-boxes to which foundational status is ascribed by fiat.

At the opposite extreme is reductive materialist explanation by “golem” constructs. This approach proceeds by decomposing end-directed phenomena into their simplest constituent parts, while then attempting to reconstruct them from what it takes to be their fundamental “building-blocks.” This could be called the leggo-block approach to analyzing experience that we have inherited from Humean atomism. The problem with such views, Deacon suggests, is that they inevitably end up presupposing that which they purport to explain. Such attempts to purge anthropomorphic, homuncular black-boxes out of scientific explanation end

up being forced to pay their dues to the qualitative loci for which homunculi are “place-holders” by bringing ever-more “cryptic homunculi” into the picture, usually in the form of “golems,” which are “fractionated homunculi.”

Deacon offers an elegant argument against this explanatory strategy by showing that explanation by golems is a cure worse than the homunculus disease because it proceeds by presupposing ever subtler homuncular properties (such as informational, representational, and functional relations) even as it explicitly denies their existence. Exemplars given of this strategy are Dennett's computational view of mind as an information-processing machine and Dawkins' replicator (i.e. selfish-gene) theory. Both take informational relations out of the larger dynamic context which makes them possible and which grounds their real-world reference. Both rely on an overly abstract definition of information that presupposes extrinsically-imposed reference – namely, a human interpreter who can fix the representational relationship, or specify what the information is about. Dennett's does this by postulating “stupid computing machines” in the brain which mysteriously manage to generate representational structure in a bottom-up fashion if enough are present. Dawkins achieves this through his characterization of genes as informational causal loci, as if genes could be causal agents shaping the genetic replication process when abstracted from their larger organismic causal network, or “represent” information.

In either case, as in many more than Deacon discusses, the reductionist approaches fail to explain ententional phenomena such as function, information, and representation, even as each presupposes these by inserting them, as “cryptic computational homunculi,” in their reductive explanations. It would seem that end-directed phenomena, by resisting any endeavour to explain them away, prove their ineliminability as a part of our starting point. In contrast to such reductionist, golem approaches, Deacon shows how information in living organisms is intrinsically-interpreted by virtue of the role that it plays in the self-organizing dynamics of life.

Ultimately, Deacon is not motivated by the same old Romantic conviction that reductionism is evil for dissecting the beauties of life and should thus be junked. Rather, he shows that reductionist analysis should be placed in its larger context, as specified by emergent dynamic systems theory, if it is to reveal its own fullest sense as well as achieve coherence.

To avoid the absurdity of both homuncular and golem pseudo-explanatory approaches, a revolution in our paradigm's regulative theory of form is needed. The key, as Deacon sees it, is to reframe the materialist paradigm in terms that replace its current substance logic with an emergent dynamic systems logic. The real logical leap can occur once we learn to re-conceive of form as dynamic process. To this end, he offers a negative concept of form as constraint on the possible movement of a system's constituent parts. As constraint, form is a limitation on, or a “concrete abstraction” from, the variety of a system's possible dynamical states. This negative concept of form is Deacon's proposed third alternative to the age-old dichotomy between realism and nominalism, the former of which insists on the reality and causal efficacy of general types and functions, while the latter insists that such general forms are heuristic cognitive constructs abstracted from particular existents that alone are causally efficacious.

Deacon's own strategy is to explain mind and life, as well as the functional-informational properties that are at their basis, by specifying the dynamic context within which these emerge and which has been left out of virtually all other accounts. Letting the overlooked dynamical context “speak” is at the center of his “figure-ground” shift of perspective. To foreground the constitutive role played by this background dynamical context, Deacon brings together the disconnected empirical evidence from a breathtaking array of disciplines - from thermodynamics, to information theory, to evolution, to semiotics – and shows the unnoticed connections criss-crossing between them.

Basic to our paradigm is the concept of information. Information is a primordial manifestation of an ententional logic at work in nature. As such, it is the key to re-defining both our concepts of the material and the mental. And because it regulates inquiry in virtually all disciplines, it needs more careful definition. Deacon shows that an implicit substance metaphysics led prior theorists to reify information, in much the same way that it led thinkers in the 19th century to conceive of energy as some ultimate "stuff." But end-directed processes like information, being defined as they are by specific "constitutive absences," are the reverse of substances. They are defined by their relation to something absent, possible, or abstract. Information, then, isn't some ultimate stuff either of brains, genes, organisms, or universes. We need instead a dynamic, relational concept of information.

Deacon points out that our paradigm cannot account for why living systems, with their end-directed pattern of change, manage to persist in apparent defiance of the second law of thermodynamics. He observes that evolution itself, as a constraint-propagating process that leads to ever greater elaboration of form, seems to go against the natural grain. The concept of constraint turns out to provide Deacon with the golden thread that leads him to a more fully-fleshed concept of physical causation that makes sense of this queer seeming-discontinuity.

He notes that an important source of our current impasse stems from the modern reduction of the concept of cause to its restrictive sense as efficient, mechanical cause alone, which makes it difficult for us to characterize formal and teleological forms of change that are evinced by living systems. Ironically, resurrecting some chunks of the Aristotelian corpus is once again the key to solving our explanatory deficits. The epiphany comes when we recognize that constraint is the product of thermodynamic work (i.e., of the efficient causality characteristic of energetic exchanges and molecular interactions). But constraint on a system's dynamics can also become the formal condition for higher order forms of organized work. And information is constraint.

This insight into the relationship between formal constraint and physical work is the key to Deacon's emergent, three-level model of forms of causality. The basic level that supports all the rest is the level of homeodynamics. This is the level of thermodynamic energetic exchanges, and can, as such, be characterized according to our concept of efficient/mechanical causation. At this level, the spontaneous, global tendency of change is towards constraint-dissipation, i.e. entropy.

The morphodynamic level supervenes upon the homeodynamic, and introduces a new domain of causal possibilities. At this level, interacting thermodynamic processes lead the system's components to converge on collective patterns of behaviour that are more efficient at dissipating constraints than was the disorganized behaviour of the system's uncoordinated components. He offers as examples of morphodynamic processes Benard cell formation in boiling liquids, vortex-formation in a stream, snow-flake crystal formation, or the harmonic resonance formed by breath passing through a flute. This level is characterized by a constraint- or form-generating causal dynamic that loosely corresponds to Aristotle's formal cause.

Deacon points out that morphodynamic processes, being self-undermining and unstable by virtue of their tendency to deplete their physical-energic substrates, are the exception in nature. Teleodynamic modes of organization make possible a dynamical context in which morphodynamic processes can be stabilized. The teleodynamic level emerges from the interaction of underlying morphodynamic processes. Teleodynamics, by creating what he describes as an "entropy ratchet," manages to use the universal entropic tendency against itself in order to create more organized forms of physical work. This is because, at this level, a self-organizing dynamic emerges out of the mutually-supporting interactions of component morphodynamic processes, that are themselves fueled by component thermodynamic processes.

In teleodynamics, the parts cannot be specified apart from their functioning in the emergent systematically-organized whole, even as the whole is constituted by the interactions of its constituent parts. Deacon notes that this self-organizing dynamic is difficult for us to conceive, since it violates the fundamental logical-type rule, which states that the class cannot be a member of itself. Yet it is only by interpreting the empirical evidence that we already have in terms of such a circular, dynamic logic that we can explain – rather than explain away - the teleodynamic phenomena that we can't do without in explanation.

This three-tier, nested hierarchy of dynamical organization is Deacon's answer as to why the reductionist, bottom-up approach must in the end fall short of explanation. It is only at the level of teleodynamic processes of physical organization that we can speak of information and organismic functional organization. We can thus hardly reconstruct the organization of these end-directed processes simply by looking, as reductionists do, at the homeodynamic level of interactions between their physical constituents. Deacon's emergent logic provides the basis for conceiving of semiotic relationships as an integral part of the causal fabric of the physical world, while also explaining the informational and functional relations that competing reductionist theories rely on but cannot explain.

Among the many pleasures of this book is a breathtaking way of rethinking the physical significance of evolution, which he describes as a teleodynamic process. Evolution, in his view,
is nature's way of exploring (and fully tapping) the causal possibilities of the emergent morphodynamic domain of causation. The emergence of the first self-organizing process (which he calls an "autogen") is a revolution in the map of causal possibilities. Through evolution, teleodynamics creates an island sheltered from the seemingly universal entropic tendency of the surrounding physical world. In this self-enclosed causal space, thermodynamic work can be used to propagate constraints that make possible the emergence of ever higher levels of self-organization, which lead not just to organisms, but to selves, to sentience, to cultural meaning, and finally, to the emergence of value in a physical world. Thus, he puts evolution back in its physical context (as is seldom done in an intellectual culture overly divided by specialism) by showing that a self-organizing physical dynamic is the presupposed substrate of natural selection. The formal possibilities of self-organizing behaviour are ultimately what provide the physical context within which the evolutionary process can most fully be understood.

Ultimately no theory of mind has much value if it doesn't inform our ordinary self-understanding.
The big surprise that his theory brings is that our identity is not as a substance, either material or ideal. Rather, we are individuated in this continuum of physical interchanges by the fact that we are quasi-stable dynamic systems organized by constraints. Our identity is indeed defined by a special locus of interiority, as we know it to be in direct experience. However, this locus on which we stand in the midst of things is a dynamic pattern.

Another highlight was Deacon's account of emotion, which he describes as the inner feel of the general teleodynamic process of life. Emotion, as "the inner feel of what happens" (as Damasio also put it), is the basis of mental life. What a way to dissolve the gap between the inner feel and the outer look of physical process in a way that brings it home to us! It makes sense that a dynamic approach like his would reveal the significance of integrated emotional response, in contrast to computational theories that must give priority to formal cognitive structure.

So are we home yet? Did we circle back, in theory, to our true, inescapable starting point as existents, as we must do, in any theory of mind? I am not sure yet, but I do know that this has brought me closer to home than most naturalistic accounts of experience that I've tried on for size so far. The best development of functionalism seems to be this emergent dynamic systems approach.

Ultimately, Deacon provides us with guidance revealing how we can better think about what we already see. He shows us a way to conceive the unity of phenomena we already see by bringing together the scattered pieces that our paradigm lacks resources to integrate until it revisits its own foundational metaphysical assumptions. Above all, he shows how much deeper philosophy of mind has to dig if it is to answer its questions. To get better concepts of mind, we need a more fully fleshed out metaphysics of the physical world in general. He shows how a common logic applies to mental and physical phenomena. He also shows that empirical analysis alone, without conceptual analysis, will culminate in a scattered heap of disconnected information the true sense of which cannot be appreciated until it is placed in a systematic whole. Deacon manages to reveal these interdisciplinary connections by going back to the fundamental regulative conceptions of our paradigm, concepts such as pattern, cause and information. We can't resolve the empirical problems until we solve the conceptual ones.

In the end, bridging the explanatory gap has more than “just” theoretical value. It has ethical import. In the conclusion, Deacon observes that in the current materialist paradigm we cannot place ourselves as valuing existents on the map. As such, ethical and theoretical knowledge remain ever split for us. Our naturalism leads to value nihilism. Instead, he wants to show us that we can call this physical world home to our innermost meanings and values. Ultimately, he is right to recognize the larger philosophical significance of these problems in philosophy of mind. Scientific knowledge can only become personally-sustaining knowledge once the mind/matter explanatory gap is bridged.

Roy Kenagy says

Deacon's "Symbolic Species" is the most comprehensive and persuasive text I know for explaining the development and function of language and "information." From the reviews so far, this book takes the next step in explaining what it means to be human.

PW Review: http://bit.ly/tWj2dH

"In a tour de force encompassing biology, neurobiology, metaphysics, information theory, physics, and semiotics, Deacon, a neuroscientist and chair of anthropology at UC-Berkeley, attempts to resolve the issue of how life and mind arose from inanimate matter. As he did in his previous book, The Symbolic Species, Deacon asks a very big question and provides the framework for an answer. He argues persuasively that complexity can comfortably emerge as a higher order function from simplicity and extends this point to discuss how nonmaterial entities such as ideas and emotions can generate physical consequences."

Myles says

This was one of the hardest books I've ever read largely because it presupposes an indepth knowledge of mechanics, chemistry, genetics, biology and physics. Much of it flew right over my head.

It deserves four stars if for nothing else, its impenetrability.

Sarcasm aside, the mystery and the glory of the quest is worthwhile.

Deacon seeks nothing less than to fill the scientific vacancy between mind and matter. A lot of pages in this

book are filled with the historical blind alleys that thought has taken us in the quest....too many pages, in my opinion.

Logic and physics tell us that life is impossible, that entropy will drain the universe of thought and meaning. We know, of course, that this isn't entirely true. That there must be something else at work because life exists. What exactly that something else is forms the storyline of this book. It's not an anthropomorphic creature. It's not little green men from space.

Deacon never tries to answers the why question. He creates a framework for the how based on what we do know about how the universe operates, and it is obviously more than the Second Law of Thermodynamics.

The key is in the title to the book..."emergence". Matter organizes itself. It doesn't need little green men. Life may have come about in an accident, but the pillars of thought exist in the same realm as biology and mechanics. Perturbance, motion, activity create the same powers in mind as in geology or anything else.

And that's about as far as I got.

Adam says

George Orwell wrote six rules for writing. I'm not saying that we should necessarily defer to him just because he was a great writer, but they're good rules of thumb. This author breaks 2/3 of them. Here they are:

1:Never use a long word where a short one will do.
2. If it is possible to cut a word out, always cut it out.
3. Never use the passive where you can use the active.
4. Never use a foreign phrase, a scientific word or a jargon word if you can think of an everyday English equivalent.

Here's a quote from an excellent review (by Michael) that sums up how badly the book is written:
“his writing style is abusive to the reader. His average sentence has to be around thirty-five words long and spans over five lines. And many are filled with words he literally made up. It's painful and leaves you with the constant question, "What the hell did I just read?" Better editing would have made this work vastly more accessible. I asked myself if he got paid by the word over and over again...”

I think Michael was generous with the average number of words. It felt more like the average number of words per sentence was just another book he'd accidentally quoted the entirety of (kek). It actually reminded me of how back in school you'd get a rough idea from the teacher about how many words to write for an essay and you would throw in as many adjectives as you could to reach the goal. As Michael pointed out, it's even worse than that because he just makes up words that simply don't help the discussion.

To quote Eric's review:
“Deacon finds it necessary to coin new words and phrases without explaining why they are necessary. Examples include orthograde, contragrade, autogeneses, homeodynamic and morphodynamic. Why must new words be introduced for these ideas? My suspicion is that they help conceal sloppy thinking: 'This capacity of constraints on dynamical change to propagate new constraints to other linked dynamical systems is the capacity for morphodynamic work.'”

I think they may conceal sloppy thinking, but it could also be a case where someone is trying to coin terms and have other people run with them, furthering their creator's credentials.

Either way, pretentious book is pretentious.
