Chapter Three

“There Is No World”: Deconstruction, Theoretical Biology, and the Creative Universe

As we have noted in the previous two chapters, much ink has been spilled on questions of “epistemology” and “phenomenology” in relation to Stevens’ poetry and poetics. In the next two chapters—and in this one in particular—I want to lay the foundations for what would be, in a different context, an extensive undertaking: to show how the epistemological and phenomenological questions in Stevens’ poetry are actually better understood if they are reframed in terms of a reconceptualization of ecological poetics that is available to us by means of a cross-conjugation of theoretical biology and post-structuralist thought (my example will be deconstruction, though it need not be limited to that in the larger project to which I have just gestured). The emphasis here, as I have already insisted, is a non-representationalist understanding of poeisis: whether we are talking about the poiesis of “life” and the evolution of the biosphere in theoretical biology, or the poiesis of worlding and world-making in deconstruction, or the poiesis of Stevens’ poetic practice.

Part of my motivation is that deconstruction has been considered less relevant than other approaches to the kinds of questions around “life” and ecology that I will be pursuing. Martin Hägglund has noted, for example, that “the revival of `life’ as a central category during the last decade of continental philosophy” has led to the downgrading of deconstruction “in the name of a return to the real, the material, and the biological,”1 while Vicki Kirby asserts that “there is no doubt that deconstruction is out of favour in critical theory circles” today, asking if deconstruction can “reinvent itself as `new,’ as `creative,’ as different from its former manifestations?”2 I think the answer is “yes,” not in spite of the fact but because of the fact that in Derrida’s work, as Kirby puts it, “a model, or representation, is not a third term in-between the biologist and biology or the writer and the world,”
but rather “the one who knows, the measuring apparatus and the object to be interpreted are strangely involved.”

What Kirby characterizes as the reinvention of deconstruction is what part of what I have been trying to do over the past twenty years by bringing deconstruction into conversation with biological and social systems theory. Take, for example, this passage from Humberto Maturana and Francisco Varela that I quoted in my book *Animal Rites* from 2003, where they offer their own version of what Kirby calls “strange involvement.” The nervous system, they argue,

does not operate according to either of the two extremes: it is neither representational nor solipsistic. It is not solipsistic, because as part of the nervous system’s organism, it participates in the interactions of the nervous system with its environment. These interactions continuously trigger in it the structural changes that modulate its dynamics of states. . . . Nor it is representational, for in each interaction it is the nervous system’s structural state that specifies what perturbations are possible and what changes trigger them.

But this leads to “a formidable snag,” as they put it, because “it seems that the only alternative to a view of the nervous system as operating with representations is to deny the surrounding reality.” All this indicates, however, is the need (to use Niklas Luhmann’s language) to pay attention to not just first-order but second-order observation, to shift to the observation of observations. Thus, “as observers,” they explain,

we can see a unity in different domains, depending on the distinctions we make. Thus, on the one hand, we can consider a system in that domain where its components operate, in the domain of its internal states and structural changes. . . . On the other hand, we can consider a unity that also interacts with it. . . . Neither of these two possible descriptions is a problem per se: both are necessary to complete our understanding of a unity. It is the observer who correlates them from his outside perspective. . . . The problem begins when we unknowingly go
from one realm to another and demand that the correspondences we establish between them (because we see these two realms simultaneously) be in fact a part of the operation of the unity.\(^6\)

Methodologically speaking, this leads to the conclusion that contrary to a common implicit or explicit belief, scientific explanations...constitutively do not and cannot operate as phenomonic reductions or give rise to them. This nonreductionist relation between the phenomenon to be explained and the mechanism that generates it is operationally the case because the actual result of a process, and the operations in the process that give rise to it in a generative relation, \textit{intrinsically take place in independent and nonintersecting phenomenal domains}. The situation is the reverse of reductionism... [T]his permits us to see, particularly in the domain of biology, that there are phenomena like language, mind, or consciousness that require an interplay of bodies as a generative structure but do not take place in any of them. In this sense, science and the understanding of science lead us away from transcendental dualism.”\(^7\)

And away, it should be emphasized, from the \textit{representationanism} that we have already seen dismantled, in philosophical terms, by Richard Rorty in the previous chapter.

Deconstruction has traditionally been thought of as inimical to the idea of “nature,” and suspicious of biology and ecological concepts in general. What Michael Marder calls “deconstruction’s allergy to ecology” stems in no small part from the holism and organicism that has typically characterized the concepts of nature and ecology as a site of “the persistence of logos” in the familiar forms of presence, gathering, harmony, the proper, the given, plenitude, origin, non-supplementarity, and so on.\(^8\) Here, however—and I’ve made a similar point elsewhere about Derrida’s wary view of the concepts of “communication” and “information” in his work at mid-career—what is problematic is not the concept of ecology \textit{tout court}, but rather the traditional ways (what we might call “first-order” ways)
of thinking about it. I’ll attempt to provide an alternative to that view here, extending considerably some of the formulations I introduced in my previous book, Before the Law, regarding how a deconstructive rethinking of these concepts can be brought into a quite robust articulation with contemporary ecological and biological thought. For both deconstruction and contemporary theoretical biology, our attention needs to be focused squarely on the problems of temporalized complexity, the co-implication of observer and observed, and the contingent relationship between organism and environment. To put it slightly otherwise, we find a fundamental non-presence and radical supplementarity or self-supplementarity at the heart of the evolution of the biosphere—there is no “there” there, in short—and it is this open-ended, non-teleological (though purposive) self-surpassing that theoretical biologist Stuart Kauffman calls “creative,” and that Derrida’s early work associates with the idea of “play.” This fundamental non-presence is actually crucial, as we’ll see in the next chapter, to the ethical implications Derrida derives in the second set of seminars on The Beast and the Sovereign from this remarkable passage, centered on his reading of Paul Celan and Martin Heidegger (though we need to hear the sense of “world” here that Heidegger inherited in part from biologist Jakob von Uexküll). Pedagogically tuned to the setting, Derrida Socratically offers three theses, with a sustained meditation on third as the seminars unfold:

1. Incontestably, animals and humans inhabit the same world, the same objective world even if they do not have the same experience of the objectivity of the object. 2. Incontestably, animals and humans do not inhabit the same world, for the human world will never be purely and simply identical to the world of animals. 3. In spite of this identity and this difference, neither animals of different species, nor humans of different cultures, nor any animal or human individual inhabit the same world as another. . .and the difference between one world and another will remain always unbridgeable, because the community of the world is always constructed, simulated by a set of stabilizing apparatuses. . .nowhere and never given in nature. Between my
world. . .and any other world there is first the space and time of an infinite difference, an interruption that is incommensurable with all attempts to make a passage, a bridge, an isthmus, all attempts at communication, translation, trope, and transfer that the desire for a world. . .will try to pose, impose, propose, stabilize. There is no world, there are only islands.  

We’ll return to this important passage in a different key in the next chapter, but for now, we can say that one of the reasons “There is no world” is that “life” or “nature”—rather than being a site of fullness, positivity, and identity (that is to say, non-supplementarity)—is importantly in a relationship of différance, asynchronicity, and “spacing” to itself because of the fundamental circularity and recursivity that takes place in an ever changing environment for biological life forms—the fundamental “repetition with difference” familiar to us from post-structuralist philosophy but radicalized and, as it were, three dimensionalized, by theoretical biology. And this enables, in turn, what I will call a “topological” rather than “topographical” way of thinking the ecological. As Ana Soto and Giuseppe Longo note, “biological systems are characterized by the simultaneous co-existence of opposite as exemplified by change and stability, the incomplete separation between internal and external (topology), and before and after (time), the notions of extended present, memory and anticipation.” The issues here are both ontological and epistemological and they lead inexorably, in fact, to an ongoing deconstruction of the ontological/epistemological divide—a deconstruction that poetry can handle better than philosophy, as we saw Gregory Bateson suggest in the previous chapter.

What I mean by “topological” is that the issues involved here are not just “ecological” in the straightforward sense. To be sure, both the ecological and topological senses of the evolution of the biosphere push back against the “central dogma” that has dominated the conversation about life in the biosphere for the last fifty years. That dogma, famously formalized by Francis Crick and institutionalized by molecular biology and figures such as Richard Dawkins, holds that in evolutionary heredity, inheritance that has evolutionary significance is limited to the “vertical” transmission of DNA sequences;
that the only variations that are heritable in organisms take place in DNA sequences; and that variations in organisms do not occur as a result of somatic changes or environmental pressures, but only take place by means of random mutations in DNA sequences. Now as Russell Winslow and Denis Noble (among others) have noted, well-known biological phenomena such as “horizontal inheritance,” epigenetic inheritance, niche construction, “adaptability drivers,” and so on make it clear that the understanding “in which identities are fundamentally tied to family lineages of vertical inheritance must be replaced by something far more ecological.” In the so-called “Baldwin effect” of niche construction, for example, an organism moving to a new niche “can change the course of evolution even with no mutations whatsoever,” as biologist Denis Noble points out, resulting in “an evolution of the genome by combinatorial selection, not selection of new random mutations.” Niche construction and its effect on evolution only dramatize the fact that “construction,” not “adaptation,” is *le mot juste* in this situation. As none other than Richard Lewontin argues, “the claim that the environment of an organism is causally independent of the organism, and that changes in the environment are autonomous and independent of changes in the species itself, is clearly wrong. It is bad biology, and every ecologist and evolutionary biologist knows it is bad biology.”

More radically still, as Winslow notes, “insofar as the organisms niche-construct, they inscribe themselves into the environment phenotypically; they carve the history of their *capacities* into the hieroglyphic cave-walls of organismic space and time.” And this means that “spaces are not substances, they are not *present* things. . .insofar as the ecosystem contains the trace of former, past activity and already gestures toward a future.” This is anything but a generic process, of course—and not just because of the gap between what G. Evelyn Hutchinson called “the ecological theater and the evolutionary play”—and it mitigates any kind of holistic or topographical concept of ecology (even though of course we may search for, and find, underlying regularities in how that process takes shape).

Part of the reason that holism in any familiar sense is out of the question is that in such topological
forms of “mereological” relations, the relationship between the part and the whole is radically changed, and so are the qualitatively different forms of causality that obtain at different levels. We typically think of causation in the scientific domain as bottom-up (as we do in the “central dogma,” where the lines of causality run from the gene to the physical characteristics, biomorphology, and so on of the organism). But in the dynamic, self-organizing, autopoietic forms of life in the biosphere, we find a much more complex relationship between component (or element) and system, because causality often operates in top-down fashion as well. As Alicia Juarerro notes, these “mereological” relationships (part-to-whole or whole-to-part) have “bedeviled philosophers of science for centuries,” but what we now see is that “the unpleasant whiff of paradox” that “remains in any mention of recursive causality” in living systems is unavoidable, and indeed productive. What we find in autopoietic biological systems, in fact, is what she calls a “decoupling in the locus of control: the components’ behavior suddenly originate in and are under the control, regulation, and modulation of the emergent properties of the macro level, as such,” which in turn “loosens the one-to-one strict determinism from micro to macro levels.” In contrast to physical systems that show emergent self-organization—dust devils, tornadoes, Bénard cells, and so on—where “external agents or circumstances are responsible for the conditions within which physical self-organization takes place,” in autopoietic systems, those conditions and constraints are introduced and maintained by the system itself, resulting in a strong “downward causation” in which systemic closure becomes “a closure of constraint production, not just a closure of processes.”

What this means—and here I think a strong return to deconstruction is unavoidable—is that (as Juarerro notes, following Stuart Kauffman), “it is impossible to predict emergent properties even in principle because the `categories necessary to frame them do not exist until after the fact.’” Is this uncertainty epistemological or ontological, Juarerro asks. “Does emergence therefore simply come down to an epistemological ignorance, to our human inability to exhaustively list every ceteris paribus and disjunctive condition (even though such an exhaustive set of conditions in fact exists and there is a
1:1 correlation between each fully specified set of conditions and corresponding emergent property?"23

And here is where I think the epistemology/ontology divide cannot be maintained. Indeed, if everything we have said of biological organisms is also true of us, it is, in fact, all the more the case with us, and for the reasons Juarrero notes: the more complex the autopoietic life form, the more we find a “dynamic decoupling” of the causative relationships between the micro- and macro-levels. Or as she puts it:

System and environment co-evolve over time in such a way that the identification between macro-property and specific configuration becomes irrelevant; as we go up the evolutionary ladder, the go of things issues more and more from higher and higher levels and according to criteria established at progressively emergent levels. Just as living things are autonomous and self-directed in a way that physical dissipative structures are not, sentient, conscious, and self-conscious being are even more autonomous and self-directed.24

But here, I think, is where we need an astringent dose of deconstruction, specifically, Derrida’s critique of the “auto-” of autonomy, auto-affection, autobiography, and the like—in short, his critique of intentionality and of related concepts such as “agency.”25 It’s not that autonomy and self-directedness don’t increase, as Juarrero suggests, with the increasing decoupling of micro- and macro-structures and the growing importance of downward causality. They do. It’s just that the picture that intentionality and autonomy gives to itself of its situation is unavoidably partial, reductive, and blind to its full infrastructural conditions of possibility for emergence (or what we have already called its “ecological” embeddedness). Or to remember Maturana’s claim above: “there are phenomena like language, mind, or consciousness that require an interplay of bodies as a generative structure but do not take place in any of them.” Or as Maturana and Varela put it in Autopoiesis and Cognition,

the domain of discourse is a closed domain, and it is not possible to step outside of it through discourse. Because the domain of discourse is a closed domain it is possible to make the
following ontological statement: the logic of the description is the logic of the describing (living) system (and his cognitive domain).

This logic demands a substratum for the occurrence of the discourse. We cannot talk about this substratum in absolute terms, however, because we would have to describe it. . . . Thus, although this substratum if required for epistemological reasons, nothing can be said about it other than what is meant in the ontological statement above.  

What this means—more radically still—is that when intentionality does attempt to give itself a non-reductive or complete picture of this situation, it is unavoidably subject to the phenomenon of recursivity that is at the core not just of deconstruction but also of theoretical biology. And it is also “blind” to the self-reference of its own description. As Kirby reminds us, in deconstruction, “the purported gap that secures and separates the analytical instrument from the subject who uses it and the object scrutinized, is confounded,” and this means that we are always already in “an ecology that is so intricately enmeshed and all-encompassing that even those expressions (of itself) that appear circumscribed, isolated, and autonomous, are ‘themselves’ generated by this generality.”  

All of the foregoing should make clear what I am not doing here. I am not engaging in the kind of argument that is all too familiar from approaches such as “literary Darwinism,” “neuroaesthetics,” “cognitive cultural studies” or “cognitive poetics,” all of which, as Carsten Strathausen puts it, presume “to understand all aspects of human culture, including art and politics, in biological terms as part of our evolutionary heritage, often in the process embracing an oversimplified and reductionist version of Darwinian theory.” Unlike the position I am developing here, “biologism calls on art for the sole purpose to verify what it already knows. It fails or refuses to acknowledge that fact that the concepts we use co-determine the objects we analyze.” In short, the position I am developing here is the opposite of reductionism, and I am happy to say that it is increasingly shared by exciting and inspiring new work in theoretical biology. Or as Denis Noble puts it, regarding the importantly posthumanist sense of
“observation” that I am invoking here, “a proton (a hydrogen ion) views a cell much as we view the universe. And that is also how a single cell views us. Universes within universes within universes—and beyond what we can see and know about, who knows? ‘Know’ is the right word here. We have no idea what, if anything, could lie beyond what we see and observe. That should inspire humility.” And yet, this is not a generic, generalizable observation—as if there were just one type of thing called “observing”—precisely because of the qualitatively different kinds of causation and constraint in different physical and biological phenomena that we have discussed above.

The relationship between deconstruction and the life sciences (and more generally the systems theory that is underneath contemporary theoretical biology) has been taken up in the past, of course, by figures such as Anthony Wilden and, more recently Christopher Johnson, in his book System and Writing in the Philosophy of Jacques Derrida. Johnson provides a useful overview of the interdisciplinary matrix out of which the crosstalk between deconstruction and the life sciences emerged. As he notes, during the 1960s, we find an epistemic shift “occurring within structuralism—or between structuralism and ‘post-structuralism’—with respect to the linguistic analogy, involving a change of emphasis from ‘language’ to the more specific notion of ‘writing.’” This shift coincided in France with the Nobel Prize winning work of theoretical biologists Francois Jacob, Jacques Monot, and André Lwoff on the role of RNA in the transmission of genetic information, and opened the door for the reconceptualization of “writing” in terms of code and program that Derrida famously explores in Of Grammatology, whose first chapter, “The End of the Book and the Beginning of Writing,” begins with a section called “The Program.” In fact, the first chapter of Jacob’s influential book The Logic of Life, from 1965, is also called “The Programme,” where he argues that “heredity is described today in terms of information, messages, and code,” and thus (and here we find a clear through-line to Derrida’s reading of Saussure, Husserl and, especially, Austin) “the intention of a psyche has been replaced by the translation of a message. The living being does indeed represent the execution of a plan, but not one conceived in any
mind.” It is in this sense that *Of Grammatology* announces a “primary writing” that therefore “comprehends language” as we usually think of it, in the same way that the “contemporary biologist speaks of writing and *pro-gram* in relation to the most elementary processes of information within the living cell. And finally,” Derrida continues,

whether it has essential limits or not, the entire field covered by the cybernetic *program* will be the field of writing. . . . Even before being determined as human (with all the distinctive characteristics that have always been attributed to man and the entire system of significations that they imply) or nonhuman, the *grammè*—or the *grapheme*—would thus name the element. An element without simplicity.34

As we know, this claim leads directly to Derrida’s assertion years later—one that makes clear the theoretical underpinnings of his later, well-known work on “the question of the animal”—that “the elaboration of a new concept of the *trace* had to be extended to the entire field of the living, *or rather to the life/death relation*, beyond the anthropological limits of `spoken’ language.” Or as he puts it in the interview “Eating Well,” “If one reinscribes language in a network of possibilities that do not merely encompass it but mark it irreducibly from the inside, everything changes. I am thinking in particular of the mark in general, of the trace, iterability, of *différance*. These possibilities or necessities, without which there would be no language, *are themselves not only human*. . . . And what I am proposing should allow us to take into account scientific knowledge about the complexity of ‘animal languages,’ genetic coding, all forms of marking.”35

But I want to come back to an important point easily missed in *Of Grammatology* and amplify it. Namely: why does Derrida assert that the *grammè* is “an element *without simplicity*”? Rather than launching into a long discussion of Derrida’s early work at this juncture, I will rely here, for the uninitiated, on Matthias Fritsch’s able summary of “deconstruction ‘in a nutshell”’ (as he puts it). For deconstruction (and I hope the resonances with theoretical biology will already be clear),
the object is not seen as preexisting its context but as owing itself to the environment of its emergence and being. . . . But the context is not itself exhaustively analyzable, as if we could list all of its elements in a complete list. . . . [T]he context is inexhaustible, not because the list would be too long to itemize, but rather for the more essential reason that the context is itself undergoing change as it constitutes the elements of which it is made up. . . . Further, and for the same reason, the dependence on a constitutive context is not fully determining for an element, for it can be recontextualized; an entity can, indeed cannot but, shift from context to context.

It is these two moments of differentiation and recontextualizability (or iterability) that Derrida sought to capture economically with the neologism *différance*. The term is to encompass difference and deferral—that is, situation in context but without final determinability, anticipation of future environments (for not anything goes), but also exposure to the open-ended future the elements in an ongoing system cannot know. And despite having first developed it in the context of structuralist accounts of language and culture, it is the notion of *différance* that Derrida sees as “co-extensive” with mortal life.\(^{37}\)

A few crucial points follow from this. First, *time* is thus constitutive of the problem of the system/environment relationship for Derrida as it is for systems theory (a point that Martin Hägglund has made well in his book-length study of Derrida) which is why Derrida writes that the play of *différance* designates “the unity of chance and necessity in calculations without end,” precisely in the sense that we will see described in a moment by Stuart Kauffman on the terrain of chemistry and biology.\(^{38}\) Or, to combine the terms of systems theory and deconstruction, the formal element of a system can never be characterized by any kind of basal simplicity because its meaning depends upon the real-time dynamic state of the system in which the element functions—what Derrida would call the moment of the element’s “performativity” or “iteration.” Indeed, one of the ironies of our story is that Derrida, like Monod before him (who emerged as a foundational figure for molecular biology), became
associated with the obsession with “code,” “text,” and so on that would encourage the more reductive tendencies of the neo-Darwinian synthesis, even though Derrida had made it clear from the beginning that code was always only half the story—and not just in *Of Grammatology*, but also, in his work on “general” versus “restricted” economy in *Writing and Difference*, which references Bataille, who in turn references Vernadsky’s *The Biosphere* (one of the founding texts in the genealogy of ecological thought) in *The Accursed Share, Vol. 1.* As biologist Denis Noble points out, even for Jacob and Monod themselves, “code” was only part of a much bigger picture. The concept of the genetic “programme” may have been borrowed from the computer program, and “in principle, the code is independent of the machine that implements it,” but when we ask, “where, then, does the full algorithmic logic of a programme lie?,” the answer “is in the cell or organism as a whole, not just in the genome.” As Jacob wrote in *La Logique du Vivant* in 1970, “the incessant execution of a programme is inseparable from its realisation.” Or as Noble notes—in a passage utterly consonant with Derrida’s sense of the “programme” in *Of Grammatology*—“There is no meaning in the nucleic acid sequences themselves. Meaning arises as a consequence of the contextual logic within which they are interpreted within a living organism.”

What this helps bring into focus, as Christopher Johnson notes, is that “Derrida’s appropriation of this vocabulary is profoundly unstructuralist,” and has “a greater affinity with the metamorphic and adaptational (‘open-system’) models found in systems theory.” But I would make an even stronger claim here: namely, that Derrida gives us a theory of something like the relationship of the genetic (or systemic, formally code-bound) and the epigenetic factors (the environmental or contextual setting in which the code is deployed) that we will see developed on the biological side, beginning in the late 1950s, by Conrad Waddington and Stuart Kauffman, among others. In the 60s, Derrida is formalizing and ramifying a theory of the relationship between the genetic, the epigenetic, and the ecological that is being pioneered at the same time (1957) by Waddington, but which is only now being fully articulated
after fifty years of hegemonic rule by neo-Darwinian reductionism, with its over-emphasis on the genetic level of code or “script” alone.44

To put it this way is to enable a more robust understanding of the second point that follows from our examination of “deconstruction `in a nutshell’” above—what I have elsewhere called the question of “double finitude” that attends both human and non-human life, and that is in turn subtended by the genetic/epigenetic form of iterability theorized in the 60s by Derrida: our finitude not just as embodied and vulnerable beings who are dependent on our environments and who need care, but also as ones who, to enter into communicative relations and social bonds with others at all (human or non-human), are by necessity subjected to the “not me” and “not ours” of semiotic systems characterized by différence and the trace that, as Derrida puts it, must “be extended to the entire field of the living, or rather to the life/death relation, beyond the anthropological limits of ‘spoken’ language.”45 It’s not just human beings, in other words, who are subjected to the finitude of différence and the trace—any creature that engages in communicative, semiotic behaviors is—and that means that this second form of finitude is not held in reserve for a “human” who can thereby be ontologically separated decisively from other forms of life.

Third, and crucially, this enables us, in turn, to understand the importance of what I have elsewhere called the “second-order” turn of systems theory (which, in my view, formalizes the problem more clearly than deconstruction) showing us that—contrary to the understanding of autopoietic systems as solipsistic—the operational closure of systems and the self-reference based upon it arise as a practical and adaptive necessity precisely because systems are not closed: that is, precisely because they find themselves in an environment of overwhelmingly and exponentially greater complexity than is possible for any single system. To put it another way, systems have to operate selectively and “blindly” (as Niklas Luhmann puts it) not because they are closed, but precisely because they aren’t, and the asymmetrical distribution of complexity across the system/environment difference is in fact what forces
the strategy of self-referential closure and autopoiesis.\textsuperscript{46} Indeed, as we saw in the last chapter, the “second-order” turn, as I have argued elsewhere,\textsuperscript{47} is to realize that the more systems build up their own internal complexity through recursive self-reference and closure, the \textit{more} linked they are to changes in their environments to which they become more and more sensitive, but in relation to which they may also have more “management strategies” by building up their own internal complexity (both ontogenetically and phylogenetically). This is why the system/environment relationship is more multidimensional and complex for a bonobo hunting for food in the forest than for an amoeba swimming up a gradient of sugar solution on a microscope slide.

As Johnson points out, a crucial causal principle for open systems is one framed by one of the founding figures of systems theory, biologist Ludwig Bertalanffy: the principle of “equifinality,” which in turn makes possible the recursive feedback loops through which autopoiesis occurs. As Bertalanffy writes,

\begin{quote}
In any closed system, the final state is unequivocally determined by the initial conditions. . . . If either the initial conditions or the process is altered, the final state will also be changed. This is not so in open systems. Here, the same final state may be reached from different initial conditions and in different ways. This is what is called equifinality, and it has a significant meaning for the phenomena of biological regulation.\textsuperscript{48}
\end{quote}

We find a path-breaking example of the principle of equifinality in the work of Kauffman’s mentor Conrad Waddington, whose famous model of the “chreode” (or “developmental landscape”) models the sort of relationship between biological system and its environment that we are interested in here. As Noble notes in an article in the \textit{Journal of Experimental Biology}, Waddington was able to demonstrate, in a classic experiment, “the inheritance of a characteristic acquired in a population in response to an environmental stimulus,” which August Weismann had attempted to do, unsuccessfully, in 1890—a failure that, along with his assumption that genetic mutation was random, laid the foundations for the
neo-Darwinian “Modern Synthesis” that we have already touched upon. Waddington realized that the developmental plasticity of organisms (in his case, fruit flies) could be affected by environmental factors that interceded at different points along the developmental timeline. He used the term “canalized” for this type of environmental influence, and he “represented the developmental process as a series of ‘decisions’ that could be represented as a series of ‘valleys’ and ‘forks’ in a developmental landscape,” what Waddington dubbed a “chreode.” As Noble explains,

He knew from his developmental studies that embryo fruit flies could be persuaded to show different thorax and wing structures, simply by changing the environmental temperature or by a chemical stimulus. In his landscape diagram, this could be represented as a small manipulation in slope that would lead to one channel in the landscape being favoured over another, so that the adult could show a different phenotype starting from the same genotype. The next step in his experiment was to select for and breed from the animals that displayed the new characteristic. Exposed to the same environmental stimulus, these gave rise to progeny with an even higher proportion of adults displaying the new character. After a relatively small number of generations, he found that he could then breed from the animals and obtain robust inheritance of the new character even without applying the environmental stimulus. The characteristic had therefore become locked into the genetics of the animal. He called this process genetic assimilation. What he had succeeded in showing was that an acquired characteristic could first be inherited as what we would now call “soft” inheritance, and that it could then be assimilated into becoming standard “hard” genetic inheritance. Today, we call “soft” inheritance epigenetic inheritance, and of course, we know many more mechanisms by which the same genome can be controlled to produce different epigenetic effects.

We thus end up with the fundamental evolutionary and developmental unit being—as Gregory Bateson would put it thirteen years after the publication of Waddington’s book The Strategy of the
Genes (1957)—not organism-as-printout of a genetic code, nor even organism-as-printout varied in its successive copies by random genetic mutations, but rather what Bateson calls “flexible organism-in-its-environment” (with “flexible” here denoting not just behavioral flexibility but the very plasticity that Waddington had exploited in his experiment)—all versus the neo-Darwinian identification of the “unit of survival” as “the breeding individual or the family line.” This reconceptualization is captured quite well in Noble’s modification of Waddington’s own image in the article just quoted (reproduced later in Noble’s book Dance to the Tune of Life: Biological Relativity), because it emphasizes an aspect that will become crucial to Kauffman’s own work, namely the “functional networks”—that is, the real time dynamic interactions—that interact with environmental influences in specific ways to produce the developmental landscape, which can be varied by altering either the organism in question or the environmental factors that influence it. As we shall see in a moment, this is precisely where Stuart Kauffman’s work on emergence, self-organization, and complexity picks up the story—and picks up on it in a way that is, for Kauffman, consonant with Bateson’s insistence that the redefinition of the fundamental unit of evolution has ethical, not just scientific, consequences. As Bateson writes, “you have at each step to include the completed pathways outside the protoplasmic aggregate, be it DNA-in-the-cell, or cell-in-the-body, or body-in-the-environment. . . . Formerly we talked about the breeding individual or the family line or the taxon, and so on. Now each step of the hierarchy is to be thought of as a system, instead of a chunk cut off and visualized as against the surrounding matrix.”

We are now ready to trace the broader ramifications of these principles in Kauffman’s work, which will in turn enable us to understand that the more radical and profound way of thinking ecology is not “everything is connected” and not “nothing is connected,” but rather “some things are connected and some things aren’t—and in highly specific ways.” (Indeed, this is what we find in Waddington and Kauffman’s focus on the quite specific, radically contingent system/environment interactions that result in the emergence of what Kauffman calls “order for free,” but only under some conditions and not
others, just as in epigenetics, the plasticity of a certain material, genetic substrate will result developmentally in some expressions and not others, but only under quite specific conditions and interactions—hence Noble’s modification of Waddington’s developmental landscape above). And crucial here, as we shall see, is what I am prepared to call Kauffman’s “deconstructive” assertion that all such designations are unavoidably retroactive attributions. As Kauffman argues, because “we cannot prestate the relevant functional variables” that will end up being indispensable for further evolutionary states, and because causal consequences “pass from organism to world and back to the organism,” there is “no noncircular way to define the ‘niche’ of the organism separately from the organism. But that niche is the boundary condition on selection. The “niche” is only revealed after the fact, by what succeeds in evolution.”55

We have already touched on the radical implications of this seemingly straightforward point noted by Alicia Juarrero (among others), so now I want to focus on Kauffman’s recent book Humanity in a Creative Universe (2017), and in particular its third and fourth chapters, to illustrate the importance of the point a bit more. In this text, Kauffman—co-founder of the famed Santa Fe Institute and a former MacArthur Fellow—ranges from organic chemistry and biology to economics, quantum mechanics, and much else, but what I am most interested in here is the central claim of the book: namely, that there are no “entailing laws” that predetermine the evolution of the biosphere (hence the “creative universe” of the book’s title). As Kauffman notes, “Newton’s laws yield classical physics, causally closed, and an entirely ‘entailed’ view of the becoming of reality,” a view that was turbo-charged by what Kauffman calls “the birth of reductive materialism”: Laplace’s claim that a “demon” who knew all of the positions and momenta of the particles in the universe could calculate the entire past and future of the universe based on Newton’s differential equations.56 But in 1898, Henri Poincaré introduced an important crack in the edifice of reductive materialism by showing that there is no analytical solution for the “three body problem” that Newton had worried about (in the form of the Sun, Earth, and Venus). Poincaré
introduced what would become known in chaos theory as “sensitivity to initial conditions” by showing that “two `infinitely close' initial positions and momenta can follow trajectories that veer apart, becoming ‘exponentially’ more distant with time,” meaning that “determinism no longer implies predictability for we cannot measure initial conditions to infinite accuracy.”

In the section of Kauffman’s book that I am interested in, he assumes, almost exclusively, classical chemistry and physics, and “the point is not to show that Newton’s laws do not often work (they do). . .but to begin to demolish the hegemony of reductive materialism and its grip on our scientific minds.” The central thrust of this section of the book, which forces us to rethink not just the evolution of the biosphere but the entire concept of ecology, is that “at least part of why the universe has become complex is due to an easy-to-understand, but not well-recognized, `antientropic’ process that does not vitiate the second law [of thermodynamics]. Briefly,” he continues, as more complex things and linked processes are created, and can combine with one another in ever more new ways to make yet more complex amalgams of things and processes, the space of possible things and linked processes becomes vastly larger and the universe has not had time to make all the possibilities. . . . There is an indefinitely expanding, ever more open space of possibilities ever more sparsely sampled, as the complexity of things and linked processes increases. . . . [T]here is a deep sense in which the universe becomes complex in its exploration of these ever more sparsely sampled spaces of what is next possible because `it can.’

One of the more compelling examples Kauffman gives of this principle obtains at the level of organic chemistry, before we even get to the domain of autopoietic organisms, or what he calls “Kantian wholes,” where we would more likely expect to find such forms of complexity. In a core passage for the book, he writes, “Proteins are linear strings of amino acids bound together by peptide bonds. There are twenty types of amino acids in evolved biology. A typical protein is perhaps 300 amino acids long, and some are several thousand amino acids long. Now,” he continues,
how many possible proteins are there with 200 amino acids? Well, there are 20 choices for each of the 200 positions, so $20^{200}$ or $10^{260}$ possible proteins with the length of 200 amino acids. This is a tiny subset of the molecular species of CHNOPS [Carbon, Hydrogen, Nitrogen, Oxygen, Phosphorus, Sulfur] with 100,000 atoms per molecule. Now the universe is 13.7 billion years old and has about $10^{80}$ particles. The fastest time scale in the universe is the Planck time scale of $10^{-43}$ seconds. If the universe were doing nothing but using all $10^{80}$ particles in parallel to make proteins the length of 200 amino acids, each in a single Planck moment, it would take $10^{39}$ repetitions of the history of the universe to make all the possible proteins the length of 200 amino acids just once! . . . As we consider proteins the length of 200 amino acids and all possible CHNOPS molecules with 100,000 atoms or less per molecule, it is obvious that the universe will never make them all. History enters when the space of what is possible is vastly larger than what can actually happen. . . . A next point simple and clear: Consider all the CHNOPS molecules that can be made with 1, with 2, with 3, with 4, with $n$, with 100,000 atoms per molecule. Call the space of possible molecules with $n$ atoms of CHNOPS the phase space for CHNOPS molecules of $n$ atoms. That phase space increases enormously as $n$ increases. Consequently, in the lifetime of the universe, as $n$ increases, that phase space will be sampled ever more sparsely.\textsuperscript{50}

As Kauffman shows, this “nonergodic” principle obtains even more radically and obviously at the level of the biosphere, in which “its becoming cannot be prestated, is not ‘governed’ by entailing laws, in which what becomes constitutes ever-new Actuals that are ‘enabling constraints’ that do not cause, but enable, ever-new, typically unprestatable, Adjacent Possible opportunities into which the evolving biosphere becomes.”\textsuperscript{61} When we reach the level of what he calls “Kantian wholes,” or autopoietic organisms, this process is (not surprisingly) even more striking.\textsuperscript{62} If we think about the concept of biological function, for example, it is clear that while “in classical physics there are only ‘happenings. The
ball rolls down the hill, bumps a rock, veers,” and so on, in biology we have to distinguish function from mere physical happenings. “The function of the heart is to pump blood,” Kauffman notes, but the heart “causally also makes heart sounds, jiggles water in the pericardial sac,” and so on.\textsuperscript{53} Classical physics will not help us here, because “the function of the part is its causal consequences that help sustain the whole”; “function” is causal, in other words, but \textit{causal in a qualitatively different way from classical physics}.\textsuperscript{64} As Kauffman notes, another nail in the coffin for the reductionist approach is the fact that “this capacity to define a function as a subset of causal consequences that can be improved in evolution further separates biology from physics, which cannot make the distinction among all causal consequences into a subset which are functions.”\textsuperscript{65} As Kauffman baldly puts it, “Dawkins wrote \textit{The Selfish Gene} (1976) as if DNA replicators were the heart of biology, and the organism merely a `vehicle’ for the self gene in evolution. I completely disagree. Organisms are autopoietic self-creating wholes that achieve functional sufficiency, often improvable, as the biosphere becomes. . . . [I]t is the functional closure/sufficiencies of organisms as Kantian wholes, not the genes they carry along, which is the heart of life and its evolution.”\textsuperscript{66}

Having established the importance of the concept of biological function, Kauffman hypothesizes that “we cannot prestate the evolution of new functions in the biosphere, hence cannot prestate the ever-changing phase space of biological evolution which includes precisely the functions of organisms and their myriad parts and processes evolving in their worlds. But these ever-new functions,” he continues, “constitute the ever-changing \textit{phase space} of biological evolution.” And what this means (logically enough) is that “we can have \textit{no entailing laws} at all for biological evolution.”\textsuperscript{67} He offers a nice, compact example of this process in his discussion of what are called Darwinian “pre-adaptations” or “exaptations”—the emergence of new, possibly useful, traits through random genetic mutation (staying within the neo-Darwinian orthodoxy for the moment). All that need happen in an autopoietic biological entity—an \textit{E. coli} bacterium, let’s say—is that it “\textit{finds a use that enhances the fitness of that}
bacterium in its local world. Then, if there is heritable variation for that screwdriver, natural selection acting, not at the level of the screwdriver, but at the level of the Kantian whole cell in its world, will probably select a modified E. coli with a new use or function. Three major comments are critical,” Kauffman continues:

(1) We cannot prestate this new use or function, which after selection, becomes part of the evolving biosphere and feeds into the future evolution of the biosphere. (2) This “finding of a new use” is “the arrival of the fitter,” never solved by Darwin. Darwin could not have solved this issue, for the “arrival of the fitter” is typically unprestatable in its new functionality. (3) While we cannot prestate what selection will select, there are still `winners and losers.’ Selection does act, but we typically, in the real evolving biosphere, cannot prestate what selection will select, such as new functionalities.68

Kauffman’s especially winning example of this process—where a side-effect generated by random genetic mutation can become a functional asset under different environmental conditions, as Darwin himself surmised—is the emergence of the swim bladder in fish. The Darwinian exaptation whereby some early versions of fish had lungs, enabling them to bounce from puddle to puddle, led in time to the biological function of a ratio of air and water in fish who now live wholly in water that allows neutral buoyancy in the water column. Did this change the future evolution of the biosphere?, Kauffman asks. “Yes, and in two vastly different ways. First, new daughter species of fish with swim bladders and new proteins evolved. But second,

once the swim bladder exists, it constitutes a new Actual condition in the evolving biosphere. The swim bladder now constitutes a new, empty but Adjacent Possible niche, or opportunity for evolution. For example, a species of worm or bacteria could evolve to live, say exclusively, in the swim bladder. The Adjacent-Possible opportunities for evolution, given the new swim bladder,
do not include all possibilities. For example, a T. Rex or giraffe could not evolve to live in the swim bladder.⁶⁹

One of the key theoretical points here—and it is one that articulates directly with deconstruction in my view—arises when Kauffman asks, “do we think that selection, in any way at all, ‘acted’ to achieve the swim bladder as constituting a new adjacent-possible empty niche in which a worm or a bacterial species might evolve to live? No.”⁷⁰ Further, he adds—and again I would point out how resonant this is with the fine print of the deconstructive apparatus—“does the swim bladder, once it has come to exist, cause the worm or bacterial species to evolve to live in it? No. The swim bladder enables, but does not cause, the bacterial or worm species to evolve to live in it. Instead, quantum random mutations to the DNA of the bacterium or worm yield variations in screwdrivers that may be selected at the level of the whole organism by which the worm or bacterial species evolves to live in the swim bladder.”⁷¹ And what this means—to return now to Derrida—is that “code,” in Derrida’s understanding, is, as Johnson puts it, “therefore constituted in process rather than in anticipation. Despite the suggestion of precedence implied. . .in Derrida’s articulation of the word programme (programme), the gram, the trace, the inscription are never absolutely primary. There is instead a kind of precipitation towards sense that is ignorant of its future,”⁷² so that “the system is not pulled into the future by a mysterious first (and last) principle, but is pushed a tergo by what is handed down, selected and recombined, from its ancestral past. This philosophy is, in essence, a philosophy of evolution.”⁷³ And that is why—again to quote Kauffman—“there is, therefore, no noncircular way to define the ‘niche’ of the organism separately from the organism. But that niche is the boundary condition on selection. The ‘niche’ is only revealed after the fact, by what succeeds in evolution.”⁷⁴

It is hard to imagine a clearer articulation, in robust naturalistic, biological terms, of what Derrida calls “the becoming-space of time and the becoming-time of space,” the “will have been” of that which is “to come,” unprestatable and unanticipatable, with Darwin’s “pre-adaptations” being precisely
the material substrate, the trace, on which retentions of the past and protentions of the future are inscribed. As Martin Hägglund explains:

Given that every temporal moment ceases to be as soon as it comes to be, it must be inscribed in a trace in order to be at all. This is the becoming-space of time. The trace is necessarily spatial, since spatiality is characterized by the ability to remain in spite of temporal succession. The spatiality of the trace is thus a condition for the synthesis of time, since it enables the past to be retained for the future. The spatiality of the trace, however, is itself temporal. Without temporalization a trace could not remain across time and relate the past to the future. . . . In order to remain—even for a moment—a trace cannot have any integrity as such but is already marked by its own becoming past and becoming related to the future. Accordingly, the persistence of the trace cannot be the persistence of something that is exempt from the negativity of time. Rather, the trace is always in relation to an unpredictable future that gives it both the chance to remain and to be effaced75

--exactly in the manner by which Kauffman describes the non-entailed evolutionary process of the biosphere. Equally important (and I think this helps to underscore and indeed clarify an aspect of Kauffman’s argument that is often only implicit) is what Hägglund calls the fundamental “negativity” of time, “which undermines both the idea of a discrete moment and the idea of an absolute continuity. Only if something is no longer—that is, only if there is negativity—can there be a difference between before and after. This negativity must be at work in presence itself for there to be succession. If the moment is not negated in being succeeded by another moment, their relation is not one of temporal succession but of spatial co-existence.”76 It is precisely the combination of this negativity of time with what Hägglund calls the “arche-materiality” of the trace that makes Kauffman’s non-entailed evolution of the biosphere thinkable. “Precisely because every temporal moment negates itself,” Hägglund writes, “the duration of time can never be given in itself but depends on the material support of spatial
inscription” in the form of the trace; “without the later inscription nothing could persist and there would be no movement or passage of time.” 77

Indeed, we find here the site of a double inscription, not just on the material substrate of the living being (whether we think of Waddington’s “soft” and “hard” inheritance or the pre-adaptation of the swim bladder) but also in the dynamic contingency of the organism/environment relationship in which that ontogenetic inscription happens, which can make the “same” inscription function differently at different points in time. As Gregory Bateson points out in his discussion of “iconic genotypic signals,” it is common to find what he calls “a secondary statistical iconicism” in the animal kingdom of the following type:

Labroides dimidiatus, a small Indo-Pacific wrasse, which lives on the ectoparasites of other fishes, is strikingly colored and moves or “dances” in a way which is easily recognized. No doubt these characteristics attract other fish and are part of a signaling system which leads the other fish to permit the approaches of the cleaner. But there is a mimic of this species of Labroides, a saber-toothed blenny (Aspirdontus taeniatus), whose similar coloring and movement permit the mimic to approach—and bite off pieces of the fins of other fishes.

Clearly the coloring and movements of the mimic are iconic and “represent” the cleaner. But what of the coloring and movements of the latter? All that is primarily required is that the cleaner be conspicuous and distinctive. It is not required that it represent something else. But when we consider the statistical aspects of the system, it becomes clear that if the blennies become too numerous, the distinctive features of the wrasses will become iconic warnings and their hosts will avoid them. 78

If theoretical biology reminds us of this fact of double inscription, deconstruction reminds us that there is no evolution without the negativity of time and its inscription in the arche-materiality of the trace, figured on a larger biological canvas as the dynamic complexity of the organism/environment
relationship. No negativity of time, no evolution; but also: no materiality of inscription in the trace, no evolution.

I want to end this section by amplifying a couple more theoretical points before stepping back onto more thematic terrain that will prepare us for the next chapter. First, as Kauffman notes, he and others (such as Longo, Soto, Noble, and Juarrero) seek “what might be called formal cause laws of organization that are independent of the specific matter and energy involved,” but the really interesting question here, Kauffman notes, is whether such constraints and laws might evolve. In my view, it is hard to imagine why not, particularly if we are talking about the biosphere. If that’s the case, then it means, as he puts it, that “our specific laws are foundationless!” This is, I think, an important moment in Kauffman’s book, and one that is different in character from William Rasch’s related observation that “complexity can never be fully reduced to an underlying simplicity since simplicity, like complexity, is a construct of observation that could always be other than it is. Contingency, the ability to alter perspectives, acts as a reservoir of complexity within all simplicity.” In Kauffman’s account of why this is so, the accent falls on the “foundationless” nature of the “formal cause laws” at work in the evolution of the biosphere—not just the non-entailed nature of its evolution—because the laws themselves are subject to evolution: that is to say, they are, strictly speaking, contingent. For Hägglund and Rasch, on the other hand, the fundamental point here is not ontological but logical.

But I want to step back from both of these for a moment and note that either orientation fundamentally changes how we think about our relationship to the rest of existence. As Peter Sloterdijk notes—and this is to glance briefly in the direction of our final chapter—what we find here is a “pluralistic ontology” that will eventuate in the historical shift across disciplines from “globes” to “foams” (as he puts it in his massive Spheres trilogy) as the fundamental paradigm, one “prefigured by modern biology and metabiology” and announced at its outset by none other than Jakob von Uexküll,
whose concept of “world” or umwelt reaches forward, as we have already suggested, through Heidegger to the Derrida of “there is no world” with which we opened this chapter.\(^8^4\) Sloterdijk quotes Uexküll:

> It was an error to think that the human world provided a shared stage for all life forms. Each life form has a special stage no less real than the special state of humans. . . . Through this insight we gain an entirely new view of the universe: it consists not of a single soap bubble that we have blown up beyond our horizon into the infinite, but of countless millions of narrowly bounded soap bubbles that overlap and intersect everywhere.\(^8^5\)

As Sloterdijk glosses this passage, this aggregate of “countless” soap bubbles can “no longer be envisaged as the monocosmos of metaphysics,” held together by “a logos common to all.” That gives way, instead, to “a polycosmic agglomeration,” in which “sentient existence in sense-structured environments is already developed at the level of animal intelligence.”\(^8^6\)

Here, we find Sloterdijk’s more architectonic version of Derrida’s assertion in The Animal That Therefore I Am that when it comes to the difference or border separating human from other forms of life, the interest is “not in effacing the limit, but in multiplying its figures, in complicating, thickening, delinearizing, folding, and dividing the line precisely by making it increase and multiply.”\(^8^7\) Or as Sloterdijk, puts it, in what we have called this new topological rather than topographical ecology, “Humans, for their part, after the end of the centric delirium (anthropo-, ethno-, ego-, and logo-), will perhaps develop slightly more appropriate notions of their existence in a milieu of ontological foams.”\(^8^8\)

In the next chapter, we’ll turn to one such example: Wallace Stevens’ birds.

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3. Ibid., 47.
5 Ibid., 133.

6 Ibid., 135-136.


11 Ana M. Soto, Giuseppe Longo, et al., “Toward a theory of organisms: Three founding principles in search of a useful integration,” Progress in Biophysics and Molecular Biology 122 (2016): 79. See also Louis H. Kauffman, “Self-reference, biologic, and the structure of reproduction,” Progress and Biophysics and Molecular Biology 119 (2015), who writes, “In living systems there is an essential circularity that is the living structure. Living systems reproduce themselves from themselves and the materials and energy of the environment. There is a strong contrast in how we avoid circularity in mathematics and how nature revels in biological circularity. One meeting point of biology and mathematics is knot theory and topology. This is no accident, since topology is indeed a controlled study of cycles and circularities in primarily geometical systems” (386).


13 Ibid., xiv.

14 Denis Noble, Dance to the Tune of Life: Biological Relativity (Cambridge: Cambridge University Press, 2017), 222.
Qtd. Winslow, 117.

Ibid., 123.

Qtd. in Derek Woods, *What Is Ecotechnology?* (unpublished dissertation, 2017). As Alexander Wilson puts it, “selection and adaptation do not take place on a single playing field: each basin of selection is nested within other selecting systems. There is thus a whole hierarchy of nested selection principles at work in each given adaptation. Furthermore, Niles Eldredge showed that the regimes of ecology and evolution are “divorced from each other” meaning that there are two distinct classes of hierarchy that condition each given organism in parallel. On the side of the environment and ecology, the genomic organism is subject to conditioning from its avatars (or actual incarnations of the genome within an individual), these avatars are conditioned by their local ecosystems, and these local ecosystems by their wider regional ecosystems. On the side of evolution and genealogy, the organism’s genome is contained and conditioned within the individual’s own developmental individuality. The individual is conditioned by the *demes* its immediate ancestry has emerged from, the demes are limited and constrained by the species and its boundaries, and the species is itself constrained by more general phyletic constraints such as *body plans*. This nested aspect of the selection units and the causal relations between the reservoirs of information they select from, make the correlation of a specific trait to a specific adaptive goal that much more difficult. They also leave open the possibility of *substrate independent* selections: i.e. symmetry breaks in null regions, which result in “emergent” expressions that are irreducible to the specific pressures of the lower selective basin.” Alexander Wilson, *Aesthesis and Perceptronium* (Minneapolis: University of Minnesota Press, forthcoming 2019).


Ibid., 511.
Ibid., 519.

Ibid., 512-513.

Ibid., 518.

Ibid.

Ibid., 520.


Qtd. in Cary Wolfe, Animal Rites: American Culture, the Discourse of Species, and Posthumanist Theory (Chicago: University of Chicago Press, 2003), 94. For a fuller discussion of these issues, see 78-94.


Ibid., 9.

Noble, Dance to the Tune of Life, 262.


Ibid., 165.


I am indebted to Derek Woods for drawing my attention to the Vernadsky reference in Bataille’s text.

Noble, *Dance to the Tune of Life*, 147-148.

Ibid., 147.

Ibid., 180.

Johnson, 7-8.

As Ana Soto et al. note, part of the story here is that “during most of the twentieth century experimental and theoretical biologists lived separate lives.” The “Central Dogma” of molecular biology “was a theory, except that it was not usually formulated as such. It was presented as fact, a *fait accompli*. Meanwhile the pages of journals of theoretical and mathematical biology continued to be filled with fascinating and difficult papers to which experimentalists, by and large, paid little or no attention.” Anna Soto, Giuseppe Longo, and Denis Noble, “Preface to `From the century of the genome to the century of the organism: New theoretical approaches,’” *Progress in Biophysics and Molecular Biology* 122 (2016): 1, 2.


Namely, in *What Is Posthumanism?*, xx-xxv.

Qtd. Johnson, 146.


Ibid. As Noble points out, as standard neo-Darwinian explanation would be that random mutations in the population accounted for the change, but that is extremely unlikely, given the time scale of the experiment (only a few generations). And in any event, random mutations would manifest in individuals, not in the whole group at once. A much simpler explanation, Nobel explains, is that Waddington’s experiment “exploited plasticity that is already present in the population,” suggesting “that all the alleles (gene variants) necessary for the inheritance of the characteristic were already present in the population, but not initially in any particular individuals in the correct combination. The experiment simply brings them together” (“Conrad Waddington and the Origin of Epigenetics,” 816).


Noble, *Dance to the Tune of Life*, 259.

Bateson, *Steps to an Ecology of Mind*, 460. Bateson takes this in a direction that sometimes courts a kind of vitalism—and a vitalism that is indissociable from his holism—when he asserts that
I now localize something which I am calling “Mind” immanent in the large biological system—the ecosystem. Or, if I draw the system boundaries at a different level, then mind is immanent in the total evolutionary structure. If this identity between mental and evolutionary units is broadly right, then we face a number of shifts in our thinking. . . . The individual mind is immanent but not only in the body. It is immanent also in the pathways and messages outside the body; and there is a larger Mind of which the individual mind is only a sub-system. This larger Mind is comparable to God and is perhaps what some people mean by God, but it is still immanent in the total interconnected social system and planetary ecology (Steps 461).

Bateson’s project is thus roughly split between this sort of neo-vitalist holism and the other side of his work—closer to Kauffman, Derrida, and second-order systems theory in general—which emphasizes time and again that “the map is not the territory.” Waddington himself rejected vitalism for the very same reasons that the term does not apply to Kauffman. As Waddington put it, “Vitalism amounted to the assertion that living things do not behave as though they were nothing but mechanisms constructed of mere material components; but this presupposes that one knows what mere material components are and what kind of mechanisms they can be built into.” As Roger Levin points out in his book on complexity theory, “Waddington was an emergentist, but not a vitalist. He believed that the assembly of a living organism is subject to physical laws, but that their product is not derivable from the laws themselves” (Roger Lewin, Complexity [New York: Collier, 1992], 179). Interestingly enough, Bateson hypothesizes that the takeaway from Waddington’s work, which “can be read in various ways” (Steps 256), is framed in terms of what Bateson calls “stochastic” process. As he puts it,

To achieve a result by trial and error which could have been achieved in any more direct way necessarily consumes time and effort in some sense of these words. Insofar as we think of adaptability as achieved by stochastic process, we let in the notion of an economics of adaptability. In the field of mental process, we are very familiar with this sort of economics, and
in fact a major and necessary saving is achieved by the familiar process of habit formation. We may, in the first instance, solve a given problem by trial and error; but when similar problems recur later, we tend to deal with them more and more economically by taking them out of the range of stochastic operation and handing over the solutions to a deeper and less flexible mechanism, which we call `habit.’ It is, therefore, perfectly conceivable that some analogous phenomenon may obtain in regard to the production of bithorax characteristics. It may be more economical to produce these by the rigid mechanism of genetic determination rather than by the more wasteful, more flexible (and perhaps less predictable) method of somatic change (Steps 257).

Bateson’s point here leads directly to the discussion we have already had regarding Derrida’s work on “scripts,” archives, “writing,” and their machinalité and automaticity in relation to the question of “life” and, more specifically still, the difference between “response” and mere “reaction” as a means of protecting the ontological domain of the “human.” And in this connection, it is worth noting that Derrida insists on the cross-contamination of the genetic and epigenetic—a cross-contamination highly specific to the environmental factors of what he calls, in “Signature Event Context,” the “pragmatic instance” that Bateson, still laboring under the Weismannian hegemony (Steps 346), purifies in his reassertion of the then-Weismannian orthodoxy that “no message can pass from the more superficial somatic system to the germ plasm” (Steps 258).


56 Ibid., 15, 16.

57 Ibid., 17.

58 Ibid., 40.

59 Ibid., 42.

60 Ibid., 43.
61 Ibid., 64.
62 Ibid., 67.
63 Ibid., 65.
64 Ibid., 66.
65 Ibid., 67.
66 Ibid., 69.
67 Ibid., 70.
68 Ibid., 71.
69 Ibid., 72.
70 Ibid., 73.
71 Ibid.
73 Ibid., 163.
74 Kauffman, *Humanity in a Creative Universe*, 75.
76 Ibid., 43.
77 Ibid.
80 Ibid., 205.
81 Ibid., 206-207.

Ibid., 60.

Ibid. Sloterdijk’s recourse, here and elsewhere in the *Spheres* project (sometimes explicit, sometimes tacit, but always at hand) to the Spinozan figure of the monad is far from fortuitous. Denis Noble, in fact, argues that Spinoza is a precursor to systems biology and its opposition to the mechanistic reductionism that derives from Descartes. See *Dance to the Tune of Life*, 164-168.


Sloterdijk, *Foams*, 60.