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Heterodox Thinking on Evolution and Radical Enlightenment

by Richard I. Vane-Wright

Normal Science is productive and powerful, but comes at a cost—the homogenization of views, leading eventually to a chronic inability to embrace not only radical new ideas but also the rejection of many valuable insights from the past. Current dissatisfaction with the gene-centred Modern Synthesis vision of organic evolution fits this general scenario—with the risk that any resultant shift to a new paradigm will be doomed, in the same way, later to become just another orthodoxy. A basic tenet of the Modern Synthesis has been that evolution is driven by accidental genetic changes. Current challenges embrace a pluralism that includes emphasis on various forms of agency of organisms. On this basis, evolution is not a random process; it is a purposeful and intention-driven phenomenon. The Radical Enlightenment counters homogenization of interpretation through the conservation of diverse and even incompatible ontologies. If heterodox views are not themselves to become ossified into orthodoxy, a critical yet embracing, respectful yet continuing, pluralism in science needs to be fostered. This would entail a fundamental change in how science is to be understood, appreciated, and used in modern society.

Introduction: Heterodoxy and Orthodoxy

> We absolutely must leave room for doubt or there is no progress and there is no learning.
>
> —*Richard Feynman,* The Pleasure of Finding Things Out *(2001)*

> An *embedded theory* is a theory that is supported by much convincing evidence and that has become central to the way scientists understand their world.
>
> —*P. Eastwell,* Understanding Hypotheses, Predictions, Laws, and Theories *(2014)*

Denis Noble's (2012) theory of biological relativity proposed that organic evolution is affected by numerous processes, including the internal (or inherent) agency of living cells and organisms as purposive wholes acting at multiple levels of organisation.[1]

Among these, no process or level holds a privileged, exclusive, or dominant role. This heterodox understanding of evolution (derived from systems theory) contrasts with evolutionism's orthodox paradigm, derived from Julian Huxley's (1942) "Modern Synthesis" (MS). The MS focusses on mutation and recombination as the primary source of upward causative novelty, coupled with Darwinian natural selection as an external, creative mechanism. Acting together with genetic drift and migration, these factors have long been considered the primary if not exclusive processes responsible for evolution. Although Noble is far from a lone voice in challenging the MS, MS thinking (often called "Neo-Darwinism") remains the basis of "Standard Evolutionary Theory" (SET)—which protagonists defend, and most mainstream biologists accept and still work within.

One can only hold a heterodox position on a subject if there is an orthodox view to challenge—in this case, the embedded opinion of the majority. For science to progress, there must be some agreement—but also challenge, spawned of Feynman's doubt, referenced in the epigraph. Without regular challenge, learning will ossify; without any agreement, there will only be chaos.

Nevertheless, for each discipline within any given period, one particular set of interpretations (theories and hypotheses seen to be consistent with known observations) usually becomes dominant. As Thomas Kuhn famously explored, this then becomes "normal science"—within a given field, a socio-economic matrix emerges that regulates what aspiring scientists learn and, notably through control of funding and personal advancement, determines which scientific questions are pursued.

Normal science can be seen as low on innovation and high on conformity, with underlying theory and assumptions rarely challenged. Progress largely becomes incremental, refining measurements, exploring details, or new examples that are fitted to the standard theory.

However, it has also to be acknowledged that, while normal science is in Kuhn's words, "a pursuit not directed to novelties and tending at first to suppress them . . . [it is] . . . nevertheless . . . [very] effective in causing them to arise." And so it is that embedded paradigms do change, usually due to new observations, ideas, or existing insights previously ignored that become too difficult to accommodate. Such changes can happen slowly—or rapidly at some critical point: a Kuhnian "paradigm shift." Earlier ideas are either totally superseded (e.g., phlogiston theory), or seen as limiting cases (e.g., Newton's Laws in relation to Einstein's Relativity). Sometimes more than one interpretation can persist for long periods, as rival theories (Goethe *versus* Newton on color, perhaps)—but one or other usually emerges at any given time, to become the "embedded theory" in Eastwell's sense, until all are eventually replaced by new paradigms. Rather like species, the fate of all scientific theories seems to be one of extinction—or, at best, assimilation. Personal commitment to an existing normal science framework can however engender very strong resistance to change—which, nonetheless, can be beneficial for ensuring meaningful, critical progress.

Current Dissatisfaction with the Modern Synthesis

> The "modern synthesis" generally refers to the early to mid-[20th] century formulation of evolutionary theory that reconciled classical Darwinian selection theory with a newer population-oriented view of Mendelian genetics that attempted to explain the origin of biological diversity.
>
> *—V.B. Smocovitz, "The Modern Synthesis,"* Oxford Bibliographies, *2019.*

The gene-centric model came to the fore in the early 1940s, notably with publication of Julian Huxley's (1942) landmark *Evolution: The Modern Synthesis,* which sought to meld the Darwin/Wallace theory of natural selection with the emergent twentieth century discipline of population genetics. In the mid-nineteenth century scientific culture of Newtonian determinism, natural selection was seen as the decisive mechanism that made a theory of evolution plausible (still tellingly referred to by many as a "force"). At the beginning of the twentieth century, following rediscovery of Gregor Mendel's theory of particulate inheritance, the Darwin/Wallace theory was temporarily eclipsed by "mutationism." August Weismann's previous distinction between somatic (acquired) and heritable variation, together with the subsequent application of Mendel's laws to populations, complicated matters further. Huxley's Modern Synthesis unified these disparate threads.

Huxley's 1942 work, influenced also by the likes of Theodosius Dobzhansky, Conrad Waddington, and Ernst Mayr was a rich source of ideas and inspiration. But, in the hands of several influential scientists, the Modern Synthesis soon narrowed in scope, or "hardened" as Stephen Jay Gould later put it, to the point where evolution came to be defined solely in terms of changes in gene frequencies within a population (or "gene pool"). In some respects, this was comparable to seventeenth century corpuscularism, with gene variants (alleles) being seen as almost immortal, having the ability to move between and transcend successive generations, individually and collectively driving evolution and speciation by deterministic, upward causation. At one point, Mayr conceived the genome as a program that not only determined the form of an organism, but also its appetitive behaviors. Richard Dawkins's "selfish gene" metaphor followed, giving spurious agency to genes. This "hardening" can be traced back to the second edition of the *Modern Synthesis*, where Huxley himself made the incorrect but sadly influential suggestion that the recently discovered helical structure of DNA molecules "makes them self-reproducing."[2] Denis Noble picked up on this to lay bare a number of myths or fundamental illusions that render the Modern Synthesis, in its narrowest form at least, untenable.

The Modern Synthesis Undermined

Weismann's "Barrier": Very early in the development of many multicellular animals, those cells that in the adult will produce ova and spermatozoa are set aside from those that form the body. This realisation led to August Weismann's (1892) germ-plasm theory of heredity, which proposed that the inheritance of any changes acquired by an organism during its life would not, or even could not, be inherited. Even though this early segregation of a germ-cell-line has no equivalent in plants, or in early multicellular animals such as sponges and corals, the idea of a (metaphorical) "barrier" between body cells and germ cells became a cornerstone of the Modern Synthesis—including the idea that genes might, in some sense, be immortal. Even in "higher" animals it is now known that the germ cells, including their DNA, are not immune to all changes that happen during development. Nilsson *et al*. state that "the concept that somatic cells do not impact the germline . . . is incorrect"—a conclusion which, despite some rescue attempts, is now widely accepted.

The Central Dogma: It was during the 1950s that the double-helix structure of DNA was discovered. It comprises two very long complementary chains formed from two pairs of complementary nucleotide subunits that can be arranged in any possible linear sequence. This immediately suggested how these huge aperiodic molecules could be replicated accurately during cell division. It was also realized that the specific nucleotide sequences could provide the fundamental information necessary for accurate synthesis of all the different proteins, the complex and highly diverse molecules that play so many fundamental roles in all known organisms.

Even before the Pasteur Laboratory announced the formal discovery of messenger RNA in 1961, Francis Crick proposed his Central Dogma of Molecular Biology: information flows from genes (conceived as specific segments of the DNA) to RNA "templates" in the cytoplasm, and thence to the assembly of specific proteins—but never the reverse. As Crick put it, "once 'information' has passed into protein *it cannot get out again*."[3] [emphasis original].

Numerous studies since have shown that DNA is only replicated extremely accurately *in vivo* because of numerous feedback and repair processes characteristic of whole, intact living cells, and that information can flow in both directions. To use a computing analogy, the genome is not a read-only memory system (ROM), as Crick effectively proposed, but a read-write (RW) system.[4] Not only can some changes in the genome of one cell affect the genomes of other cells, including those of the germ-line (an impossibility according Weismann's theory), but also internal changes within a cell can affect its DNA molecules by numerous processes, almost all unknown in 1958.

Since that time, Crick's ROM-type model was often thought to be equivalent to Weismann's "barrier"—but this a category error. The Central Dogma is about protein synthesis, whereas the Barrier is a proposition about germ cell isolation and heredity.

Genetic determinism: Another related illusion that promoted hardening of the MS is the frequent belief that the genome deterministically controls all aspects of cellular function, and thus the ontogeny and life of all organisms. Thus, the genome is often likened to a computer program, a blueprint, or seen as the "secret," "language," "code," or "information book" of life. However, the genome *does not* contain all the information needed to build and operate a cell or whole living organism. Far from it, and far better, as Barbara McClintock long ago proposed, the genome should be seen as "an organ of the cell"—an information store for very many things and processes that worked in the past. Moreover, this information store is controlled and used *creatively* by the living cell in the present—*not* the reverse.[5] Even the metaphor of "the genetic code" is unfortunate; genes are arguably better seen as templates—in the sense that, as Crick originally conceived, each discrete linear nucleotide sequence, once copied to a messenger RNA molecule, then acts like a "template" or "jig" against which the amino-acid chain that makes up the specified polypeptide is then faithfully assembled.

Natural selection: With the Weismann Barrier, the Central Dogma, and the concept of the genome as a central-directing agency all refuted, it is also necessary to question the nature of natural selection. Natural selection is not an external, measurable "force," cause or source of action; it is rather an observable outcome of differential survival among individual organisms. Where statistically some individuals survive better than others due to one or more advantageous attributes that are heritable, or later become heritable, then this will affect the course of evolution over successive generations. But there is no *act* of selection as such; as widely understood, Darwin and Wallace used "natural selection" as a metaphor. In other words, it is not literally the case that a discrete selective *process* is involved. I am not suggesting that differential survival and reproduction of organisms that differ in part due to heritable variations is unimportant or misleading—to the contrary, this is a vital element of the evolutionary process (for discussion of which, the term "natural selection" often remains metaphorically useful). However, on this post-MS view, although "faulty" genes can be a major disadvantage, even lethal (as in some monogenic disorders), differential survival is at least as much due to the active, creative use that organisms make of all that they inherit, including their genes—but they are not subordinated to, or "prisoners" of them.

Challenges to the Modern Synthesis

If the above arguments against some of the fundamental assumptions of the Modern Synthesis are accepted, where is orthodox Standard Evolution Theory to go? There are three possibilities: SET may be reformulated, extended, or replaced.

In the first instance, the assumptions of SET are either reformulated or "insulated" in one or more ways so that the overall theory can be maintained. For example, soon after Francis Crick announced his original formulation of the Central Dogma, which asserted that information could only flow from DNA to RNA, Howard Temin and co-workers discovered reverse transcription of RNA to DNA, adding a reverse arrow to the Central Dogma. Rather than abandon his idea, Crick reformulated it to include this possibility. In the circumstances, as he subsequently argued, this was not unreasonable, but the views stated above regarding the untenable basis of, for example, the Weismann Barrier and, eventually, the Central Dogma itself, now make alterations of this sort more and more difficult to justify without invoking *ad hoc* reasoning.

A second approach is to *extend* SET to take account of new findings and insights. In effect, the MS formulation is seen as a special or limiting case, rather like, as often claimed, is Newton's theory of gravitation in relation to Einstein's theory of relativity. Thus, the Modern Synthesis becomes a special case within a general Extended Evolutionary Synthesis (EES), which includes developmental biology ("evo-devo") and ecology ("evo-devo-eco"). The EES is a very active field of research and debate. However, it now involves various riders and auxiliary hypotheses, several of which seem to me incompatible with the original formulation of the MS (e.g., the active role of the individual organism during ontogeny can and will affect its adult phenotype). Despite this, some evolution scientists see no need even to "extend" the MS,[6] considering it to be an accommodating theory capable of its own evolution and development. In contrast, others point to differences in fundamentals, and in the predictions that can be made (e.g. "novel phenotypic variants will frequently be directional and functional, not simply random"[7]).

The third option is wholesale replacement of the MS and its derivatives—in other words, a Kuhnian paradigm shift (in the opinion of James Shapiro, this has already occurred). While no complete "*new* New Synthesis" yet exists, some of those involved in the EES, together with a number of others, do in effect regard the MS as "broken," in the sense that it is no longer capable of being "fixed" by *ad hoc* modifications and/or additions. I am one of those who consider this to be the case—but for reasons explored below, I am wary of attempts to create a new omnispective theory. Stoltzfus (2017) notably regards even the goal of a new "master theory" as detrimental to progress.[8] There are, however, several related proposals already in existence that present, in my view, many of the ideas and factors that would have to be considered if any satisfying new, post-MS "Darwinian" synthetic theory of evolution could ever be formulated.

Four Heterodox Views on Evolution

> . . . genes are the tools whereby organisms exist and not the contrary.
>
> —*E. Haukioja 1982*[9]

Forty years ago, Peter Corning (1983) published his *Synergism Hypothesis.* After noting that "one of the most significant trends in evolution has been an increase in the capacity for internally controlled purposive changes ("teleonomic selection"), which has in turn played an increasingly important role as a causal agent in the overall course of evolution," Corning claimed his cooperative Synergism Hypothesis "provides a general theory of progressive evolution." In 2005 Corning published a re-statement and elaboration of his ideas under the title "Holistic Darwinism."[10]

Drawing on the rich ideas of Humberto Maturana and Francisco Varela, Stuart Kauffman, Eva Jablonka and Brian Goodwin, Stephen Jay Gould's and Richard Lewontin's critique of the adaptationist program of the hardened MS, and Development Systems Theory inspired by the work of Susan Oyama,[11] Evan Thompson (2007) proposed his theory of *Enactive Evolution.* He stated, "The idea of enactive evolution represents . . . an attempt to inscribe the principles of autonomous self-organization proper to living beings in the evolutionary narratives of the Darwinian heritage. 'Enaction' evokes the image of living beings laying down historical pathways through their own dynamics and those of the environments to which they are structurally coupled."[12] Thompson did not refer to Corning's *Synergism Hypothesis*.

Denis Noble's *Biological Relativity*, first separately articulated just over a decade ago, proposed that there is no privileged level of causality in biological systems. It is an attempt to answer two questions never clearly addressed by the hardened MS (Noble 2012: 56): "Are molecular events somehow causally more important than events that occur at the scales of cells, organs or systems? And are there causally efficacious processes that can only be characterized at higher scales?" — to which he answered no and yes, respectively. Noble's approach, which starts with a critique of the Central Dogma, is embedded within systems theory. Noble did not refer to Corning's *Synergism Hypothesis*, or Thompson's *Enactive Evolution.*[13]

In "Organisms, Agency, and Evolution," Denis Walsh (2015) argued that the worst deficiencies of the Modern Synthesis stem from its almost total disregard for the activities of whole organisms, coupled with unwavering insistence on genes as the essential, molecular units of evolution. A major part of the book is devoted to exploration of his proposal for an ecologically-based alternative: *Situated Darwinism.* When viewed in this way, Walsh contended that many of the distinctions "crucial to Modern Synthesis thinking," such as the separation of inheritance, ontogeny, selection, and the origin of evolutionary novelties, simply disappear. Walsh brought together a very wide range of ideas and proposals that challenge the MS—including work by the authors and inspirers of the *Synergism Hypothesis*, *Enactive Evolution* and *Biological Relativity.*[14]

The process of attempting to integrate these closely related strands of thought, all in some degree or other attempts to free evolutionary theory from deficiencies of Modern Synthesis thinking, have continued apace since 2015. Yet, none of these alternative theories, or any other heterodox solution, has gained ascendancy, or made a strong bid to supplant SET, which is founded on, and still embraces, much of the Modern Synthesis.

In my opinion these alternatives are largely compatible with each other, and with many original elements of Darwinism, but are fundamentally incompatible with various tenets of the "hardened" Modern Synthesis. It seems likely that an attempt to create a radically new framework, in the hope of precipitating a paradigm shift, will appear. I have personally witnessed one, so far abortive, collective attempt to do that, and Peter Corning's (2020) "Inclusive Biological Synthesis" could even be a contender.

Chance versus Intention

> Agency . . . endows organisms with directionality, i.e. intentional, forward-looking action
>
> *Noble & Noble, 2021: 293*[15]

A cornerstone of the hardened MS is that, even though evolution, as change, is driven by natural selection, it rests ultimately on genetic mutation as the source of variation—a fundamentally random process. Conrad Waddington was among the first to suggest that mutation was not necessarily always random, but it was not until the publication of James Shapiro's (2011) *Evolution: A View From the 21stCentury* that the extent to which, in serving the universal imperative of what some have called "problem-solving" faced by all organisms, mutation and genomic reorganization were understood to be greatly influenced by these fundamental needs. In the case of the immune system, this had been known for quite some time, but Shapiro's encyclopedic approach showed that creative control over the genome is practically universal. As Shapiro recently put it, "mobile DNA cassettes serve as dedicated change operators . . . capable of causing major genome rewriting under stress [they] are essential purposive tools needed for life to survive in dynamic ecologies."[16]

Such a view, which acknowledges both purpose and agency in living systems, opens hitherto "forbidden" areas of thought for understanding evolution—notably, values, consciousness, and intentionality. Stuart Kauffman has long been of the opinion that agency, consciousness, and values are fundamental to life and evolution; Baluška & Reber (2019) discuss consciousness in cells and the emergence of mind; Jablonka and Ginsburg (2023) consider how organisms could evolve to attain goals "guided by imagination"; Ray & Denis Noble (2021) discuss how intentional agency might work, including the ways in which living systems can "harness stochasticity"—in other words, how organisms can intentionally (consciously or not) manage randomness to their advantage, rather than simply be beholden victims. In the MS-inspired world of "blind watchmakers," values, purposes, and intentions are unthinkable. The widening gap between MS thinking and the "Third Way" conspectus that encompasses Synergism, Biological Relativity, Enaction, Situated Darwinism, etc., seems unbridgeable.

The Radical Enlightenment

My concerns about the desirability, or not, of a paradigm shift—that is, the wholesale replacement of the MS-based SET accounts of evolution—stems not from any personal doubt about the incorrectness of so much of the MS, but from issues about the way that science works, progresses, and is used. These concerns have been made clearer for me by recent work, notably by Arran Gare, on the "Radical Enlightenment" (RE). This term was first introduced by historian Margaret Jacob in 1981, but since has been explored on an almost epic scale by Jonathan Israel (e.g., 2001). Israel contrasts the RE, which is founded on materialism and egalitarianism, with the "Moderate Enlightenment" (ME), which continued to incorporate religious views coupled with acceptance of privileged individual power and entitlement.[17]

My doubts are exacerbated by the naive belief, which I believe is held by many, that science is about "hard facts" and "proofs" (certainty), rather than observations and their interpretation in light of competing and thus uncertain hypotheses. In our increasingly adversarial world, scientific experts, when called on by opposing vested interests, often disagree over the "facts" and what they "prove." This seems to be leading to an ever-increasing distrust of science and scientific expertise.

For many people, their education (and religion) leads them to believe in absolutes, so that competing ideas, uncertainties, and probabilities are difficult to comprehend, let alone use as a basis for action. Yet, at the same time, technological gadgets based on the application of science, such as mobile phones, are embraced worldwide, while politicians often seek to absolve themselves of responsibility by appeals to "science." Such paradoxes point to the misunderstanding of science, and its replacement and exploitation by "scientism," the belief that science is the only way to truth.

In our efforts to understand how organic evolution comes about (not the reality of evolution itself, which is fully accepted), we must continue to embrace much uncertainty—and I contend, as recognised by the Third Way website,[18] this requires attention to, and acceptance of, plural theories and interpretations. I personally see no other "way." This is the basis of my reluctance to pursue a new, standardized theory of evolution: any such agreement will almost certainly be doomed to become just another ossified orthodoxy. Adopting the values of the Radical Enlightenment (as discussed by Gare 2023)[19] can help counter homogenization of interpretation through the conservation of diverse and even incompatible ontologies.

If heterodox views are not to become just more orthodoxies over time, a critical yet embracing, respectful yet continuing, pluralism in science needs to be fostered. This would entail a fundamental change in how science is to be understood, appreciated, and used in modern society.

Discernment and Respect

One of the advantages of a predictive hypothesis is the invitation of critical testing. Crick's "Central Dogma" (in reality a hypothesis) provided stimuli for challenge so powerful that it has since been refuted. That was valuable (so much was learned in the process)—yet the subsequent determination to reify it, past the point of no return, was not.

For over a century, many scientists ridiculed the evolutionary ideas of Jean-Baptiste Lamarck (1744–1829). Not only was this largely based on a failure to read his works properly, and even just poor translation, but it also involved scientific chauvinism: bolstering the idea that Darwin's vision represented the only correct way to understand how evolution came about. Latterly, the emergence of neo-Lamarckism is rehabilitating several of Lamarck's insights.

While the disrespect shown to Lamarck and various others has proved unhelpful (in the context of evolution, Richard Goldschmidt and VC Wynne-Edwards also spring to mind as "victims"), I am not advocating some sort of postmodern "anything goes" miasma. All our scientific hypotheses must be judged, critically, against observation and internal consistency. But a key problem with the "normal science" of an embedded paradigm is that, while it encourages criticism of "rival" theories, past and present, this rarely promotes debate about its own underlying principles or assumptions. The embrace of diversity coupled with critical evaluation (challenge) of all positions is what I mean by "discernment and respect." And in accordance with the principles of the Radical Enlightenment, all worthwhile ideas and theories, even if currently regarded as incorrect, should not be forgotten or derided—they are all part of relevant history and culture.

Conclusions

> There could be no fairer destiny for any physical theory than that it should point the way to a more comprehensive theory, in which it lives on as a limiting case.
>
> *Albert Einstein in 1917 and 1920, as translated by Karl Popper,* Unended Quest *(1986).*

Einstein was referring in the epigraph to Isaac Newton's *Principia* with respect to his own theory of general relativity. Could the Modern Synthesis be seen as a particular example of a new, more general theory of evolution? I say no—for two reasons. First, as a reductionist theory based on deterministic, one-way (upward) causation, the MS did not "point the way" to a more comprehensive theory—on the contrary, it ignored the reflexive modes of causation characteristic of, e.g., the Corning, Thompson, Noble, and Walsh visions of evolution, including the workings of the epigenome, all part of a tradition that goes back to certain eighteenth century ideas of Immanuel Kant, and twentieth century ideas of complexity and systems theory. Second, and more significantly, because the hardened MS is based on the false models of Weismannism and Crick's Central Dogma (also at odds with Kant's concept of organism), it cannot be a "limiting case."

However, this does *not* mean that mutation, natural selection (taken as a metaphor for differential survival), genetic drift, and migration do not play important roles in evolution. These factors, all of which were recognized before the emergence of the MS, must be included, or adumbrated within any satisfactory theory of how evolution comes about—as prescribed by the pluralism of Biological Relativity. To mix metaphors, in our desire to clean the Augean stables, we must not throw these babies out with the bathwater. But as Denis Noble insists, they do not hold a privileged position, any more than any of the other numerous factors involved and processes at work. But what are those other processes? What are those other factors? Where are the regularities? There is still much to be done.

For now, at least, the conflict between attack and defense of the current embedded theory of evolution, of heterodoxy *versus* orthodoxy, should be replaced with a synergy based on respect for plural, diverse views coupled with rational, critical debate. As Conrad Waddington urged, "we . . . should . . . have at our disposal several alternative philosophies, which provide different ways of interpreting chaos into sense."[20] (Waddington 1977: 17). I conclude that, in this way, *all* thinking about evolution should be aligned with the spirit of the Radical Enlightenment.

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