

Picking Holes in the Concept of Natural Selection

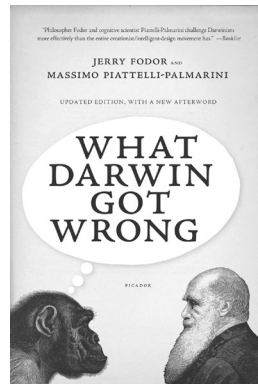
What Darwin Got Wrong. Jerry Fodor and Massimo Piattelli-Palmarini. Macmillan (Picador), 2011. 320 pp., illus. \$16.00 (ISBN 9780312680664 paper).

Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False. Thomas Nagel. Oxford University Press, 2012. 144 pp., \$24.95 (ISBN 9780199919758 cloth).

Can contemporary Darwinian biology fully explain the origin and evolution of life and the mind? Two recent books argue that it cannot. In *What Darwin Got Wrong*, Jerry Fodor and Massimo Piattelli-Palmarini, two leading cognitive scientists, argue that Darwinian evolutionary theory rests on a logical or conceptual mistake and, therefore, cannot explain the fact of evolution. In *Mind and Cosmos: Why the Materialist Neo-Darwinian Conception of Nature Is Almost Certainly False*, Thomas Nagel, a renowned philosopher, argues that Darwinian evolutionary theory is incomplete because it cannot explain the presence of the conscious mind in the living world and, therefore, cannot fully explain life, given that the mind depends on life. Much unites these two books. Both books reject creationism and intelligent design; both avow atheism, naturalism, and scientific realism; and both argue, albeit for different reasons, that the concept of natural selection is inadequate for a naturalistic explanation of the origin and evolution of life and the mind. Although the authors' arguments have problems, their books raise important questions and merit reading by anyone concerned with understanding our present scientific worldview and its possible limitations.

The primary target of these books is the concept of natural selection. Although Darwin did not provide a

precise definition of natural selection, his own argument and those of subsequent biologists made clear that evolution by natural selection has several basic requirements. There must be variation among the traits of the individuals of a reproducing population, this variation must be heritable to some degree, and this heritable variation must have an effect on the differential ability of individuals to survive and reproduce in order for differential reproduction to occur. The individual variants that leave more offspring are said to be fitter or better adapted. Therefore, natural selection is usually described as differential reproduction resulting from differential fitness within a shared environment.



Fodor and Piattelli-Palmarini present two arguments, one empirical and one conceptual, against the Darwinian theory of evolution according to natural selection. These two arguments do not sit well with each other. The empirical argument, presented in the first part of *What Darwin Got Wrong*, is essentially a review of the findings from evolutionary developmental biology (evo-devo) about the “endogenous constraints” that influence the formation of the phenotypes available to natural selection (Kirschner and Gerhart 2005). On the basis of these findings, the authors argue that there are strong internal constraints on variability and

that phenotypic traits are not the simple result of selection from the outside environment. They take both of these points to be contrary to contemporary Darwinian theory, but this is questionable for two reasons.

First, contemporary Darwinian biology conceives of selection not just as acting on the organism from the outside environment (exogenously) but also as occurring inside the organism (endogenously). For example, the production of lymphocytes in the immune system or the formation of synaptic connections in the brain is usually explained as resulting partly from selection. Moreover, what counts as exogenous versus endogenous is context dependent and relative to a scale of observation and a level of explanation. From the perspective of the whole organism acting in its environment, lymphocyte selection counts as endogenous, whereas from the perspective of the lymphocyte population, the rest of the body’s inside—the somatic milieu—counts as exogenous. The substantive issue, at whatever scale or level, is the exact relationship between selection and other causal factors, such as morphogenesis occurring as a result of physical self-organization—or what Fodor and Piattelli-Palmarini call *laws of form*, following D. W. Thompson (1992 [1961]).

Second, pointing to a variety of other causal processes at work in evolution does not necessarily diminish the importance of natural selection. Biologists since Darwin have accepted that processes other than natural selection play a role in evolution. Virtually all of the biologists that Fodor and Piattelli-Palmarini cite make this point explicitly and often in their writings. For example, Fodor and Piattelli-Palmarini invoke West and colleagues (1999) on how fractal geometry explains the fact that physicochemical and biological structures and processes scale with body mass according

to a quarter-power law whether they are in microorganisms, plants, or animals. Fodor and Piattelli-Palmarini take this work to show that “the driving force for these invariant scaling laws cannot have been natural selection” (p. 79) but must instead have been physicochemical and topological principles. However, West and colleagues (1999) presented their findings differently. They began their paper by stating, “Evolution by natural selection is one of the few universal principles in biology” (p. 1677), and they ended by suggesting that quarter-power scaling laws are perhaps just as universal. Their last paragraph highlights, on one hand, “the power of natural selection, which has exploited variations on this fractal theme to produce the incredible variety of biological form and function” (p. 1679) and, on the other hand, “the severe geometric and physical constraints on metabolic processes, which have dictated that all of these organisms obey a common set of quarter-power scaling laws” (p. 1679). This is hardly a repudiation of the significance of natural selection. Rather, it is a statement of how natural selection and topological principles of morphology may be mutually constraining.

Fodor and Piattelli-Palmarini acknowledge that the biologists they cite, such as West and colleagues (1999), usually endorse natural selection as the most important determinant of evolution. Fodor and Piattelli-Palmarini also allow that natural selection, when it is properly understood, plays a role in evolution—although not, in their view, a decisive or paramount one. In their words, “We think of natural selection as tuning the piano, not as composing the melodies” (p. 21). I am sympathetic to such efforts to rethink the nature and role of selection in relation to principles of biological self-organization. The issue is genuine and presumably tractable: Do findings from evo-devo and the physics and topology of self-organization indicate that natural selection, as it is commonly understood, either is less important than was previously thought or needs to be reconceptualized? A majority of

scientists and philosophers say *no*; a small minority say *yes*.

In the second part of *What Darwin Got Wrong*, however, the authors mount a logical argument to show that the theory of natural selection cannot have the explanatory power that it is supposed to have. This logical argument does not complement the empirical argument of the first part of the book, because it implies that the issue about the role of selection in relation to principles of biological self-organization is not genuine and tractable after all. If the theory of natural selection cannot possibly be true for conceptual or logical reasons, why go to the trouble to argue that other causal factors are more important than selection in evolution? If natural selection is not even a possible cause, how can it play any role at all, as their image of tuning the piano would suggest?

Fodor and Piattelli-Palmarini focus their argument on the distinction between traits that cause organisms to have enhanced reproductive success in a population and traits that are merely correlated with but do not cause increased fitness. For example, organisms with hearts pump their blood but also make heart-beating sounds. Suppose that we have an ancestral population in which some organisms have hearts and others do not, and suppose that, many generations later, all of the organisms have hearts. If the reason for the change is natural selection, it was presumably pumping blood and not making beating sounds that caused the organisms with hearts to be better able to survive and reproduce. Therefore, the attribute of pumping blood was *selected for* its function, which is to say that it was the cause of the differential fitness and differential reproduction, whereas making beating sounds was merely *selected* as a consequence of being correlated with pumping blood. In short, although there is a selection of the two correlated traits, there is only a *selection for* the one fitness-enhancing trait.

Sometimes, the authors seem to argue that there can be no real distinction between what is selected for and

what is simply selected; at other times, they appear to argue that Darwinian theory is not entitled to the notion of *selection for*, because nothing in the theory explains how natural selection could be anything other than the selection of phenotypic traits that are correlated with fitness rather than the selection for traits that cause fitness. Either way, the authors imply that the conceptual or logical mistake is that Darwinian theory cannot legitimize its use of the concept of *selection for*, and, therefore, Darwinian theory cannot explain the distribution of traits in biological populations.

Fodor and Piattelli-Palmarini’s argument for this verdict follows: To be able to say that hearts were selected for pumping blood rather than for making beating sounds, we need to be able to say that, in situations in which hearts pump blood but do not make beating sounds, they would still be selected, whereas in situations in which hearts make beating sounds but do not pump blood, they would not be selected. For both of these statements to be true, there must be laws of nature underlying them; if something instantiates the property of pumping blood, it must instantiate the property of enhancing fitness, regardless of the context. It is extremely implausible for such universal laws to exist, because evolutionary events are highly context sensitive: A trait that is advantageous in one context might be deleterious in another context. So, contrary to Darwinism, there is no basis for stating—in the case of hearts (or any other trait)—exactly what they were selected for. Therefore, what evolutionary theory offers are not laws about selection but, rather, post hoc historical narratives about particular, context-dependent events.

A biologist may find this argument irritating, because it relies on contentious premises drawn from the philosophy of science and ignores the actual practice of evolutionary biology. Even if we were to accept the authors’ conception of scientific laws in the case of fundamental physics (see Cartwright 1983, 1999, and Dupré

1993 for why we should not), there are other ways in which counterfactual statements about selection can be true without having to be underwritten by universal laws of selection. Instead, they can be underwritten by context-sensitive mathematical models, such as models of predator-prey dynamics or population genetic models. Or they can be underwritten by causal explanations that specify and describe the mechanisms by which traits (such as blood circulation) are produced. In both cases, evolutionary theory provides predictive generalizations rather than post hoc narratives but without requiring universal laws to do so. Philosophers of biology have worked hard to elaborate these ideas about forms of casual explanation; it is regrettable that Fodor and Piattelli-Palmarini ignore their contributions.

The authors' neglect of the philosophy of biology is unfortunate for another reason. In recent years, some philosophers have argued that natural selection, when it is properly understood, is not itself a cause or a force acting on a population but, rather, a statistical trend resulting from the aggregation of many causes and effects (Matthen and Ariew 2002, Walsh et al. 2002). In this view, certain trends get established at the population level as accumulations of lower-level events, such as individual births, deaths, mate choices, and cellular and molecular events, and these higher-order population trends constitute natural selection. On one hand, this view may partially vindicate Fodor and Piattelli-Palmarini's critique of the standard causal conception of *selection for*; on the other hand, it suggests that their critique of Darwinian evolutionary theory is misdirected, because it is based on their misunderstanding of the concept of natural selection. Moreover, the statistical interpretation of natural selection undermines their demand for laws of nature to underwrite the *selection for* process.

In *Mind and Cosmos*, Thomas Nagel shares Fodor and Piattelli-Palmarini's view (argued in the first part of their book) that Darwinian theory assigns

too much explanatory weight to natural selection and not enough to the sources of variation, but he does not endorse their critique of the concept of natural selection. Instead, he argues that evolutionary theory is fundamentally flawed because it does not explain why the emergence of conscious organisms—and not merely of behaviorally complex organisms—was likely, if not inevitable. Nagel's bold proposal is to call for a new science that would include natural teleology and would enable us to say that some events happen because they are on a path that leads to a certain outcome, such as the emergence of life, the mind, or consciousness. In this way, he believes, a teleological science could make intelligible the presence of the conscious mind in the natural world by making it expected instead of extremely improbable, as he maintains it is, given only the explanatory resources of natural selection.



Nagel's argument that evolutionary biology is incomplete rests on his well-known earlier arguments against materialistic reductionism. In Nagel (1974), he argued that science lacks the conceptual resources to enable us to understand how subjective experience could possibly arise solely from the physical workings of an organism. The problem is stark in the case of the bat, which has a sensory system (echolocation) that we lack: Neuroscience can give us detailed information about the bat's brain, but it cannot reveal to us what it feels like to be a bat from the inside. But the problem includes us

too: Science cannot tell us what a conscious state is like for the person who experiences it. Nagel's conclusion is not that materialism is false but that it is a position we cannot understand. In recent writings (Nagel 2002), however, he argued that materialistic reductionism is false. *Mind and Cosmos* proceeds on this assumption.

Suppose we knew that all and only organisms with a certain type of brain process were conscious, and suppose we knew how those organisms arose by entirely physical processes of evolution. Still, Nagel argues, we would not know how and why consciousness evolved. For any brain process that we can specify, it is always conceptually possible to ask why that process should instantiate consciousness instead of occurring in the absence of consciousness. So, no account of the evolution of the brain process will suffice conceptually to be an account of the evolution of consciousness. Nagel allows that this appearance of contingency in the relationship between the brain and consciousness may be an illusion. Even if consciousness is irreducible to the brain as it is understood in physical terms, the connection between the two is likely to be a necessary one, although that connection is concealed to us by the inadequacy of our present concepts. Nevertheless, Nagel argues, understanding how the relationship between the brain and consciousness is noncontingent would not enable us to understand the historical emergence of consciousness, because this understanding would not show that consciousness is something to be expected.

The problem with the theory of evolution by natural selection, according to Nagel, is that it does not provide an understanding of consciousness as a likely product of evolution. Therefore, we face a double mystery: We are unable to explain the relationship between the mental and the physical, and we cannot explain why and how consciousness evolved. Furthermore, given that consciousness is a feature of life, if we cannot explain how and why consciousness evolved, we cannot fully account for life.

Nagel is forthright in explaining that this argument depends not just on assuming the failure of materialistic reductionism but also on assuming that “certain things are so remarkable that they have to be explained as nonaccidental if we are to pretend to a real understanding of the world,” and that we should be guided by “the ideal of discovering a single natural order that unifies everything on the basis of a set of common elements and principles” (p. 7). However, if you are less confident about humankind’s ability to gauge what is accidental in evolution or if you believe that the classical ideal of the unity of science makes little sense in light of the actual practice of science, Nagel’s premises will seem misguided.

Nagel’s reliance on what seems to him to be likely or expected in the case of evolution makes for a weak argument. On one hand, certain phenomena—remarkable though they seem to us—may, nonetheless, be accidental. Gould (1989) argued that the outcomes of evolution may be so highly contingent that any replay of the tape of life would take evolution down a very different path from the one it took, such that the phylum to which we belong would not emerge. On the other hand, exactly how are we to determine the likelihood or unlikelihood of outcomes such as the emergence of life or consciousness? Morris (1998) replied to Gould that we can replay the tape of life as many times as we like, and the generic properties of intelligence and consciousness will still emerge as a consequence of *convergent evolution* (the independent evolution of similar features in species of different lineages). Computer models, in which the tape can be played more than once, have shown that complex self-maintaining organizations of a metabolic sort repeatedly arise in simple chemical environments (Fontana and Buss 1994). So, how can Nagel be so confident about what events are likely or unlikely from the perspective of evolutionary theory?

Nagel expresses confident disbelief in the ability of evolutionary biology

to account for the origin of life, but his incredulity seems ill informed. A growing body of work in theoretical and experimental prebiotic chemistry casts increasing light on the origins of life and its early evolution (Luisi 2010). Contrary to Nagel, I take this work to provide precisely what he thinks is lacking—namely, “a credible argument that the story [that life results from physical evolution] has a nonnegligible probability of being true” (p. 6).

Nagel neglects another important body of work closely connected to theoretical and experimental models of the origins of life. This work concerns complex or self-organizing systems and comprises theoretical biology, dynamical systems theory, and philosophy. A number of theorists have argued that certain types of self-organizing systems exhibit a kind of natural teleology in the sense of a directedness arising from being self-producing and self-maintaining (Juarrero 1999, Thompson E 2007, Deacon 2012). This kind of directedness does not involve teleological laws beyond or outside of the laws of physics, unlike the natural teleology that Nagel proposes but does not develop fully. Moreover, such self-producing and self-maintaining systems arguably exhibit protomental characteristics and thereby provide a bridge from the physical order to the orders of life and the mind. Nagel’s book falls short in not taking this work into account.

Finally, Nagel never stops to consider that his concepts of consciousness and the physical body may be part of the problem. For Nagel, consciousness is private, first-person experience, and the physical body is a complex mechanism. A different approach argues that consciousness, most fundamentally, is the feeling of being alive—a feeling that is necessarily bodily and that is also necessary for certain kinds of life-regulation processes of the body (Thompson E 2007). According to this view, there is no way to pry apart consciousness, life, and the physical body in the way that Nagel presupposes.

What Darwin Got Wrong and *Mind and Cosmos* have much in common.

Both raise important questions, both make provocative arguments deserving of serious consideration, and both neglect important work in philosophy and science, to their own detriment.

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