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TARGET ARTICLE

Reintroducing Pierre Teilhard de Chardin to modern evolutionary science

David Sloan Wilson[a,b]

[a]Departments of Biology and Anthropology, Binghamton University, Binghamton, New York; [b]Prosocial World, Austin, Texas

ABSTRACT

Pierre Teilhard de Chardin (1881–1955) developed an evolutionary worldview that was both spiritual and consistent with the scientific knowledge of his day. He has been largely forgotten by modern evolutionary scientists but remains widely read by those who are inspired by his vision of conscious evolution leading to a planetary superorganism. This article examines the major tenets of Teilhard's vision from a modern evolutionary perspective in an effort to integrate "hard" evolutionary science with spirituality, the humanities, and conscious efforts to manage cultural change.

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Pierre Teilhard (1959) was a Jesuit Priest and paleontologist who was part of the team that unearthed the skull that became known as Peking Man (now classified as *Homo erectus*) in 1929. Two biographies are Amir (2007) and King (2015). The Catholic Church has long acted as a patron of science in addition to a censor when its dogma became threatened. Hence, it was not unusual for a priest to also be a scientist and Teilhard was highly respected by his scientific peers. His writing indeed strayed into dangerous territory as far as the Church was concerned. Teilhard was blocked from taking prestigious academic positions that were offered and many of his publications were suppressed.

Le phénomène humain, which was written in the 1930s, was not published until after his death. The English translation of this book, titled *The Phenomenon of Man* (1959), includes an admiring foreword by Julian Huxley, one of the architects of the Modern Synthesis.

Teilhard has a curious status in modern times. Among academic evolutionary scientists, he has been almost totally forgotten. Yet, as the Google NGram (which charts word frequencies from Google's vast electronic library of books) in Figure 1 shows, Teilhard remains much better known among the general public than the architects of the Modern Synthesis.

The purpose of this article is to examine the work of Teilhard in the light of modern evolutionary science (see also Wilson 2019). I will show that he anticipated developments which did not take place until the closing decades of the twentieth century and in many respects are still in progress. This makes Teilhard well worth reading and discussing by academic evolutionary scientists in addition to the general public.

The reasons for reviving interest in Teilhard go beyond historical scholarship and an examination of some of his specific ideas. As the Google NGram shows, Teilhard had a way of writing about evolution that was and remains magnetically attractive to a large audience of lay readers, even life-changing for some. This was due not only to his gifts as a writer, but also his original contributions to evolutionary thought. His portrayal of evolution stands in contrast to most other portrayals, which at best appeal only to science geeks and at worst are hugely alienating to a lay audience,

CONTACT David Sloan Wilson dwilson@binghamton.edu

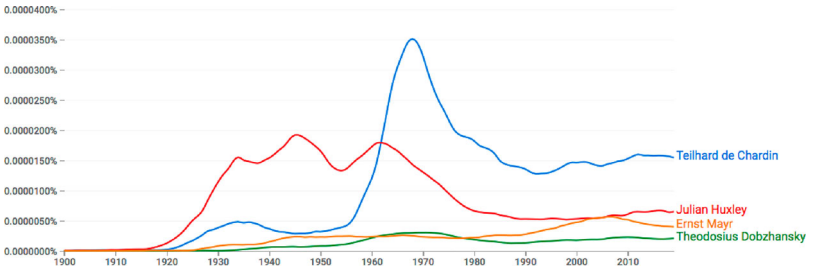

Figure 1. Frequency of word use comparing the name of Teilhard with the names of three architects of the Modern Synthesis.

spiritual seekers, and academic experts in the humanities. If Teilhard's view of evolution is scientifically legitimate, then it can be a breakthrough in how evolution is presented to these audiences.

In the first section of this article, I will examine the major elements of Teilhard's thought against the background of modern evolutionary science. In the second section, I will examine the phenomenon of Teilhard's continuing popularity among the general public and how it can be built upon in a way that is reinforced with the best of our current scientific knowledge.

The major elements of Teilhard's thought

A concise summary of Teilhard's thought is contained in Chapter 10 of his compilation of essays, *The Future of Man* (1947/1969), titled "The Formation of the Noösphere". I will use this chapter as my main text, drawing upon his other writing as needed. For each element, I will first summarize Teilhard's articulation and then connect it to developments in modern evolutionary science.

Element 1: A naturalistic view of evolution. Given Teilhard's religious upbringing and status as a Jesuit Priest, it is remarkable that his evolutionary worldview is so compatible with naturalism, which is the reliance on known laws of physics and biology as the explanatory framework. While he had a strong sense of the divine, he avoided invoking any kind of supernatural interventionist divine spark in the origin of the universe, the origin of life, or the origins of humans–much less any divine intervention in the affairs of modern humans. This is why Teilhard was accepted and admired by the evolutionary scientists of his day and why he threatened Church orthodoxy. Teilhard's naturalism is radical even against the background of the modern Catholic Church's position on evolution.[1] In his foreword to *The Phenomenon of Man*, Huxley wrote (p 12):

> Pere Teilhard starts from the position that mankind in its totality is a phenomenon to be described and analyzed like any other phenomenon: it and all its manifestations, including human history and human values, are proper objects for scientific study. His second and perhaps most fundamental point is the absolute necessity of adopting an evolutionary point of view.[2]

Element 2: An emphasis on human cultural evolution. Teilhard observed that in some respects, we are just another great ape species, "a very small offshoot" of the Family Hominidae. In other respects, however, we are a new evolutionary process—cultural evolution. That makes the origin of our species as significant, in its own way, as the origin of life. In *The Phenomenon of Man*, Teilhard asks the reader to imagine the bushy tree of life growing slowly over millions of years. Then, one twig of the tree starts branching much more rapidly, quickly overtopping the rest of the tree. In Chapter 10, he describes human cultural diversity as similar to the major genetic adaptive radiations such as the birds, mammals, and reptiles. He foresees that " … at the rate it is going, we can already foresee the day when it [the human cultural adaptive radiation] will have abolished or domesticated all other forms of animal and even plant life (p. 151)."

Teilhard's emphasis on cultural evolution stands in marked contrast to the development of evolutionary science during the middle part of the twentieth century, which became almost entirely

dominated by the study of genetic evolution. The formal study of culture by evolutionary scientists didn't resume until the 1980s, with books such as *Culture and the Evolutionary Process* (Boyd and Richerson 1985), which began to construct mathematical models of cultural evolution patterned after population genetics models developed 50 years earlier (see also Cavalli-Sforza and Feldman 1981, Lumsden and Wilson 1981).

Today, the study of human cultural evolution is thankfully experiencing a renaissance, although largely without acknowledging Teilhard's contribution. For example, an article published in *Nature* magazine titled "The Cultural Wealth of Nations" (Pagel & Mace, 2004) begins: "Why, when the human race shows comparatively little genetic variation, are cultural differences so widespread and enduring? Thinking about cultures in terms of biological species provides some provocative answers." This is the very point that lies at the heart of Teilhard's thought, but he isn't cited in the *Nature* article.

The concept of Dual Inheritance Theory (Richerson, 2017; Richerson & Boyd, 2005) is in line with Teilhard's vision, in which a cultural stream of inheritance first evolved by genetic evolution and has been coevolving with it ever since. For example, in Chapter 10 (p 157) he writes: "But after the coming of Man another kind of heredity shows itself and becomes predominant; one which was indeed foreshadowed and essayed long before Man, among the highest forms of insects and vertebrates." The latter part of this sentence acknowledges the existence of cultural traditions in other species, which is a current hot topic in animal behavior research (e.g., Whiten, 2021). Teilhard also appreciated the importance of genetic adaptations for cultural transmission during child development when he wrote: "a new matrix, coextensive with the whole human group, was formed about the newly born human child—a matrix out of which he cannot be wrenched without incurring mutilation in the most physical core of his biological being." This sentence anticipates recent books such as "The Secret of Our Success: How Culture is Driving Human Evolution, Domesticating Our Species, and Making Us Smarter" (Henrich, 2015).

Teilhard appreciated that as the fastest of the two evolutionary processes, cultural evolution takes the lead in adapting human populations to their environments, with genetic changes following at a slower pace.[3] Increasingly, human cultural evolution is being modeled not in terms of atomistic traits but rather entire systems of symbolic thought, which brings us to our next element.

Element 3: A thinking dimension to evolution. Teilhard used the terms "biosphere" and "noösphere" to describe the impact of other lifeforms and humans, respectively, on earth processes. The noösphere was not just the increasingly dominant physical presence of humans on earth, but also had a mental component. Teilhard emphasized "the psychic phenomenon of hominization" in the form of freedom of choice, foresight, and the ability to plan and construct. In the *Phenomenon of Man*, he describes humankind as "evolution becoming conscious of itself".

As with the study of cultural evolution, evolutionary science veered sharply away from the concept of evolution as having a conscious component in the middle of the twentieth Century. The modern synthesis was centered squarely on Mendelian genetics as it was understood at the time, in which variation was random (in the sense of arbitrary with respect to selection pressures) and the immediate environment did the selecting. This left no room for anything that could be regarded as purposeful about evolution. An impenetrable barrier was thought to exist between the reproductive and somatic cells, so that anything that happened during the lifetime of the organism did not influence the traits inherited by offspring.

These positions became so dogmatic that they have been resistant to change–even after change has become richly warranted.[4] Looking back, the idea that evolution can have no purpose makes sense only in the narrowest of contexts. Consider the concept of artificial selection, in which humans consciously select the traits of domesticated plants and animals. The target of selection is consciously chosen, but it is still an evolutionary process, which is why Darwin could use it to explain his concept of natural selection. With natural selection, fitness differences are caused by the environment, but this can include other members of the same species, such as sexual selection, where the traits of one sex are selected by the other sex. The term "social selection" refers more generally to the members of the same

species selecting each other's social behaviors, such as docility. Is that natural or artificial? The concept of "self-domestication" has become a hot topic in the study of many species, with human genetic evolution an outstanding example (Wrangham, 2019; Hare and Woods, 2020).

Even when variation is blind with respect to what is selected, blind evolution gives rise to organisms that adaptively respond to their environments, which feeds back to influence environmental selection pressures. This concept was celebrated as a Lamarckian process compatible with Darwinian evolution early in the twentieth century (Baldwin, 1903; Scheiner, 2014), but was largely left out of the Modern Synthesis. Advances in genetics have yielded many examples of directed mutations and mechanisms whereby the experiences of parents are transmitted to their offspring in the form of gene expression (epigenetics) rather than a change in gene frequency (Gissis & Jablonka, 2011; Jablonka & Lamb, 2006). Social learning provides another mechanism for information learned in one generation to be passed to the offspring generation. A 2021 article in *Science* magazine titled "The Burgeoning Reach of Animal Culture[5]" shows how much cultural evolution in nonhuman species of all sorts—not just the so-called "higher" primates—has been underappreciated until recently (Whiten, 2021; see also Laland, 2017).

As soon as we begin studying human cultural evolution, a directed component to the evolutionary process becomes impossible to ignore. No one can deny that what people do is very largely goal oriented. The goals might be conscious or lie beneath conscious awareness, but either way they orient activities. Yet, people seldom know exactly how to achieve their goals. Instead, they rely upon variation to select the practices that take them toward their goals. This too can be a conscious process, such as an explicit experiment, or an unconscious process, such as the kind of operant conditioning that also takes place in many other species. Either way, it leads to an accumulation of better practices over time—what B.F. Skinner (1981) called "selection by consequences". If the artificial selection of our domesticated plants and animals counts as an evolutionary process, then so does what I have just described for the selection of better cultural practices.

Acknowledging a conscious component does not imply that human cultural evolution is entirely conscious. There is plenty of room for cultural practices to result in fitness differentials that are entirely unplanned, resulting in the accumulation of those that work without anyone knowing how or why they work. An example is the elaborate processing of maize that is required for it to become a dietary staple, including soaking and cooking it in an alkaline solution to remove aflatoxins, help the dissolution of hemicellulose, and convert hemicellulose-bound niacin to free niacin. These practices appear to have arisen and been passed down by tradition in native American cultures without any causal awareness of how they worked. When maize was introduced to Europe in the sixteenth century, it was not accompanied by the cultural adaptations and resulted in an epidemic of a disease caused by a niacin deficiency called pellagra. Millions of people were afflicted without anyone guessing the cause or independently evolving the appropriate food processing techniques. Scientific understanding did not emerge until the twentieth century and even that required decades to become established (Katz, 1990).[6]

Even conscious evolution has a way of converting to unconscious evolution when intentions collide with each other. For example, the Protestant Reformation included many reform movements in cities such as Geneva, where John Calvin worked, and Zurich, where Ulrich Zwingli worked. Both were highly conscious in their reform efforts, yet the comparative success of Calvinism was based largely on the contingencies of history (Wilson, 2002, Ch 3). In one of the best studied examples of cultural replacement in the anthropological literature, an African pastoralist tribe called the Nuer was in the process of slowly replacing a neighboring tribe called the Dinka when contacted by Europeans. Members of both tribes were highly intentional in going about their lives—raising their crops, tending their cattle, getting married, forming their alliances, and so on. But the factors that gave one tribe an edge over the other in intertribal competition were incidental byproducts of their lower-level intentional strivings. There is no evidence that members of either tribe were aware that a slow replacement process was taking place, nor did they understand the underlying factors (Kelly, 1985; discussed in Sober & Wilson, 1998, pp. 186–191).

To summarize, Teilhard's focus on a thinking dimension to human cultural evolution is fully legitimate and even commonsensical, once we appreciate that the denial of anything purposeful about evolution took place in the narrowest of contexts in the history of evolutionary thought.

Element 4: Superorganisms. The concept of society as an organism was commonplace when Teilhard was writing but was treated mostly as a metaphor. Teilhard realized that evolutionary theory was required to place the metaphor on a scientific foundation:

> We feel that the relation between Society and Social Organism is no longer a matter of symbolism but must be treated in realistic terms. But the question then arises as to how, in this shifting of values, this passage from the juridical to the organic, we may correctly apply the analogy. How are we to escape from metaphor without falling into the trap of establishing absurd and oversimplified parallels which would make of the human species no more than a kind of composite, living animal? This is the difficulty which modern sociology encounters (p. 150).

It is ironic that nearly a century after Teilhard wrote these words, modern sociology and the most culture-oriented disciplines of the social sciences and humanities still associate evolution with the gene-centric view of the Modern Synthesis and are only beginning to learn about the dual inheritance view, to which they have much to contribute (See Wilson & Schutt, 2016, for the field of Sociology and Wilson & Paul, 2016, for the field of cultural anthropology).

Teilhard emphasized that the human superorganism is not just a brain, but a brain of brains:

> On the one hand we have a single brain, formed of nervous nuclei, and on the other a Brain of brains. It is true that between these two organic complexes a major difference exists. Whereas in the case of the individual brain thought emerges from a system of non-thinking nervous fibers, in the case of the collective brain each separate unit is in itself an autonomous center of reflection. If the comparison is to be a just one we must, at every point of resemblance, take this difference into account. (p. 161)

In this discerning fashion, Teilhard proceeds to organize Chapter 10 around the birth, anatomy, physiology, and growth of the Noösphere as a superorganism. He appreciates that other superorganisms exist in nature ("the termitary, the ant hill, the hive") but that they are organized around a family structure. In contrast, the human superorganism is based on "the extraordinarily agglutinative property of thought", which can bind genetically unrelated individuals into functionally organized groups (p. 154).

This way of thinking was almost totally eclipsed in evolutionary biology during the 2nd half of the twentieth century, when virtually all adaptations were interpreted as for the good of individuals and their selfish genes (Dawkins, 1976; Williams, 1966; see Sober & Wilson, 1998 and Wilson, 2015 for analysis). This individualistic perspective was part of a larger trend that included economics (the rational actor model), the social sciences (methodological individualism), and everyday life (e.g., Margaret Thatcher's famous quip that there is no such thing as society; only individuals and families). The social history of individualism is complex but here I wish to identify a factor that is not ideological: the advent of mathematical modeling. The study of most major topics appears to follow a trajectory that begins with verbal theorizing. During this phase, it is easy to emphasize the rich complexity and interconnectedness that manifestly exists. Then there is a stage of formal mathematical modeling. Mathematical models are an important advance over verbal theorizing but they require making simplifying assumptions, which is a de facto denial of complex interactions. Eventually, the mathematical models reveal their limitations and there is a return to the appreciation of complexity, aided by computer simulation modeling techniques that only became available during the 2nd half of the twentieth Century (Gleick, 1987).[7]

Another factor, more closely related to evolutionary theory, is the failure to distinguish between proximate and ultimate causation in Ernst Mayr's (1961) terminology, or the "Mechanism" and "Development" compared to the "Function" and "History" questions in Niko Tinbergen's (1963) terminology. When we confine ourselves to proximate causation, everything that takes place at higher scales can be explained in terms of the interactions among lower-level units. Against this background, the statement "all things social can be explained in terms of individual thought and

action" seems like it can't be otherwise. With ultimate causation, however, selection operating on higher-level units, such as an individual organism, shapes everything that takes place at lower levels. This is called "downward causation" (Campbell, 1990) and it provides a rock-solid foundation for the holistic claim that "the parts permit but do not cause the properties of the whole" (Wilson, 1988).

Returning to the present, Teilhard's holism stands on very firm evolutionary ground. Multilevel selection (MLS) is acknowledged as a legitimate accounting method for evolutionary change (Okasha, 2006; Wilson, 2015). Higher-level selection is a significant evolutionary force in many species and especially in the case of human cultural evolution (Henrich, 2015; Laland, 2017; Richerson & Boyd, 2005), as elaborated in more detail below. Social insect colonies and a growing list of other animal societies are studied as superorganisms, complete with social physiologies and group minds (Holldobler & Wilson, 2008; Seeley 1995, 2010).

Even more favorable for Teilhard's views is the concept of Major Evolutionary Transitions, which brings us to the next element.

Element 5: The coalescence of human cultures. Teilhard placed great emphasis on an in-folding that he regarded as unique to human evolution. For all other species, evolution takes the form of fanning out; species giving rise to other species, but never coalescing into superspecies. In humans, smaller-scale societies have been coalescing into larger-scale societies throughout human history. The end point (called the Omega Point) was for the Noösphere to become a single global superorganism.

The concept of Major Evolutionary Transitions (MET) affirms Teilhard's account of human cultural evolution but also goes beyond it in important ways (Calcott & Sterelny, 2011; Maynard Smith & Szathmary, 1995, 1999). The concept follows directly from MLS theory: Most social species are a mosaic of selfish traits that evolve by within-group selection and cooperative traits that evolve by between-group selection. However, the balance between within- and between-group selection is not fixed but can itself evolve. When mechanisms evolve that sufficiently suppress the potential for disruptive within-group selection, between-group selection becomes the dominant evolutionary force and the group becomes so cooperative that it qualifies as a higher-level superorganism.

Peter Turchin (2005, 2010, 2015) explains human history as a series of METs in a way that maps nicely onto Teilhard's account, as outlined in more detail below. But METs are not restricted to human cultural evolution. The concept originated with the symbiotic cell theory of Lynn Margulis (1970), in which nucleated cells evolve not by small mutational steps from bacterial cells but as cooperative communities of bacterial cells. Even the origin of life might be explained as communities of cooperative molecular reactions (Maynard Smith & Szathmary, 1999). Hence, Teilhard was wrong to state that coalescing events are restricted to human cultural evolution. That said, the concept of METs in both biological and human cultural evolution fits easily within his overarching evolutionary epistemology, and it remains true that the capacity for symbolic thought that underpins human cultural evolution is highly distinctive, if not unique.

Element 6: The role of technology. The ability of our species to create artifacts plays a primary role in Teilhard's account of human evolution, as in the following passage, which also illustrates his talents as a writer.

> The fact was noted long ago; What has enabled man zoologically to emerge and triumph upon earth, is that he has avoided the anatomical mechanization of his body. In all other animals we find a tendency, irresistible and clearly apparent, for the living creature to convert into tools, its own limbs, its teeth and even its face. We see paws turned into pincers, paws equipped with hooves for running, burrowing paws and muzzles, winged paws, beaks, tusks and so on—innumerable adaptations giving birth to as many phyla, and each ending in a blind alley of specialization. On this dangerous slope leading to organic imprisonment Man alone has pulled up in time. Having arrived at the tetrapod stage he managed to stay there without further reducing the versatility of his limbs. Possessing hands as well as intelligence, and being able, in consequence, to devise artificial instruments and multiply them indefinitely without becoming somatically involved, he has succeeded, while increasing and boundlessly extending his mechanical efficiency, in preserving intact his freedom of choice and power of reason (p 158–9).

Extrapolating into the future, Teilhard anticipated many of the technological developments and social consequences that indeed came to pass: "We have passive machines giving birth to the active machine, which in turn is followed by the automatic machine (159)." He emphasizes that technological innovation is not due to individual inventors but is a collective effort:

> … what has not yet been sufficiently taken into account, although it explains everything, is the extent to which this process of mechanization is a collective affair, and the way in which it finally creates, on the periphery of the human race, an organism that is collective in its nature and amplitude (p. 159).

Teilhard accurately forecasts that the endpoint of the process must be global:

> To an increasing extent every machine comes into being as a function of every other machine; and, again, to an increasing extent, all the machines on earth, taken together, tend to form a single, vast, organized mechanism. Necessarily following the inflexive tendency of the zoological phyla, the mechanical phyla in their turn curve inward in the case of man, thus accelerating and multiplying their own growth and forming a single gigantic network girdling the earth. And the basis, the inventive core of this vast apparatus, what is it if not the thinking center of the Noösphere (p. 160)?

Element 7: The sanctity of the individual within the superorganism: Teilhard was careful to distance his vision of a global superorganism from a totalitarian state that tramples the rights of individuals. His conception of a "brain of brains", with individuals remaining a "an autonomous center of reflection", has already been noted. He foresees a time when widespread unemployment from mundane activities frees individuals to engage in more creative pursuits. Globalization will make it possible for people to sympathize with other people around the world, which was unimaginable in previous centuries. This passage near the end of Chapter 10 summarizes his views (p. 170):

> You may reply to me that this is all very well, but is there not something lacking, an essential element, in this system which I claim to be so coherent? Within that grandiose machine-in-motion which I visualize, what becomes of that pearl beyond price, our personal being? What remains of our freedom of choice and action?
>
> But do you not see that from the standpoint I have adopted it appears everywhere—and is everywhere heightened?
>
> I know very well that by a kind of innate obsession we cannot rid ourselves of the idea that we become most masters of ourselves by being as isolated as possible. But is not this the reverse of the truth? … We can only achieve a wider degree of freedom by joining and associating with others in an appropriate way. This is, to be sure, a dangerous operation, since, whether it be the case of disorderly intermingling, or of some simple form of coordination, like the meshing of gear-wheels, our activities tend to cancel one another out or to become mechanical—we find this only too often in practice. Yet it is also salutary, since the approach of spirit to spirit in a common vision or shared passion undoubtedly enriches all; in the case of a team, for example, or of two lovers. Achieved with sympathy, union does not restrict but exalts the possibilities of our being. We see this everywhere and every day on a limited scale. Why should it not be worth correspondingly more on a vast and all-embracing scale, if the law applies to the very structure of things?

To conclude this section, the major elements of Teilhard's thought fare very well against the background of modern evolutionary science. Now I will turn to the phenomenon of his popularity over a period of decades when he was almost entirely forgotten by evolutionary scientists.

Evolution as a meaning system

In a section of the *Phenomenon of Man* titled "Existence Value (p. 294–296)", Teilhard makes a distinction between scientific theories and philosophical systems, invented by thinkers such as Darwin, Plato, Spinoza, and Hegel, and a religion such as Christianity. He observes that religions are lifeforms in a way that theories and philosophical systems are not. They inhabit the real world, replicate, and mutate. They engage people from all walks of life rather than an educated few. For all its flaws, Christianity has an amazing ability to bring diverse people together into a functioning community, which was its main innovation compared to the more insular religion of Judaism. It is an example of the "the extraordinarily agglutinative property of thought", mentioned above in Element 4.

It was the priestly side of Teilhard that turned an evolutionary worldview into a cultural lifeform, like a religion, except scrupulously adhering to the scientific knowledge of his day. People from all walks of life could read Teilhard and be inspired by him. His ideas were animating, in the sense of making them come alive psychologically and moving them to action. Their attraction was contagious, causing others to read Teilhard and become similarly inspired without requiring the endorsement of academic evolutionary scientists.

There is an entire tribe of thinkers that has built upon Teilhard's animating worldview, as reported by Carter Phipps (2012) book *Evolutionaries: Unlocking the Spiritual and Cultural Potential of Science's Greatest Idea*, which fittingly begins with the words "We are moving!" from Teilhard's *Future of Man*. Phipps is not an evolutionary scientist. He is spiritually oriented and became Executive Editor of the magazine *EnlightenNext*, where he encountered the evolutionary narrative of Teilhard and others alongside Humanism and the Eastern and Western religious traditions. For Phipps,

> It is not hyperbole to say that how we think about evolution profoundly affects how we think about life, the universe, and everything. That is why it is a critical pillar in the work to form a new worldview that can meet the demands of the twenty-first century (p. xvi).

In the process of writing his book, Phipps attended a 2009 academic conference at the University of Chicago celebrating the 200th anniversary of Darwin's birth and 150th anniversary of the publication of *On the Origin of Species*. He reported that

> Admittedly, there was an occasional nod to the heroic attempt to reconcile evolution and faith, but no one was on the lookout for the emergence of a new evolution-inspired spirituality. No one was talking about the way in which evolutionary ideas might transform culture and human thought in the new century (p. 6).

Thus, the tribe of evolutionary spiritual thinkers reported in *Evolutionaries* inhabits a parallel universe with almost no connection to academic evolutionary science. I speak with experience, since I belong to a group called the Evolutionary Leaders[8], whose purpose is to "collectively inspire, support, and serve conscious evolution." While the EL's are highly science-friendly and often have PhD-level educations, I am the only practicing academic evolutionary scientist among them.

This separation can be called into question if Teilhard's body of thought can be squared with modern evolutionary science. If the concept of conscious evolution isn't wrong, especially in the case of human cultural evolution, then teaching it that way and using it to select better cultural practices in real-world settings isn't wrong either. In fact, failure to do so would be professionally irresponsible. For the remainder of this article, I will sketch a path toward integrating the two parallel universes with each other.

Symbolic meaning systems from an evolutionary perspective. The modern study of cultural evolution began with models that emulated population genetics theory. The evolution of a single cultural trait was modeled, immortalized by the term *meme* coined by Richard Dawkins (1976). The transmission of the cultural trait from one person to the other could be from parent to offspring (as with genes), adult to unrelated offspring (e.g., teachers), or peer to peer within a generation. The exact mechanism of transmission was loosely assumed to be some form of copying behavior without specifying the exact mechanism.

Against this background, the publication of *The Symbolic Species* by Terrence Deacon (1998; see also Jablonka & Lamb, 2006) was a breakthrough. Symbolic thought differs from the kind of associative learning found in many species. With associative learning, mental associations correspond closely to environmental associations, such as the pairing of food with a sound in Pavlov's famous experiments. Break the environmental association, and the mental association is extinguished as well. With symbolic thought, mental associations acquire a life of their own, independent of environmental associations. For example, I could say the word "cheese" to you a million times without presenting you with cheese and your mental association of the word with the object would endure. We even have words for things such as "troll" that don't exist in the real world.

According to Deacon, symbolic thought is not necessarily computationally difficult. The main puzzle from an evolutionary perspective concerns its adaptive value. How can mental associations that don't correspond to "what's out there" increase survival and reproduction? The answer is that they result in behaviors that take place in the real world and are therefore exposed to environmental selection pressures.

This gives symbols a gene-like status. Genes don't correspond directly to anything in the environment. Instead, they result in traits that influence survival and reproduction in the environment. In this fashion, an imaginary entity such as a troll can be selected as long as it results in behaviors that are adaptive, even in a world without trolls.

Symbols resemble genes in another way—their combinatorial diversity. Ten genes with two alleles at each locus results in over 1000 genetic combinations for selection to operate upon. Likewise, even a small number of symbols connected to each other in various ways results in myriad combinations, each motivating a different suite of behaviors.

While the capacity for symbolic thought could potentially be useful to many species, it is very distinctively human. Why? Because maintaining and transmitting an inventory of symbols with shared meaning is inherently a cooperative activity. We are a symbolic species because we are a highly cooperative species.

This is where Multilevel Selection and Major Evolutionary Transitions enter the picture. Despite sharing 99% of our genes with chimpanzees, there is a night and day difference in the degree of cooperation. Naked aggression is over 100 times more frequent in a chimp community than small-scale human societies (Wrangham, 2019). Even cooperation takes place primarily in the context of alliances competing against other alliances within a community. The main context for community-wide cooperation is competition with adjacent chimp communities. A chimp community is despotic in human terms. Males in particular are obsessed with achieving alpha status, with bullying and alliance-building within the community among their main strategies for achieving it.

Something happened in human evolution to make communities much more cooperative. To the best of our knowledge, that "something" was social control. Our distant ancestors found the means to collectively suppress bullying and other forms of disruptive self-serving behaviors within their communities. The anthropologist and primatologist Christopher Boehm termed this "reverse dominance" and it is the basis of our moral psychology (Boehm, 1999, 2011; Boehm et al., 1993).

Morality inherently has two dimensions; compulsory and voluntary. The compulsory dimension includes the formation and enforcement of norms of agreed upon behavior. An individual can influence the formation of a norm but thereafter must abide by it or face consequences. The voluntary dimension is the spontaneous desire to help others, motivated by emotions such as sympathy, empathy, compassion, friendship, and love. The reason for the two-dimensional nature of morality is that the compulsory dimension is required to make the voluntary dimension safe. Otherwise, prosocial behaviors could be too easily exploited.

In evolutionary terms, this is nothing more or less than a MET; the suppression of disruptive self-serving behaviors within groups so that between-group selection becomes the dominant evolutionary force. This has led to what is sometimes called the "Cooperation came first" hypothesis (Hayes & Sanford, 2014). Nearly everything that is distinctive about our species, both physical and mental, is a form of cooperation made possible by a genetic MET that marks our origin as a species. This is why the capacity for symbolic thought is so distinctively human and why the other outstanding example of symbolic communication in nature—the famous waggle-dance of the honeybee—evolved in another ultra-cooperative species.

Once the capacity for symbolic thought evolved, it became a full-blown inheritance system that operates alongside genetic evolution. Every one of us is a collection of genes, called our genotype, that influences nearly everything that can be measured about us, called our phenotype. Every one of us is also a collection of symbols—let's call it our symbotype (Wilson et al., 2014)—that also influences nearly everything that can be measured about us—the very same phenotype. Our symbotypes and genotypes interact with each other, both during our lifetimes and over multigenerational time.

For example, the practice of meditation, which alters your state of mind, up-regulates or down-regulates a substantial fraction of your genes (Black et al., 2019; Venditti et al., 2020).

Your symbotype is very largely a product of your cultural heritage, which you began soaking up as an infant, thanks to very sophisticated mechanisms that evolved by genetic evolution, as Teilhard richly appreciated. It is also something that you have partial control over. When you are influenced by a book or a friend, convert to a new faith, or have a breakthrough in your personal thoughts, it reflects a change in the way you think and feel (your symbotype) and therefore how you act (your phenotype).

Deacon's book shifted the study of human cultural evolution away from the evolution of single cultural traits (memes) to the study of whole systems of meaning that are irreducibly social. This is much more in tune with Teilhard and others of his time, such as Emile Durkheim, which the intellectual tradition of Individualism so largely displaced during the 2nd half of the twentieth century. Now it is the concept of functionally organized groups that stands on a solid scientific foundation; first at the scale of hunter-gatherer groups and increasing over the course of human history, as chronicled from an evolutionary perspective by Peter Turchin. One of the most important cultural METs was the advent of the major religious traditions in what historians called the Axial Age. Christianity, Buddhism, and the other major religious traditions provided a kind of social glue that held societies together at a larger scale than ever before—but always in the context of between-group competition at still larger scales (Bellah, 2011; Hoyer & Reddish, 2019; Turchin, 2015). The same story can be told for the cultural evolution of nation states, leading to the nearly 200 nations that carve up planet today—much as envisioned by Teilhard.

Consciously evolving our future: Darwinian evolution, in its most general formulation, is any process that combines the three ingredients of variation, selection, and replication. Once we conceptualize it in its most general form we can see it operating all around us. Not just *inter*-generational processes such as genetic, epigenetic, and cultural evolution, but *intra*-generational processes, such as the rapid evolution of antibodies and our capacity for open-ended behavioral adaptation as individuals.

Evolutionary processes don't automatically make everything nice. They frequently result in outcomes that benefit me but not you, us but not them, or our short-term welfare at the expense of the long view. If we want evolution to result in benign outcomes, we must consciously work at it. We must define our targets of selection, orient variation around the targets, and identify and replicate better practices with context-sensitivity in mind.

This is what it means to consciously evolve our futures. It is what Teilhard had in mind and is the stated goal of spiritual evolutionary thinkers. Since it is fully in accord with modern evolutionary science, there is every reason for academic evolutionary scientists to join the effort. Those who have so far are small in number but provide a solid proof of concept. My own efforts include the formation of the Evolution Institute[9] in 2009 and its spinoff organization Prosocial World[10] in 2020, whose mission is: "To consciously evolve a world that is better for all".

While academic evolutionary scientists are late to the party of consciously evolving our future, the tools that they provide are immensely valuable and go beyond the broad visioning of Teilhard and other spiritual evolutionary thinkers. In particular, MLS theory makes clear that at every social scale and every moment in history—past, present, and future—prosocial behaviors compete against disruptively self-serving behaviors and must be protected by the equivalent of the compulsory dimension of moral systems.

The phenomenon of cancer provides an illustration of this general point (Aktipis, 2020). Multicellular organisms are symphonies of cooperation among trillions of cells that evolved by organism-level selection over hundreds of millions of years. They are the gold standard to which societal superorganisms are compared. Nevertheless, even multicellular organisms are not entirely cooperative. They are vulnerable to cancers, which are the products of selection among cells within multicellular organisms. Blind evolution has no foresight; it is simply what happens as a consequence of differences in survival and reproduction. A mutant cell that proliferates at the expense of normal

cells is therefore adaptive by this criterion. Never mind that it might ultimately bring about its own demise with the death of the whole organism.

The reason that cancers are rare and appear relatively late in the lifetime of an individual is thanks to an arsenal of anti-cancer mechanisms that evolved by organism-level selection. We are only beginning to understand the sophistication of these cellular social control mechanisms, which were required for multicellularity to evolve as a level of functional organization in the first place. One practical implication is that long-lived species such as whales and elephants might have evolved more effective cancer control mechanisms than short-lived organisms such as mice. Cancer researchers never thought to study cancer suppression mechanisms in long-lived species as a source of anti-cancer therapies in humans until they started to think about cancer from an evolutionary perspective.

Cancer researchers refer to cancer cells as cheaters. This is more than a poetic metaphor. Once we see multicellular organisms as highly cooperative societies of cells, then cancer cells really are cheaters in the same sense that we call a self-serving individual a cheater in a human social group. In both cases, agents are succeeding at the scale of within-society selection in a way that is disruptive at the society level. And the potential for cheating must be suppressed for the prosocial agents to win the Darwinian contest. Cancer suppression mechanisms in multicellular organisms and the compulsory component of human moral systems are functionally equivalent to each other.

Now let's turn our attention to small face-to-face social groups in human life. This was the only scale of society for our distant ancestors and remains an essential scale in modern times: Our families, neighborhoods, schools, churches, businesses, nonprofits, sports teams, and voluntary activities of all sorts. You might think that genetic evolution has equipped us with the instincts to cooperate effortlessly at this scale, but common experience tells us that this is not the case. No matter what kind of small group we focus upon, they invariably vary in how well they function as cooperative units, from the best to the worst. Some perform spectacularly without needing to be coached, others experience total meltdowns, and most muddle along somewhere in between.

The political scientist Elinor Ostrom made a formal study of groups that attempt to manage common-pool resources such as forests, pastures, fisheries, and the ground water (Ostrom, 1990, 2010a, 2010b). Cheating in the context of this kind of group includes taking more than one's share, leading to the famous "Tragedy of the Commons" (Hardin, 1968). Ostrom showed that groups varied in their ability to self-manage their resources, depending upon their implementation of eight core design principles shown in Figure 2, and was awarded the Nobel Prize in economics in 2009 for this achievement.

Briefly, the groups that performed best as cooperative units had a strong sense of identity and purpose; what the group was about, that they were a member, and the rights of their membership (CDP1). What members got from the group was proportionate to what they gave; it was not the case that some members disproportionately benefitted while others did most of the work (CDP2). Decision-making was inclusive; it was not the case that some members got to call the shots and others had no voice (CDP3). Agreed-upon behaviors were monitored (CDP4) and there was a response to norm violations that started out gentle and friendly but escalated as needed (CDP5). Conflict resolution mechanisms existed that were fast and regarded as fair by all parties (CDP6). The groups had the authority to manage their own affairs (CDP7) and engaged in appropriate relations with other groups (CDP8) that reflected the same CDPs. In other words, the CDPs are *scale-independent*; as useful for structuring between-group interactions as within-group interactions, a point to which I will return below.

I was privileged to collaborate with Ostrom and her associate Michael Cox to generalize her CDP approach from a MLS perspective (Wilson et al., 2013). Groups that strongly implement the CDPs are well protected against disruptive self-serving behaviors. In evolutionary terms, they accomplish a miniature MET for the group. In moral terms, the compulsory dimension is strong, making it safe to express the voluntary dimension. Not only do groups that strongly implement the CDPs perform

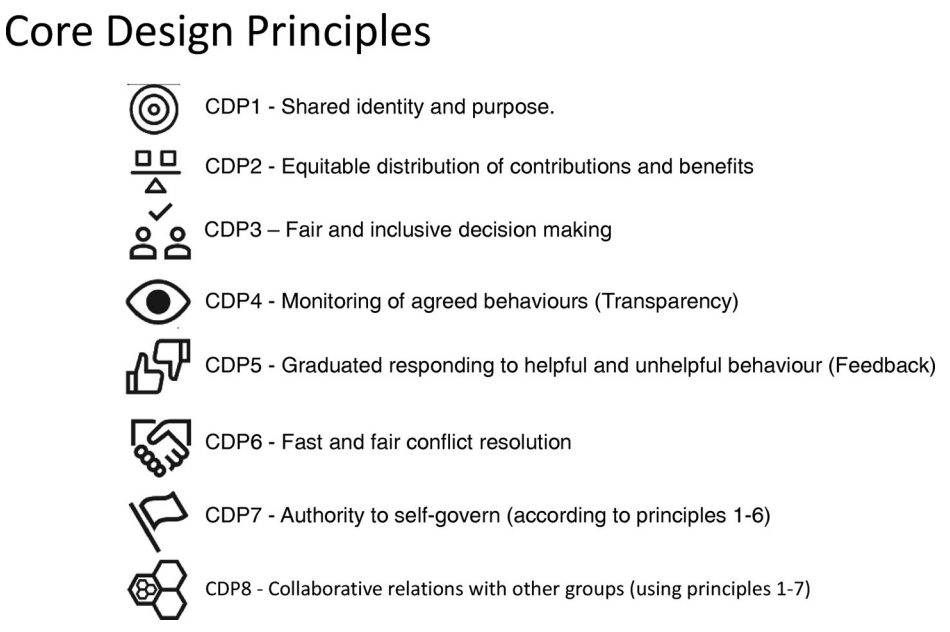

Figure 2. Eight core design principles for the efficacy of groups derived by Elinor Ostrom for common-pool resource groups. The wording has been generalized to apply to all types of groups by Atkins et al. (2019).

well, but members often feel "like family", freely behaving for the good of their groups because they know that their efforts are unlikely to be exploited.

What I have covered at the scale of small face-to-face groups reveals that consciously evolving our future must take place simultaneously at all scales, not just the largest scale of global governance. Just as multi-cellular organisms are composed of trillions of cells, large-scale human society must have a cellular structure. The cells are not individuals but small functionally organized groups. These groups much be appropriately structured, which itself must be a conscious process, since it doesn't just happen by itself. Then the cells must be organized into higher-level units and systems of functional organization to create the societal equivalent of an anatomy, physiology, and nervous system. None of this will happen by itself. We must be the conscious agents of selection and the global superorganism must be our explicit target of selection. Otherwise, cultural evolution will still take place at lower scales but will be cancerous at the scale of the whole earth. In the vocabulary of Teilhard, refined by modern evolutionary science, acting as agents of cultural evolution for the global common good is what it means for the process of evolution to become fully conscious of itself.

On the need for evolution per se and not just science in general. My 2019 book *This View of Life: Completing the Darwinian Revolution* concludes with the following passage (p. 218):

> I doubt that anyone, upon serious reflection, can deny the need for scientific understanding to solve the problems of our age. Yet, the attitudes of so many people about science are detached from their attitudes about evolution. A religious believer can be a science-friendly creationist. A politician can be a staunch supporter of science who doesn't dare utter the E-word. Social scientists and humanist scholars can assume that their particular disciplines are consistent with evolutionary theory, even though it was absent from their own education.
>
> One contribution of this book, I hope, is to reveal the problem with this detachment. For all aspects of humanity, to be a scientist requires being an evolutionist. Scientists who ignore evolution run the risk of creating stockpiles of information with no interpretive framework; of asking only some of Tinbergen's four questions; or of employing interpretive frameworks that are not, in fact, consistent with evolutionary theory. Until science and evolution become more closely wedded to each other in the minds of scientists and laypeople alike, the Darwinian revolution will not be complete.

The importance of an evolutionary worldview per se—not just a scientific worldview—is palpable in the writing of Teilhard and was noted by Julian Huxley in his introduction to *The Phenomenon of Man* when he wrote about the "absolute necessity of adopting an evolutionary point of view." It was noted by Carter Phipps in his book *Evolutionaries* when he wrote, "It is not hyperbole to say that how we think about evolution profoundly affects how we think about life, the universe, and everything".

It is somewhat discouraging that as we pass the 1/5th mark of the twenty-first century, this all-embracing conception of evolution is still confined to a tiny fraction of people. This is due very largely to the fact that the academic study of evolution became restricted to the study of genetic evolution and only recently has broadened to include all processes that include the ingredients of variation, selection, and replication. I predict that once academic evolutionary scientists join forces with evolutionary spiritual thinkers, there will be an explosive increase in the acceptance of evolution and its use to consciously evolve a world that works for all. Teilhard will be acknowledged as one of the giants upon whose shoulders we are standing.

Notes

1. https://en.wikipedia.org/wiki/Evolution_and_the_Catholic_Church.
2. Teilhard also thought deeply about concepts such as complexity and consciousness, but in a way that was thoroughly integrated with his development of evolutionary theory.
3. A closer look at rates of genetic and cultural evolution reveals that they both vary and that their distributions overlap with each other. Genetic evolution is often very slow but it can also take place in a single generation. The idea that genetic evolution takes place at ecological time scales has become an important finding of modern evolutionary ecologists. And while cultural evolution is often very fast, it can require centuries and millennia. Most important, rates of cultural evolution are themselves subject to cultural evolution. Modern rates are almost unimaginably faster than earlier centuries, where every generation was much like the one that preceded it. The idea that rates of cultural evolution can be catalyzed, similar to the catalysis of chemical reactions, is an important possibility to keep in mind while evolving the noösphere.
4. A special issue of Prosocial World's online magazine This View of Life is devoted to the question "Can Evolution Be Conscious?"
5. Whiten (2021).
6. See also the Wikipedia entry on pellagra: https://en.wikipedia.org/wiki/Pellagra#History.
7. Gleick aptly recounts how computer simulation modelers had to struggle against the hubris of formal mathematical modelers in their study of complex systems dynamics.
8. https://us02web.zoom.us/j/5095088454.
9. http://evolution-institute.org.
10. www.prosocial.world.

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COMMENTARIES

Conscious evolution of the noösphere: hubris or necessity?

Terrence W. Deacon

Department of Anthropology, University of California, Berkeley, CA, USA

In his target article David Sloan Wilson reframes the evolutionary thought of Pierre Tielhard de Chardin in terms of the current advances in evolutionary theory. He argues that recent advances in evolutionary thinking are vindicating much of Tielhard's grand evolutionary vision. This is a challenging task because it requires an effort to both bring the reader up to date with our now greatly extended understanding of the complexity of evolutionary processes and also requires recontextualizing some of Tielhard's long-rejected evolutionary speculations.

Tielhard's approach to evolution was not focused on the process of natural selection or other mechanisms driving evolutionary change, but rather on the level of the whole of the evolution of life. From this macro-evolutionary perspective the history of life appears unambiguously directional. For the first two billion years of life on earth all organisms were probably not much more complex than the bacteria alive today. Only in the last billion years or so have complex cells evolved. And only in the last half a billion years have complex multicellular organisms begun to spread throughout the sea and land.

Viewed from this cosmic perspective it is obvious that there is an evolutionary trend from small and simple to large and complex. But only within the past few decades has it become clear that a strict reliance on classic neodarwinian theory is insufficient to explain this regular increase in complexity. Even today, alternative competing theories are offered to explain how these major hierarchic transitions in complexity emerged, and a full explanation may still be decades away. Nonetheless, as the target article amply demonstrates, current advances in evolutionary theory are beginning to rehabilitate some of these macroevolutionary speculations, providing new support for an intrinsic directionality to evolution.

By the late 1990s these debates converged with the recognition that selection could operate at many levels at once: multilevel selection. It became apparent that major hierarchic evolutionary transitions, producing higher order units of selection, resulted from the evolution of stable cooperative relationships between once autonomous lower order organisms nested within each other like Russian dolls within Russian dolls. But this implied that similar evolutionary principles might apply at higher levels as well, including human social and technological evolution. This is where Tielhard's vision may have been prophetic.

Central to Tielhard's vision is the idea that humans are fundamentally unique among species in the ways they are able to communicate and share their thoughts. Although communication between organisms is the rule—from bacteria to chimpanzees—human communication is unusual. Rather than being directly linked to its context by similarity (icons) as in the aposematic coloration of poisonous butterfly wings or by immediacy (indexicality) as in a cry of pain, human language refers symbolically (in which the sign vehicle such as a word is only linked to what it is about by shared social convention). This "displacement" from its reference has freed up communication and thought from the limits of concrete association.

Paradoxically, this ungrounding from pragmatic context has made it possible to share what no other animal can: one's thoughts, memories, intentions, and experiences. But precisely because

CONTACT Terrence W. Deacon deacon@berkeley.edu

symbolic communication is ungrounded it is also entirely dependent on shared interpretive habits. We humans have access to this unprecedented social and mental tool because we are born into a social group that shares the same symbolic habits. Symbolic communication in the form of language is the glue that coordinates and maintains social cooperation, but it is only available to those who are embedded in a cohesive social group large enough to have developed and preserved these capacities. As a result, human nature has evolved mental adaptations to both more easily acquire this unusual capacity and to maintain the social cohesion that is essential for transmitting its content. In this sense, humans are like obligate endosymbionts that cannot flourish outside this larger social organism. We might therefore describe ourselves as a symbolically eusocial species. Although unlike the eusocial ants or termites, we are capable of reproducing outside of this super-organism, we are incapable of normal human thought if not reared within a symbolically-integrated social group.

In this regard, Tielhard's concept of a noösphere can be seen as a natural extension of this essential defining feature of human symbolic nature. My thoughts are not entirely my own, and are (in this present context) inextricable from thoughts once expressed by this visionary Jesuit priest turned evolutionist. But this irreversible interpenetration of our mental worlds and the inextricable codependence it requires are now being rapidly exponentially modified by electronic media and computational prostheses. Today's noösphere involves vast millions of minds spread throughout the planet sharing their thoughts in fractions of a second. As a result, we have become ever more deeply dependent on and manipulable by these extensions of the now global noösphere. Extrapolating this trend do we envision a future hive mind or an egalitarian paradise?

This leads to the practical message of the target article: How might these insights from evolutionary theory contribute to the realization of a more cooperative and universally shared mental unity of humankind? Can we glean some critical insights from examples of cooperative hierarchic transitions in evolution that might aid in an analogous human transition? Citing converging research on the structure of cooperative higher order units in biological evolution and highly successful cooperative human groups, Wilson offers a recipe for guiding this potential transition. This highlights a key element of Tielhard's vision that is a core motivation behind this target article: the concept of "conscious evolution." In other words, unlike every other major hierarchic transition in the history of life, can we humans learn from past major transitions and use this knowledge to guide the development of a global human noösphere?

I am wary, however, of the way this might blur the distinction between design processes and living processes. Designed artifacts are assembled from parts in a configuration that will hopefully function as predicted when completed. Often this requires extensive trial and error and entails innumerable unintended consequences that may not show up until too late to correct. Living organisms, in contrast, are holistically integrated. Their component structures are not assembled, but differentiate from previously less differentiated antecedents. And they must function incessantly as they differentiate and adapt to their immediate environments. It is this inverse logic that gives me pause.

Though natural selection is often caricatured by Herbert Spencer's phrase "survival of the fittest," and was compared to selective breeding by Darwin, both analogies are deeply flawed and misleadingly confuse evolution with design. Organisms adapt holistically, not with respect to isolated traits, but with respect to how the synergy of their functional organization "fits" with their local context. "Selecting" particular desired biological traits is, of course possible, as domestication amply demonstrates, but the results are seldom as robust as in the wild and are sustainable only with extensive artificial supports.

So conscious evolution, if understood in design terms, is an oxymoron. And a potentially dangerous one at that. The question is not how we can use insights from evolution to design a beneficent human superorganism, but rather how we can use our knowledge of the evolutionary

process to prevent the spontaneous evolution of a superorganism that we would not want to be part of.

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Pierre Teilhard de Chardin's enduring relevance

Celia Deane-Drummond[a,b]

[a]Laudato Si' Research Institute, Oxford, UK; [b]Department of Theology, University of Oxford, Oxford, UK

If Pierre Teilhard de Chardin were alive today he would be delighted to see that contemporary scientists are now beginning to recognize the full scope and prophetic vision of his thought. I cannot possibly do justice to all the rich insights on evolutionary theory in relation to Teilhard's thought that David Sloan Wilson elaborates in his target article. I will comment briefly on aspects of his interpretation of Teilhard's works, rather than attempt to engage with its worthiness or otherwise in terms of evolutionary knowledge. Wilson is right to acknowledge the import of Teilhard's prophetic insights for evolutionary science today. I will argue that it was the integration of science and faith that freed Teilhard from the boundaries of each, allowing him to imagine alternatives not conceivable by either his scientific or ecclesiastical peers.

Teilhard's broad assembly of reflections was never intended to be a well worked out systematic theology, but arose as a result of a tortuous personal journey to bridge his scientific fascination with the evolution of life and his strong and committed faith in God. He wanted to reach both those who believed only in earth and those who believed only in heaven (Teilhard de Chardin, 1934). He believed that one of the greatest challenges facing humanity in the Western world was finding a way to reconcile the twin truths of science and God. To claim, as Wilson does, that Teilhard is an evolutionary naturalist is correct as far as his engagement of the evolutionary science is concerned. Yet it would be a mistake to think this evolutionary naturalism was sufficient for him as a total explanatory system. As one commentator on Teilhard has aptly claimed,

> the key to his evolutionary system is the postulate of a centre of convergence for the cosmic process, a centre which must indeed be divine and transcendent if the process itself is not eventually to end in total death and therefore in absurdity. (Mooney, 1968, p. 14).

The Phenomenon of Man (or as a more recent translator has expressed it, *The Human Phenomenon*, 1999) cannot be properly understood without first reading *Le Milieu Divin* (1964).

"Milieu" means in the original French not just an environment, but the center and source. Teilhard sought therefore to reconcile both his passion for the cosmos and God, while giving full weight to both, joining the illumination of cosmic evolution with that of Christic faith. Teilhard perceived reality as a natural scientist and as a mystic simultaneously, but it was primarily his curiosity in the former realm that shaped the latter, and that, as Wilson points out, led to friction with religious authorities who failed to understand his quest. Perhaps it is worth noting that Pope Francis, who also originally trained as a chemist, was the first Pope to cite Teilhard de Chardin in an official Roman Catholic encyclical, appearing in *Laudato Si'*, dedicated to consideration of care for our common home (Pope Francis, 2015 §83). His synthetic approach, in common with his fellow Jesuit Pope Francis, may be one reason why Teilhard still appeals to those who have been influenced by contemporary science. Teilhard's writing style was passionate with personal witness statements testifying to his practical activities as both a scientist and Jesuit priest that then allowed him eventually to reconcile these two realms. This discovered reconciliation, coming after years of searching, gave a particularly dynamic energy to his thinking. It is one reason why he is still known and read among the general public today.

CONTACT Celia Deane-Drummond celia.deane-drummond@campion.ox.ac.uk

Wilson is quite correct that he avoided crude accounts of evolution that portray God as an interventionist divine spark initiating the key transitions in the earth and life's evolutionary unfolding, including human evolution, the area that is most sensitive for the Catholic church. He resisted blurring all differences, but saw, as Wilson notes, major evolutionary transitions. Thus, moving from animal to human, "is not a matter of change of degree, but change of nature, resulting from a change of state" (Teilhard de Chardin, 1964, p. 43). However, it is worth qualifying any evolutionary naturalistic view by pointing out that he remained personally unconvinced that evolutionary science alone was sufficient as an explanatory framework for the whole process. It was the synthesis of both a natural term and "supernatural term (plenitude of Christ)" that "causes the universe to grow" (Teilhard de Chardin, 1978, p. 202). But it was because he understood Christ as hierarchically ordered in relation to the natural world, and indeed as a magnification of it, that he could claim that "Spirit continues to produce itself in its natural substance at the same time as God elevates it to the supernatural order" (Teilhard de Chardin, 1978, p. 203). The natural and supernatural were for him, "conjoined ends" (Teilhard de Chardin, 1978, p. 204). Human evolution for him was consistent with his law of complexity-consciousness that allowed him to develop a progressive vision of the future, articulating the place of humanity arising at the apex of cosmic consciousness. Wilson is correct to flag the way Teilhard opens the door to a shift away from individualism to what is now recognized as collective brain. Some might even say that he anticipated the internet.

For Teilhard any language of "ultimate causation" in an evolutionary sense would need to be set alongside recognition of the spiritual, or as he preferred to call it, the "love energy" in the universe. In one of his wartime journals he writes, "Sometime I should gather all of my ideas together in a synthesis built around the foundation of everything: love" (Teilhard de Chardin, 1975, p. 186). He never wrote that synthesis. Yet there remain questions about his overall optimistic and progressive vision. While it was his position on the origins of evil that was decisive in the rejection of his views by the Catholic church, he remained bound by the idea of cosmic progressive change towards the good. Wilson recognizes that the early modern synthesis portrayed the darker side of human evolution at the expense of recognizing its remarkable capacity for generating cooperation. Teilhardian thinking brings a more hopeful tune to current ecological concerns (Deane-Drummond, 2006) and prospects for future human evolution, but the threats of fragmentation, division, and breakdown also need to be recognized as potential barriers to that progress.

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Teilhard's scientific holism: a reply to David Sloan Wilson

Ilia Delio

Department of Theology and Religious Studies, Villanova University, Villanova, USA

Introduction

David Sloan Wilson has made a significant contribution to Teilhard Studies by evaluating Teilhard's scientific ideas in view of a modern evolutionary perspective. Wilson's study is invaluable for supporting the integrity of Teilhard's science and the way he integrated his ideas with religion and culture. Professor Wilson indicates that Teilhard anticipated developments in evolutionary biology not realized until the latter half of the twentieth century. As a Jesuit priest and deeply spiritual man, Teilhard's writings reflect his deep commitment to scientific research; yet it was precisely the realm of scientific research that opened for him a new window on religion and evolution. Professor Wilson points out that Teilhard's ideas are compatible with naturalism, although Teilhard rejected materialism and reductionism. I would suggest that Teilhard follows the basic tenets of panpsychism primarily because, for him, consciousness plays a fundamental role in evolution (for a good understanding of panpsychism, see Goff 2017). My remarks here will focus on Teilhard's holistic, panpsychic paradigm and show how his ideas on evolution, religion, and culture are integrally bound in the development of life toward greater complexity and consciousness.

Pierre Teilhard was a Catholic priest but foremost a scientist who sought a comprehensive understanding of human nature, both interior and exterior dimensions, as a "fact in nature falling … within the requirements and methods of science" (de Chardin, 1999, 6). Profoundly misunderstood and labeled by some critics as a charlatan, he claimed that the real path to knowledge must begin with concrete reality, not abstract ideas. He composed his opus, *The Human Phenomenon,* not as a work of metaphysics, still less as a theological essay, but simply as a scientific treatise (de Chardin, 1959, p. 29). Yet, anyone familiar with modern science would find his talk of an imperceptible psychic "within" of matter or spiritual energy or a teleologically directed evolution as scientifically suspect. Teilhard was well aware of such suspicions; he encountered them and wrestled with them all his life long. Elizabeth Sewell noted in her book, *The Human Metaphor*, that Teilhard's greatest contribution may be methodological (Sewell, 1964, p. 26). What Teilhard contributes is a renewed scientific methodology that connects cosmos with *logos,* science with *eros,* and matter with *mens*, in a way that impacts the whole social order and the course of evolution. The ambivalent reception of Teilhard's writings in the theological world, and the marginalization of his ideas in the scientific world, render Professor Wilson's paper an advance for both science and religion. Wilson states, "if Teilhard's view of evolution is scientifically legitimate, then it can be a breakthrough in how evolution is presented" (p. 3). He provides an excellent summary of Teilhard's scientific contributions and states:

(1) ideas are compatible with naturalism
(2) emphasizes cultural evolution
(3) posits a thinking dimension to evolution
(4) society is an organism advancing to superorganism

CONTACT Ilia Delio idelio1334@gmail.com

(5) causation is top-down, bottom-up
(6) views the role of technology in evolution as a global process
(7) considers the sanctity of the individual within the superorganism
(8) evolution is a meaning system
(9) humans are symbolic species
(10) humans are consciously evolving the future

I would add to this list that Teilhard emphasizes an integral relationship between religion and evolution, which I will discuss further on.

Teilhard's paradigm

Paleontologist Daryl Doming notes that Teilhard received his scientific training in France just after the turn of the twentieth century, when Gregor Mendel's discoveries in genetics had just been rediscovered, and at a time when Darwin's view of the importance of natural selection had reached a low ebb of acceptance among scientists. It wasn't until the 1930s and '40s that genetics had been fully digested by biology and put together with many other lines of evidence to form what we call the Neo-Darwinian Synthesis, in which selection has regained its rightful prominence, and which remains our dominant paradigm in biology today. By the '30s and '40s, Teilhard's theological vision had already crystallized, and it reflected French biology in general, which inclined toward French evolutionary ideas like "Neo-Lamarckism" and the vitalistic philosophy of Henri Bergson but had little use for British notions like Darwin's natural selection (Doming, 2015). As a result, Teilhard did not consider Darwin's notion of natural selection as significant to the overall process of evolution. Rather, he saw evolution as a persistent development toward thought and opted for Bergson's dynamic impulse of creative evolution.

Teilhard wrote his magnum opus, *The Human Phenomenon,* at a time of war, "from a sense of organic crisis in evolution, to free humanity from fear and despair so as to give new hope and heart for life" (Appleton-Weber, 1999, p. xxi.). This work frames his comprehensive vision of science and religion. The purpose of *The Human Phenomenon* is to introduce the reader to the "epic and drama of space–time" (Appleton-Weber, 1999, p. xxi). Evolution is more than an explanation for biological diversity, according to Teilhard; it is an open process of increasing complexity and consciousness on every level of biological life. In *The Human Phenomenon* he wrote:

> They truly are blind who do not see the scope of a movement whose orbit, infinitely transcending that of the natural sciences, has successively overtaken and invaded the surrounding fields of chemistry, physics, sociology, and even mathematics and history of religions. Drawn along together by a single fundamental current, one after the other all the domains of human knowledge have set off toward the study of some kind of development. Is evolution a theory, a system, or a hypothesis? It is much more: it is a general condition to which all theories, all hypotheses, all systems must submit to and satisfy from now on in order to be conceivable and true (de Chardin, 1959, p. 219).

In the revised edition of Teilhard's *The Human Phenomenon*, Sarah Appleton-Weber, who translated the text, provides some very helpful insights that help situate his work. She writes that the title of the 1959 translation, *The Phenomenon of Man,* is incorrect because Teilhard's subject is not the "phenomenon of man" as one among other species, but the ever-evolving human phenomenon, as it is developing in and around us at this very moment. The human phenomenon is a unique biological, collective, and global phenomenon, whose past, present, and future is intimately bound up with the formation, life, and ultimate transformation of the earth. How Teilhard positions the human in the overall scheme of cosmic life is significant. From a certain limited perspective of science, the human being appears to be an object of study only in the body—a trivial thing in nature, and nature itself appears to be a fragment. The human is seen as analogous to a "bee" or a "rose." But once the whole of the human is integrated—the "inside" as well as the "outside"—into a coherent representation of the world, the human comes to be seen as the very axis and arrow indicating

the direction of evolution itself. If we are to see ourselves completely and survive, it must be as part of humanity, with humanity as part of life, and life as part of the universe (de Chardin 1999, p. 5).

A holographic method

Teilhard's new paradigm emerges from his original methodology. His ideas formed from his work as a paleontologist, and the genius of his scientific work was based on his observations of fossils in nature. He does not ask the causal question, "how did we get here?" Rather, he begins with the present human experience of thought. If the human is a fragment of the whole (comparable to a fossil), what is the whole of human existence? The key to Teilhard's method of cosmic evolution lies in the power of vision. He identifies his work, *The Human Phenomenon,* as a scientific treatise and states in the prologue that true scientific understanding depends—not on the power of observation per se—but on the power of vision. Teilhard's *Human Phenomenon* is, in a sense, a "science of science," an attempt to see how it is that sight is possible at all. In this respect, he challenges scientific materialism by introducing a metaphysics compatible with evolution. Teilhard thought that as matter complexifies, consciousness and spirit rise toward thought, and he posited a "metaphysics of union" in which the totality of existence rests on the future (de Chardin, 1971a, p. 178).

Understanding Teilhard's move toward scientific holism with its metaphysical claim requires tracing his method of study. He indicates that the more we cleave and pulverize matter, the more we can see its fundamental unity. He writes, "there are no isolated things in the world. There are only elements of a whole in process" (de Chardin, 1999, p. xix). The magnitude of the human phenomenon, therefore, begins on the level of matter's first forming of the planet earth, encompassing the human future within its globe and motion. Tracing the composite human back to its source in the stuff of the universe, Teilhard identifies the three major pillars of life as matter, energy, and plurality, that is, he positions the human phenomenon within the unfolding of space–time. He begins the work with the stuff of the universe: "Moving an object back into the past is equivalent to reducing it to its simplest elements; followed as far as possible in the direction of their origins, the last fibers of the human composite are going to merge in our sight with the very stuff of the universe" (de Chardin, 1999, p. 11). By tracing the human back to its origin in the universe, Teilhard finds a collective, the *totum* or whole, which influences the bottom-up activity. This wholeness is centered in a principle he identifies as Omega. Omega is both a principle of evolution and the personal center of God. Omega is fully organic, independent of time and space, and escapes the collapse of forces with which evolution is woven; it is autonomous, actual, irreversible, and transcendent. Omega undergirds the psychic, convergent universe, with its openness to more life.

It is not entirely clear how Omega functions as an organizer of evolution, but Teilhard is clear that development is a "top-down, bottom-up" process which, according to Professor Wilson, is only now taking shape in modern biology. For decades, Wilson states, biologists failed to distinguish between proximate ("from below"/upward) and ultimate ("from above"/downward) causation. Today, he writes, "multilevel selection is recognized as a legitimate accounting method for evolutionary change," both on the biological level as well as the cultural level of evolution. Teilhard emphasizes the collective reality in the opening chapter of *The Human Phenomenon,* where he states, a collective reality is more than the sum of its parts. Appleton-Weber writes, "it [the whole] has a mysterious unity and active power in itself—a birth, unfolding, and a passing. Humanity belongs to this category" (Appleton-Weber, 1999, p. xix). Hence, the human is part of a whole, an insight reminiscent of Einstein's famous passage:

> A human being is a spatially and temporally limited piece of the whole, what we call the "Universe." He experiences himself and his feelings as separate from the rest, an optical illusion of his consciousness. The quest for liberation from this bondage [or illusion] is the only object of true religion. Not nurturing the illusion but only overcoming it gives us the attainable measure of inner peace (Einstein, 1972).

Similarly, many passages in Teilhard's writings express a strong sense of the interdependent unity and organic nature of all living things. He wrote in 1942 that through studying the history of the cosmos and of all forms of life,

> we have gradually come to understand that no elemental thread in the Universe is wholly independent in its growth of its neighboring threads. Each forms part of a sheaf; and the sheaf in turn represents a higher order of thread in a still larger sheaf—and so on indefinitely … This is the organic whole of which today we find ourselves to be a part, without being able to escape from it … in countless subtle ways, the concept of Evolution has been weaving its web around us. We believed that we did not change; but now … we are becoming aware of the world in which neo-Time, organizing and conferring a dynamic upon Space, is endowing the totality of our knowledge and beliefs with a new structure and a new direction (de Chardin, 2004, pp. 74–89).

Teilhard's method is like a hologram in movement and requires a capacity to see whole-parts: vision is a level of integrated consciousness, beyond the analytical capacity to examine and rationalize. By "vision" Teilhard means something more than mere physical sight. The inner eye must see what the physical eye observes, so that vision expresses inner depth, that is, the integration of mind and senses in the perception of that to which one relates. He writes: "To see is to develop a homogenous and coherent perspective of our general experience as it extends to the human being; that is, to see a whole that unfolds" (de Chardin, 1999, p. 6). His objective is to see and to make others see. To see is not only to know, it is to unite: "One can say that the whole of life lies in seeing—if not ultimate, at least essentially … unity grows … only if it is supported by an increase of consciousness, of vision" (de Chardin, 1999, p. 3). He goes on to say "if we lack these qualities of sight, no matter what anyone does to show us, the human being will indefinitely remain for us … an erratic object in a disconnected world" (de Chardin, 1999, p. 5). Teilhard's holistic vision distinguishes the knowing process as an act of engagement. Those who see "have the sense of the world as a unified whole in movement. Those who do not see, do not see beyond the multiple. They perceive the world as fragmented and ultimately absurd" (quoted in Appleton-Weber, 1999, p. xix).

The kinematic method of development

The whole-parts relationship is the interpretative key to Teilhard's human phenomenon, and he challenges science to see from a different perspective the whole inner and outer dimensions of this phenomenon. In his view, the relationship of parts to the whole is the ultimate problem to be solved by science, and he seeks to contribute to this relationship in the narrative of *The Human Phenomenon*. Scientific research and invention, he claimed, are indispensable for explaining the movements of life through the unfolding of space–time. As Appleton-Weber explains: "In each of the four parts, first the element is presented, then the whole of which it is a part, and then the whole is set within its context of the global evolution of the earth" (Appleton-Weber, 1999, p. xix). Teilhard's method is based on development, and he identifies his method as "kinematic," a technique used by paleontologists of his time to represent the development of vertebrate and human forms based on fossil evidence over very long periods of evolution. Teilhard writes that "distant or slow movements of evolution, their beginnings erased by the passage of time and at this moment imperceptible directly to ordinary experience, are represented through a visual sequence of forms speeded up by something akin to time-lapse photography" (quoted in Appleton-Weber, 1999, p. xxix). One can compare this method to non-linear dynamics of chaos systems, in which rhythmic periodicity gives rise to fractals over time. What is significant about Teilhard's method is that space–time and duration are integral to the processes of development.

Teilhard looks for structural patterns throughout the development of life by which he can understand the construction of the universe and the properties of thought that distinguish the human. He tells us at the end of the prologue of *The Human Phenomenon* that he particularly chose the expression "human phenomenon" to affirm that "the human" is authentically a fact in nature, falling (at least partly) within the province of the requirements and methods of science. He writes: "To see is to develop a homogenous and coherent perspective of our general experience as it extends to the human being; that is, to see a whole that unfolds" (de Chardin, 1999, p. 6). Teilhard's subject is the ever-evolving human phenomenon, as it is developing in and around us at this very moment, a unique biological, collective and global phenomenon, whose past, present, and future is intimately bound up with the formation, life, and ultimate transformation of the earth. He is not, *pace* his

critics, anthropocentric; rather the term "human" is key to understanding the whole of cosmic and biological life and its future. The human is not "the static center of the world … but the axis and arrow of evolution," which Teilhard adds, "is much more beautiful" than being a mere center (de Chardin, 1999, p. 7). The human person is "evolution become conscious of itself." To this idea he adds, "the consciousness of each of us is evolution looking at itself and reflecting upon itself" (de Chardin, 1959, p. 221). Thus the human person emerges from the evolutionary process and is integral to evolution. She/he is "the point of emergence in nature, at which this deep cosmic evolution culminates and declares itself" (de Chardin, 1971b, p. 23). Teilhard sees the human phenomenon as the cosmic phenomenon: "We discover we are not an element lost in the cosmic solitudes but that within us a universal will to live converges and is hominized" (de Chardin, 1959, p. 36).

Withinness–withoutness

The emergence of consciousness, according to Teilhard, is integral to physical evolution. He referred to this infinite depth dimension as the "withinness" of matter, a psychic quality or dimension of radial energy that escapes scientific measurement. Matter's withinness is complemented by a "withoutness," the agglutinative property of matter which causes matter to aggregate, what Teilhard called tangential energy. These two dimensions of the material world reflect an evolutionary process of interiorization and subjectivity, which begins on the simplest levels of life and develops into complex organisms and species on higher levels, culminating in the complex, conscious human species. "There is only one real evolution," he wrote, "the evolution of convergence, because it alone is positive and creative" (de Chardin, 1971a, p. 87).

Science has been too narrow in its models and concepts, limited by material reductionism, Professor Wilson writes: "Modern biology centered squarely on Mendelian genetics and random variation left no room for anything that could be regarded as purposeful evolution." By ignoring the place of mind in nature, science has stifled our understanding of the whole, just as religion has stifled the whole by separating divinity and materiality, emphasizing supernaturalism over naturalism. Since humans are thinking creatures, evolution gives rise to thought or, in Teilhard's words, "we are nothing else than evolution become conscious of itself" (de Chardin, 1999, p. 154). Following the complex patterns of matter and energy, he notes that mind is integral to matter, and consciousness increases with complexity. He posits a fundamental principle of evolution, the law of complexity-consciousness. This principle works as the background for human emergence, as well as the future of human evolution so that the "option for the evolving future of the earth, and her thinking layer (ourselves) lies in our own hands" (quoted in Appleton-Weber, 1999, p. xxvii). Teilhard identifies evolution with the advance toward thought and claims that the very end of thought is to have no end. The evolution of mind is a new layer of thinking or what he calls, "noögenesis" (de Chardin, 1999, p. 123). As evolution proceeds through the layers of phylogenesis, thought increases and gives rise to technology and culture. With the emergence of noögenesis, humankind enters a new age, and a new spirit of the earth is born. The human phenomenon represents a new zone in the universe, independent, yet somehow born of the entire maturation of the earth: "Humanity is the earth hominized" (Appleton-Weber, 1999, p. xviii).

In a postscript written to *The Human Phenomenon* eight years after its completion, Teilhard describes the social phase of human evolution as the rise toward a collective step of reflection, a second stage of hominization, whose final success is by no means certain, although this process has certain irreversible features. He wondered how we can fail to see in this revealing association of technical arrangement and psychic centration that it is forever the same great force at work (although in a proportion and depth never attained before)—the very force that made us (de Chardin, 1999, pp. 219–220). Just as the fibers of the human are extended back to where they merge in our sight with the stuff of the universe, so the boundaries of science, although they have been too narrow to include the totality of the human, are now widened ahead to embrace thought on a planetary scale, in a "mega-synthesis," empowered by the Omega principle.

Religion and evolution

Teilhard's scientific methodology enabled him to see a new relationship between science and religion in view of evolution. Aware of the tension and seeming conflict between these two disciplines, he indicated that the only way forward for the good of the earth is a new synthesis. He wisely stated:

> After almost two centuries of passionate struggle, neither science nor faith has managed to diminish the other; quite the contrary, it becomes clear that they cannot develop normally without each other, for the simple reason that they are both animated by the same life. In fact, science cannot reach the full limits of itself either in its impetus or in its constructions without being tinged with mysticism and charged with faith (de Chardin, 1999, 203).

He spoke of science and religion as "the two conjugated faces or phases of one and the same act of complete knowledge—the only one which can embrace the past and future of evolution as to contemplate, measure and fulfill them" (de Chardin, 1999, p. 204). Science and religion are like two lenses of a single pair of eyeglasses; not opposing disciplines, but two ways of knowing the one world. Just as science is the study of cosmic and biological life, so too, religion does not begin on the level of humankind but with the genesis of the universe. He wrote: "Religion, born of the earth's need for the disclosing of a god is related and coextensive with *not the individual man but the whole of humankind*" (de Chardin, 1971a, 119). Ursula King states, "Teilhard is one of the few modern thinkers on religion for whom evolution provided the dominant note of his entire work" (King, 2011, p. 179).

The relationship between cosmos and religion is so fundamental to the earth that in 1916 he wrote:

> Religion and evolution should neither be confused nor divorced. They are destined to form one single continuous organism, in which their respective lives prolong, are dependent on, and complete one another, without being identified or lost … Since it is in our age that the duality has become so markedly apparent, it is for us to effect this synthesis (King, 2011, pp. 179–180).

Religion, therefore, is not strictly a personal matter of salvation or individual belief but is integral to transcendent nature itself. Religion is born of nature's capacity to evolve, meaning that religion is larger than humanity and integral to the future of the earth; it "is biologically (we might almost say mechanically) the necessary counterpart to the release of the earth's spiritual energy" (de Chardin, 1971a, p. 119). Hence, religion is not about individual salvation or lines of escape; rather, religion emerges from the whole and concerns the whole. Religion and evolution, therefore, are interdependent. In Teilhard's view, religion is the energy of cosmic personalization and unification. In his essay "The Spirit of the Earth" (1931), he wrote that the true function of religion is "to sustain and spur on the progress of life" (quoted in King, 2011, p. 186). The religious function increases in the same direction and to the same extent as "hominization," that is, the emergence and growth of religion corresponds to the growth of humankind; the emergence of the human *in nature* brings with him/her the emergence of a divine pole to give one balance, as one is drawn up ahead (de Chardin, 1971b, pp. 43–45).

The emergence of self-conscious life in evolution formed the basis of Teilhard's faith, which he described as "adherence of our intelligence to a general view of the universe" (de Chardin, 1971a, p. 98). "To believe," he said, "is to effect an intellectual synthesis" (de Chardin, 1971a, p. 98). His own religious spirit was deeply connected to his love of the earth. "By upbringing, I am a child of heaven," he wrote, "by temperament and intellect I am a child of the earth" (de Chardin, 2004, p. 261). He was aware that a renewed planet of life will not arise if religion does not undergo a radical transformation of ideas, acquire new metaphors, and tell a new story that can harness the spirit of the earth along the lines of evolution. He devoted himself to developing a new theology of evolution in an effort to renew the vitality of cosmic life. The kind of religion we seek today, he thought, cannot be found in the religious traditions of the past that are linked to static categories. "God has become too small to nourish in us the desire to go on living and to live on a higher

plane" (de Chardin, 1970, p. 240). Teilhard lamented. Science now tells us that the cosmos has become a cosmogenesis, and this fact alone "must lead to the profound modification of the whole structure not only of our thought but of our beliefs" (de Chardin, 2004, p. 261). What is needed, he thought, is a new religion that can utilize all the "free energy" of the earth to build humankind into greater unity.

Teilhard saw that no one religion can satisfy the religious spirit of the earth because religion is directly concerned with the universe and its evolution towards Omega. For Teilhard, any religion which focuses only on individuals and heaven is insufficient, people are looking for a religion of mankind and of the earth which gives meaning to human achievements; a religion that will enkindle cosmic and human evolution and a deep sense of commitment to the earth (King, 1989, p. 109). On the human level, religion is primarily "on the level of consciousness and human action, rather than on the level of institutions or belief systems, except insofar as these systems manifest and give direction to the former" (de Chardin, 1963, pp. 240-242). Hence the experience of divinity and the language in which these experiences are articulated must find new forms of expression.

Although he was a Catholic priest, Teilhard did not see Christianity as normative of religion but normative of evolution, and the direction of evolution toward cosmic personalization, which is the building up of cosmic personhood (the body of Christ) in the universe. The further evolution of humanity toward greater unity, he said, "will never materialize unless we fully develop within ourselves the exceptionally strong unifying powers exerted by inter-human sympathy and religious forces" (King, 2011, p. 193). He suggested that the different religions must come together and find an axis of convergence through respect, dialogue, and encounter, meeting on the level of mysticism and action. Without religious convergence, we are left with "unsatisfied theism." Rather than a religion that focuses only on individuals and heaven, he said, people are looking for a religion of mankind and of the earth that gives meaning to human achievements, a religion that will enkindle cosmic and human evolution and a deep sense of commitment to the earth. The vitality of religion at the core of evolution is essential, he thought, if we are to have a future together.

Towards the future

Reflections on the future of humankind and its further social, cultural, and spiritual development feature prominently in Teilhard's work. He saw humanity moving into a new environment, into a world that is *being born* instead of a world that *is*, with a new relationship between matter and spirit, a new humanism, and a new understanding of God—complementary movements which mark the beginning of a new era for humankind. Ursula King writes that "he expressed with clarity and forcefulness that we are *one* humanity, with *one* origin, and *one* destiny. We are also a group of humans that has not yet reached maturity in terms of its possibilities. Its immense problems somehow resemble the turmoil of youth" (King, 2018, p. 143). Teilhard argued that all of humankind bears a profound sense of responsibility for the shape of its own future, and that humanity's future must be developed in close interrelation with all forms of life, with the whole of nature in its global and planetary dimensions.

We find ourselves today on the threshold of a new age, one that requires entirely new dimensions and values. The primacy of the whole caused Teilhard to ask: How can we be architects of the future? How can we develop a better, higher life for the human community? He reflected on the conditions and criteria by which human beings might become more united—economically, politically, and spiritually. How will the human species evolve further? His book, *The Future of Man*, carries the motto: "The whole future of the Earth, as of religion, seems to me to depend on the awakening of our faith in the future" (King, 2018, p. 144). He combined his faith in the future with what he called faith in the world, that is, a faith in the further development of human beings, and in the greater global collaboration and unity among the peoples of the earth (de Chardin, 1971a, p. 121, 175). He spoke of a new threshold in the development of human consciousness and organization, not simply a search for the continuity of life or mere survival. What is needed is the

development of life to a higher stage, which involves an effort to create a higher form of life, a more unified humanity.

The problem of the future is paramount for the present: Will humanity survive or be annihilated? Will it progress or stagnate? Teilhard thought we have no decisive evidence for either hope or despair, but one thing is certain: we need to find the right road, make the right choices and put our will into effective action to create the right world for humanity today. He was convinced that despair cannot provide the necessary energy for action, but hope can. Humanity now bears full responsibility for its own future; both education and scientific research play a great role in this. It is also an immense challenge; the kind of future we will get depends to a large extent on the quality of people who shape it. Teilhard emphasized the need for a *homo progressivus* (de Chardin, 2004, p. 130), for future-oriented, future-affirming beings with a wide, open awareness who have the energy of thought, the vision and perception to recognize the problems of the future and find their solutions, and who possess the necessary energy and will to action for putting them into practice.

The agglutinative property of thought, enhanced by the development of the internet, now propels evolution at an exponential rate. We are evolving into a super-organism; the thinking layer of evolution, the noösphere, now enhanced by computer technology, has given rise to a global brain—not just a brain but a brain of brains. Science has not paid attention to the impact of cultural evolution but, as Professor Wilson points out, mathematical modeling of complex systems shows otherwise. The social integration of people around the globe into some kind of "super-humanity" presupposes the further self-evolution of the whole human species towards a higher order. Teilhard took it for granted that a basic mutation has already taken place in modern, post-Darwinian, post-Marxian, and post-Freudian consciousness, but he postulated yet another necessary mutation: a greater awareness of humanity's necessary collectivity and the emergence of a higher collective consciousness to form a higher, new collaborative reality, just as the individual brain is something over and above being a collection of innumerable cells.

Conclusion

Teilhard's kinematic method of evolution and holistic paradigm of science and religion, with its attention to the inner and outer dimensions of biological life, impelled him to posit a deep relationship between mysticism and evolution. For him, scientific research is a form of adoration, a spirituality in itself that can enhance human energy. The scientific quest, at its deepest level, is closely related to the deep human longing for union that expresses itself in the scientific, religious, and mystical quest. He never tired of pointing out that our understanding of science is much too narrow, particularistic, and fragmentary. Its power of analysis must now be matched by attempts at synthesis, by a more holistic and global way of thinking. Scientists have analyzed the physical-biological, as well as the mental and psychic, aspects of the human being; now we need new methods of seeing the world as an emergent, complex whole. Teilhard's holistic vision is grounded in both science and faith; both are approached from an all-embracing perspective that is evolutionary, convergent, and universalist. Its comprehensiveness and depth offer a tremendous challenge to our contemporary world. It is a challenge that can empower people to think, act, and live differently—not simply to live, but what Teilhard calls to "superlive": to live a fuller, better, more rewarding life shared with one's fellow human beings.

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A contemporary interpretation of Teilhard's law of complexity-consciousness

Francis Heylighen

Center Leo Apostel, Vrije Universiteit Brussel

David Sloan Wilson has produced an excellent review of Teilhard de Chardin's evolutionary worldview (Wilson, 2022), showing how ideas that seemed incompatible with neo-Darwinism now turn out to be in agreement with more recent perspectives on evolution. As a biologist working on the evolution of sociality, Wilson's arguments mostly focus on the social mechanisms needed to overcome the problem of free riders undermining cooperation. As a systems scientist, I prefer to focus on Teilhard's more general *law of complexity-consciousness*, a principle that unifies much of Teilhard's wide-ranging and often convoluted philosophy (Savary, 2014; Steinhart, 2008; Teilhard de Chardin, 1959, 1966). The "law" states that systems evolve to become simultaneously more complex and more conscious, implying an inherent directionality for evolution.

The argument is most compelling for complexity. The best-known examples of complexification, the "major evolutionary transitions"—such as the emergence of multicellular organisms or of societies—are well described by Wilson. But the underlying mechanism, which I have elaborated in earlier work (Heylighen, 1999), applies as well to "minor" evolutionary changes. Complexification can be understood as an increase in both *differentiation* (greater diversity of components) and *integration* (greater connectivity between components). We see this in the origin of multicellularity, where the cooperation between cells makes them more dependent on others (integration). Yet, because they can rely on others for common functions (such as provision of food), they can now specialize in particular functions (e.g., reproduction), thus becoming more differentiated.

We see the same dynamic in the development of human societies. The division of labor increases the variety of specialized functions. As the requirements and outputs of these specialists diversify, they require an ever more complex network of relationships to coordinate their work, and thus ensure that products and services reach the ones that need them. Teilhard described this as a growth in *connections* between individuals, noting that the resulting *union* creates further differentiation (Luquet, 2006; Savary, 2014; Teilhard de Chardin, 1959). As Wilson notes, the expected outcome of this process at the level of human society is the emergence of a planetary super-organism, whose cognitive apparatus was described by Teilhard as the noösphere or "brain of brains" or, in my terminology, a "global brain" (Heylighen, 2007, 2011).

This dynamic of mutually enhancing differentiation and integration is ubiquitous throughout evolution. For example, a newly appearing habitat, such as the volcanic islands of the Galapagos, will be colonized by an increasing diversity of species. Even when only a limited number of species manage to immigrate, these species differentiate into subspecies specialized in exploiting different niches, as illustrated by Darwin's finches. This differentiation is self-reinforcing, because a larger number of species provides a larger number of niches to be exploited by further species (Gatti et al., 2017). The integration here is performed by the emerging ecosystem, i.e., the network of synergetic relations between all these biological and physical agencies (Heylighen, 2023).

To explain the second part of Teilhard's law, the growth of consciousness, we must note that Teilhard does not see matter and mind as separate. He assumes that even particles have

CONTACT Francis Heylighen fheyligh@vub.ac.be

rudimentary "mental" capabilities, such as being able to sense the forces they are subjected to. I have argued (Heylighen & Beigi, 2018) that such a "panpsychist" perspective is much less mystical than it may appear, being perfectly compatible with sciences such as quantum field theory or complex adaptive systems. From an evolutionary point of view, it is clear that sensitivity, goal-directedness, and cognition did not suddenly appear with the emergence of *Homo sapiens*. Therefore, we must assume that precursors of these properties exist in simpler physical and biological systems, which I have called "agencies" (Heylighen, 2023).

For Teilhard, an agency being conscious means that it *senses* or *is aware of* certain phenomena. It becomes more conscious when the range of these sensed phenomena increases. Levin (2019) has proposed the notion of "cognitive boundary" to describe the extent of such awareness across space and time. Bacteria can sense only what is present at this moment just outside their cell wall. A dog may be aware of what happened yesterday and what it can find within a 5-mile radius of its home. Humans can reflect about remote galaxies and the Big Bang.

Consciousness increases not just with the space-time volume sensed, but with the ability to understand what sensed phenomena mean. Pragmatically, phenomena are meaningful for an agency if they indicate some potential benefit or disturbance. The wider the range of phenomena an agency can *make sense of,* the more effective it will be in exploiting the opportunities while evading the dangers, and therefore the fitter it will be. Therefore, evolution through natural selection can be expected to continuously extend this range—which I have called "prospect" (Heylighen, 2012, 2020).

Growth in consciousness and growth in complexity are mutually reinforcing. As the range of an agency extends, it becomes aware of the activity of other agencies. That allows it to adapt its own actions to those of others, facilitating the coordination between these activities, and thus the emergence of a cooperative organization. Vice versa, this coordination creates connections between remote agencies along which information flows. This extends the spatiotemporal and semantic range of phenomena that a given agency can sense. For example, a cell within a multicellular organism receives hormonal and electrical signals about a variety of remote events, unlike an isolated cell (Levin, 2019).

A remaining issue is in what way the consciousness of an emerging whole, such as a planetary society, differs from the consciousness of its parts, such as human individuals. I have started addressing that issue by extending neuroscientific theories of human consciousness to the consciousness of the noösphere (Beigi & Heylighen, 2021), i.e., the planetary network across which conversations take place. A provisional conclusion is that these processes still lack integration, so that global consciousness is characterized by fragmentation, conflict, and misunderstanding. A compelling narrative of conscious, directed evolution, such as the one proposed by Teilhard and updated by Wilson, may help create a more coherent, shared prospect.

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Teilhard's teleology: his greatest spiritual strength, and greatest scientific weakness

Michael E. Price

Centre for Culture and Evolution, Brunel University London, Uxbridge, UK

The insightful, provocative, and highly enjoyable target article suggests that the integration of religion and science could be facilitated by Teilhard's evolutionary spiritual worldview. Teilhard portrays human biocultural evolution as a directional process, culminating in an "Omega Point": the complete mental unification of humanity, and formation of a single global superorganism. The article emphasizes the compatibility of Teilhard's approach with contemporary evolutionary theory, and portrays him as having been "highly respected by his scientific peers."

While the article argues extensively for Teilhard's compatibility with contemporary science, it focuses much less on his compatibility with contemporary religion. Numerous scientific ideas are emphasized as being consistent with Teilhard's approach, ideas like multilevel selection, major evolutionary transitions, dual inheritance theory, and selection pressures that favor prosociality over selfishness. But no specifically religious ideas (e.g., belief in God or an afterlife) are emphasized for their consistency with Teilhard. The article does approach such an emphasis, by suggesting that "conscious evolution" is central to both Teilhard and the "tribe of evolutionary spiritual thinkers" described in *Evolutionaries* (Phipps, 2012). But it's not clear why conscious evolution is singled out for spiritual relevance. Conscious evolution, the article explains, involves humanity taking control of its own future evolution, "to consciously evolve a world that is better for all." But humanity's ability to engage in conscious evolution will (and to some extent, already does) depend heavily on scientific knowledge and technological advancements in areas like genetics, biocultural evolutionary science, human evolutionary psychology, and medicine. So it's clear that conscious evolution would depend heavily on applied scientific knowledge, including knowledge about how to empirically identify the type of world that would most satisfy the "better for all" criterion. It's less clear, however, that conscious evolution would necessarily rely on any spiritual influence (e.g., reliance on divine revelation as a means of identifying maximally utilitarian goals).

One major aspect of Teilhard's worldview actually does seem essentially religious, but the article largely downplays it: Teilhard sees evolution as an inherently teleological process, predestined towards the Omega Point goal. Whereas evolution is normally seen as the cause of certain outcomes, such as adaptation and speciation, Teilhard reverses this causal direction. As evolution's predetermined outcome, the Omega Point exerts an inexorable "pull" on evolutionary processes, ensuring their culmination in the Omega Point itself (Vidal, 2021; Wright, 2000). The Omega Point represents the fulfillment of God's evolutionary plan: "Christ in human-cosmic dimension" is "the animator of evolution" (Teilhard de Chardin, 1948/1975).

Teilhard's worldview invokes "transcendent teleology"—that is, it sees natural events as being purposefully caused by supernatural powers—and therefore has much in common with religious belief systems. Although this teleology makes Teilhard's vision potentially workable as a spiritual approach, it essentially disqualifies it as a scientific one. The target article notes several compelling points of compatibility between Teilhard's ideas and mainstream evolutionary science, but downplays the extent to which his overall approach has nevertheless been criticized by many biologists.

CONTACT Michael E. Price michael.price@brunel.ac.uk

Rose (2007) thought "most biologists" saw Teilhard as "little more than a charlatan," and Dawkins (2000) described his work as "the quintessence of bad poetic science." A major reason for this rejection has been Teilhard's teleological stance (Vidal, 2021).

Why have biologists been so dismissive of Teilhard's teleology? Not because the general idea of "goal directedness" is irrelevant to evolution. On the contrary, if by "goal-directed" we mean "serving to perform some function," it's one of the most essential concepts in evolutionary theory. The power of evolutionary selection to seemingly "design" viable organisms rests entirely on its ability to produce goal-directed traits. These traits are adaptations, and their goals (i.e., functions) promote survival and reproduction: the goal/function of eyes is to enable sight, the goal/function of the heart is to pump blood, et cetera. On the other hand, biologists have tended to object vehemently to the idea that the evolutionary process in general—as opposed to just the adaptations it produces—could be goal-directed. That's because evolutionary selection itself is the only known natural process that can generate functional, goal-oriented systems. So an evolutionary process could be goal-directed only if it were itself the product of some higher-order selective process ("meta-natural selection" [Wright, 2000]).

The concept of evolved goal-directed functionality can be confusing: biologists have seen it as essential for adaptationist analyses, yet deeply misleading when applied to the evolutionary process itself. They have tried mitigating this confusion by inventing a new word, "teleonomy," to characterize the goal-directedness of evolved adaptations specifically (Mayr, 1974; Pittendrigh, 1958). Fearing that "teleology" may imply the goal-directedness of an intentional agent or force, they intended teleonomy to explicitly *not* imply that, and to instead denote goal-directedness produced by evolution. Mayr (1974) hoped the new terminology would help in disassociating biology from "the concept of teleological determination of evolution," noting that "Teilhard de Chardin's entire dogma is built on such a teleology."

In conclusion, although some aspects of Teilhard's worldview could probably serve as important bridges between religion and science, the quality that makes it most suitable spiritually—its reliance on transcendent teleology—is the same quality that makes it least suitable scientifically. Overcoming this obstacle seems like a formidable challenge. Belief in transcendent teleology is a ubiquitous feature of human religiosity, and to perceive any spiritual meaning in the evolutionary process, many people may need to believe it is oriented towards some higher goal. But for this goal-directedness to be acceptable to science, it would have to be the product of some higher-level version of the only natural process that can generate goal-directed functionality: evolutionary selection. I have written elsewhere on the kind of cosmological natural selection that this scenario would require (Price, 2017, 2019, 2021). But science cannot currently produce any real empirical support for the idea of a naturally goal-directed evolutionary process. Unless and until science can do so, its integration with Teilhard's worldview, or with any belief system invoking transcendent teleology, may be impossible.

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Reintroducing the direction of evolution

Clément Vidal

Center Leo Apostel, Vrije Universiteit Brussel, Brussels, Belgium

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Introduction

Teilhard was a visionary who saw a large-scale directional pattern in the unfolding of cosmic evolution. To support his vision of directed evolution, he relied on:

(1) an internal, spiritual or "radial" energy
(2) an epistemology hinging on final causes
(3) a central mechanism for evolutionary change, *orthogenesis*.

Unfortunately, these three approaches have been vehemently rejected by modern science. Teilhard's concept of "radial" energy is heavily influenced by Bergson's (1984) now outdated *élan vital*, final causes are not considered as valid causal mechanisms, and orthogenesis—an internal directional bias—has been refuted and forgotten in favor of natural selection (reasons why Teilhard still held onto orthogenesis are exposed in Murray, 1967). As Donceel (1965) wrote, "It is not surprising that Teilhard insists so much on this point [of orthogenesis and directionality]. For with it his whole system stands or falls."

Furthermore, issues of evolutionary progress and direction were excluded from the modern evolutionary synthesis by the architects of the synthesis—despite those architects actually believing in them (see Ruse, 1996, pp. 410–455). So we are left today with the task of explaining the directional patterns that Teilhard saw in evolution. Is it possible to reintroduce a direction of evolution without a mysterious energy, final causes, or orthogenesis?

As a first step, D.S. Wilson (2022) usefully highlights developments in modern biological and cultural evolution that are compatible with Teilhard's vision, emphasizing human cultural evolution, conscious evolution, the role of technology, and the formation of a planetary superorganism.

However this does not do justice to the sweep of Teilhard's vision, because it focuses mostly on evolutionary mechanisms that have emerged more recently during the evolution of life on Earth (e.g., artificial or social selection).

What remains to be done is to review and integrate all the directional evolutionary mechanisms that have been identified, including the ones in biological evolution. Such an integration should inform us in which ways and to what extent evolution is directional or not. The challenge remains immense, but nearly all the pieces of the puzzle seem to be within our reach. Reintroducing the issue of the direction of evolution would go a long way towards probing Teilhard's vision more deeply while also expanding evolutionary theory beyond its sometimes narrow scope.

What directionality is not

Let us first outline what establishing a direction in evolution is *not*. First, it is wrong to reason that since evolutionary outcomes produce goal-directed organisms, evolution as a whole is

CONTACT Clément Vidal contact@clemvidal.com

goal-directed. This is an example of a *fallacy of composition*, where what is true for individual members of a class is wrongly assumed to be true for the class considered as a whole (e.g., Pirie, 2006, p. 31).

As mentioned above, a scientific foundation for a direction in evolution can't be supported by a mysterious "radial energy," as non-natural forces are rejected by modern science; nor from a "pull" from the future, as modern science rejects "explanations" based on final causes; nor by the idea of a built-in direction (orthogenesis), a mechanism that has been refuted (Simpson, 1949).

Turning to the related notion of *evolutionary progress*, it is inherently value-laden in a way that directionality is not. Such value-ladenness often contains moral and political implications that can be highly controversial or massively misused.

Finally, one should not see directionality as a unique, deterministic direction, but a general trend, more like predicting that rain water will tend to go downhill on a mountain, not predicting the paths of every single droplet (Teilhard de Chardin 1966, pp. 271–272; Vidal, 2021).

What directionality is about

I propose to outline here some key concepts, theoretical frameworks and mechanisms that are highly promising starting points to probe and discuss the extent to which evolution is directional. The concept of *major evolutionary transitions* is especially important as it is "not restricted to human cultural evolution," as Wilson puts it. Closely related is the concept of *evolvability*—the evolution of evolution—coupled with cooperation at larger and larger scales (Stewart, 2000; 2014; 2020). As Wilson (1997) suggests, a framework to model this rising cooperation is through *multilevel selection theory*. The science of *evolutionary-developmental biology* has also opened new understandings on the developmental constraints in evolution (e.g., Bonner, 1982; Carroll, 2005; Salthe, 1993; Smith et al., 1985). In ecology, evolutionary trends have also been identified, for example in terms of *ecological succession* (Clements, 1916) or *developmental ascendency* (e.g., Coffman, 2006; Ulanowicz, 1997). Immense progress has been made in discussing and elaborating *convergent evolution* (e.g., Conway-Morris, 2003; McGhee, 2011), although one should note the meaning here is *not* the same as the convergence of phyla posited by Teilhard. The field of *epigenetics* has also brought many surprises, as Wilson points out. The issue of directionality is often discussed through the related debate about the *growth of complexity* in biological evolution (e.g., Heylighen, 1999; McShea & Brandon, 2010), which clearly happens for example in arms race dynamics (Dawkins et al., 1979). *Evolutionary ratchets* are also central mechanisms that seem to provide a direction (e.g., Dawkins, 1997; Lukeš et al., 2011).

At the epistemological level, the concepts of *purpose*, *goal-directedness*, *teleology*, and *teleonomy* or *teleodynamics* are also carefully being grounded naturalistically thanks to works in cybernetics, systems theory, or complexity science (e.g., Corning, 2014; de Rosnay, 1979; Deacon, 2012; Heylighen, 2022; Rosenblueth et al., 1943).

Conclusion

One way to test the central issues in this debate is to ask: "What would remain the same if the tape of life were replayed?" as Gould (1990) famously asked. How would Teilhard or D.S. Wilson answer this question?

In sum, I have recalled spiritual (radial energy), scientific (orthogenesis), and epistemological (appeals to final causes) reasons why Teilhard was rejected by modern science. I argued that the first step to reintroduce Teilhard to modern evolutionary science is to reintroduce the issue of directionality in evolution. Pursuing D.S. Wilson's efforts, our task is to continue to integrate and evaluate the extent to which new evolutionary mechanisms support or refute a general direction in biological, cultural, or technological evolution.

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ORCID

Clément Vidal http://orcid.org/0000-0001-6689-5570

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RESPONSE

Reply to commentators of "Re-introducing Pierre Teilhard de Chardin to modern evolutionary science"

David Sloan Wilson[a,b]

[a]Departments of Biology and Anthropology, Binghamton University, Binghamton, New York; [b]Prosocial World, Austin, Texas

I am grateful for this set of commentaries, which is both supportive and critical in constructive ways, thereby advancing the agenda of my target article. I especially appreciate the diversity of the commentators. **Terrence Deacon** is an authority on major evolutionary transitions and the evolution of human symbolic thought. **Celia Deane-Drummond** and **Ilia Delio** have a theological background and bring a depth of scholarship about Teilhard that I could never hope to match. **Francis Heylighen** has a background in cybernetics and leads a research group on Evolution, Complexity, and Cognition. **Michael Price** has a background in evolutionary psychology and a special interest in the biocultural evolution of religio-spirituality. **Clement Vidal** is a member of Heylighen's Evolution, Complexity, and Cognition group who has also written on Teilhard. I have had extended conversations with **Deacon**, **Heylighen**, and **Vidal** under the auspices of Human Energy, whose mission is to place the concept of the Noösphere on a strong scientific foundation "as a source of meaning and orientation in our rapidly changing world."

Deacon's commentary builds upon my own account of his work in my target article. Teilhard's vision was at a macro scale. Whatever we might think about evolution as a directed process at the micro scale, there is undeniably a direction toward increased complexity and the scale of functional organization at a macro scale, which can be extrapolated into the future. Multilevel Selection (MLS) and Major Evolutionary Transitions (MET) are the key concepts for updating Teilhard's macroevolutionary account and connecting it to a microevolutionary account.

I also enjoyed reading **Deacon's** depiction of symbolic thought in his own words. Compare Teilhard's phrase "the extraordinarily agglutinative property of thought" with **Deacon's** "We might describe ourselves as a symbolically eusocial species"!

Deacon thinks that there is an important distinction between human design processes and living processes. Living processes are always selected holistically and must "function incessantly" as they evolve. Designed objects are assembled from parts and can exist on a drawing board before being exposed to the real world. In my view, this distinction is not as foundational as Deacon seems to think. I see design efforts, whether on or off the drawing board, as variation-selection-replication processes, similar to living processes. I look forward to continuing the conversation with **Deacon** and others on this point.

That said, I agree with **Deacon** that there are types of superorganisms that aren't worth wanting, along with dysfunctional outcomes of macroevolution, such as societal collapse or a global despotic society that works only for the elites and is highly stable. There is nothing inevitable about the benign global superorganism that we are attempting to consciously evolve!

The inclusion of two theologians in this set of commentaries, **Deane-Drummond** and **Delio**, is unusual for a scientific journal but integral to the relevance of Teilhard, which I tried to develop in the second part of my target article. A good starting point is Deacon's phrase "symbolically eusocial species". The functional demands of such a symbolic system are to highly motivate members of a

CONTACT David Sloan Wilson dwilson@binghamton.edu

community to work for the common good. That is precisely what religious and spiritual symbolic systems are designed to do. Emile Durkheim grasped this truth when he defined religion as "a unified system of beliefs and practices relative to sacred things … which unite in one single moral community called a Church, all those who adhere to them." It was also Durkheim who wrote, "Social life, then, in every aspect and throughout its history, is only possible thanks to a vast body of symbolism."

It is worth dwelling on the general study of spirituality and religion from an evolutionary perspective before concentrating on the specific case of Teilhard. To the extent that they serve as a motivational and institutional glue for holding societies together, all spiritual and religious systems can be studied scientifically in the same way that evolutionists study biological species. I have been doing this since my book *Darwin's Cathedral* (Wilson, 2005), most recently in an earlier target article published in this journal (Wilson et al., 2017; see also Wilson, 2005; Hartberg & Wilson, 2017).

Returning to Teilhard, he was clearly trying to construct a symbolic system that extends eusociality to the global scale, using evolution as its narrative core. So many of the passages by Teilhard quoted by **Delio** emphasize unity, such as "There are no isolated things in the world. There are only elements of a whole in process" and "Religion and evolution should neither be confused or divorced. They are destined to form one single continuous organism."

I sense a difference between **Deane-Drummond** and **Delio** in their assessment of Teilhard's commitment to naturalism. Deane-Drummond maintains that Teilhard had a sense of God, expressed in his book *Le Milieu Divin*, which did not fall within his commitment to naturalism. The passages quoted by **Delio** suggest a stronger commitment to naturalism. I do not feel qualified to weigh in on this matter, although I do think that Teilhard's emphasis on love as the foundation of everything can be given a naturalistic formulation. Love is the unreserved giving to others and one's group as a whole, which is ecstatic for the loving individual. It is possible for love to evolve in a Darwinian world, but only under special conditions specified by MLS theory. The challenge for achieving a global superorganism is to establish the special conditions at a global scale.

A question for all of us is whether the construction of a symbolic system capable of turning the whole earth into a eusocial species is a legitimate enterprise for scientists. I believe that it is, as long as the narrative scrupulously remains within the bounds of naturalism. Indeed, I believe that it is unethical for scientists to refrain from using their knowledge to construct and live within such a symbolic system. Scientists have a responsibility to use their knowledge to improve the human and planetary condition and there is no more important application than a way of thinking, feeling, and acting capable of uniting the entire earth system.

Heylighen and **Vidal** represent the broad area of complex systems science. **Heylighen** focuses on the "Law of Complexity-Consciousness" which is that "systems evolve to become simultaneously more complex and more conscious, implying an inherent directionality for evolution." He points out that diversity and integration are important phenomena in their own right, in addition to Major Evolutionary Transitions. He also stresses that many aspects of consciousness, which have appeared beyond the pale of science in the past, can be given a scientific formulation, even for non-living entities.

At this point, it is important to distinguish between micro and macro accounts of evolution. Directionality over immense periods of time does not imply directionality over short time periods. At any given moment, the evolution of cooperation at a given scale is a tug of war between levels of selection. Lower-level selection can easily win the contest, resulting in conflict and dysfunction at the level of the whole system. When I write for complex systems scientists, I distinguish between two meanings of the key term Complex Adaptive Systems (CAS): A complex system that is adaptive *as a system* (CAS1) and a complex system *composed of agents following their respective adaptive strategies* (CAS2; Wilson, 2016; Wilson & Madhavan, 2020). The key insight provided by MLS theory is that CAS2 systems do not self-organize into CAS1 systems in the absence of selection at the

level of the whole system. The metaphor of the invisible hand in economics, which pretends that the pursuit of lower-level interests robustly benefits the common good, is profoundly untrue.

This is also the case for biological systems. Most animal societies and multi-species ecosystems are CAS2 systems, not CAS1 systems. They are no more adaptive at the level of the whole system than laissez-faire human economies. It takes a process of selection at the level of the whole system – such as colony-level selection for the eusocial insects, group-level selection in humans, or ecosystem-level selection in the case of microbiomes – to convert CAS2 systems into CAS1 systems.

A contemporary micro-evolutionary narrative is different from Teilhard's and many other macroevolutionary narratives of conscious evolution (Wilson, 2022). There is little comfort in trends that unfold over immense period of time. In the present, it is up to us to alter the balance between levels of selection to expand the scale of cooperation, ultimately at the global scale. Otherwise, it will assuredly not happen.

I thank **Vidal** for identifying elements of Teilhard's thought that deserve to remain forgotten, similar to Darwin's muddled thoughts on inheritance. As several of the other commentators also point out, Teilhard lived at a time when the Modern Synthesis was still a work in progress and concepts such as *élan vital* were current. After identifying what directionality is not, we can set about defining what it is from a modern evolutionary perspective.

Vidal asks how I would answer Gould's (1989) famous question "What would remain the same if the tape of life were replayed?" I would say that major evolutionary transitions would occur, given enough time – bearing in mind that, as pointed out by **Deacon**, life on earth remained at the bacterial stage for 2 billion years! Symbolically eusocial life forms similar to humans might never occur. Both Gould and Teilhard emphasized the combination of unlikely events that led to the origin of our species. If such life forms evolve, then they might never achieve a global scale of cooperation, just as this is still an open question for our species.

Price is arguably the most skeptical of the commentators. In places, he seems to assume that religion and spirituality require belief in supernatural agency: e.g., "It's less clear, however, that conscious evolution would necessarily rely on any spiritual influence (e.g., reliance on divine intervention as a means of identifying maximally utilitarian goals)". I take issue with this assumption. What's remarkable about Durkheim's definition of religion is that it is centered on the concept of the sacred in the formation of moral communities, without mentioning supernatural agency at all.

When we ask whether a eusocial symbolic system can invoke the concept of the sacred without invoking supernatural agency, the answer is "of course it can". All that's required is a feeling of being part of something larger and more important than oneself, which motivates a desire to subordinate one's selfish concerns to serve the larger good. That's how the word "sacred" is used in everyday language without any religious connotations. As a highly group-selected species, we are psychologically primed to feel this way in contexts where it is appropriate. These contexts can easily be invoked by narratives and institutions that do not invoke supernatural agency.

The question of whether Teilhard relied upon supernatural agency has already been discussed in my response to **Deanne-Drummond**, **Delio**, and **Vidal.** Either way, I agree with Price and most of the other commentators that the eusocial symbolic systems of the future can and should be fully commensurate with scientific knowledge.

I thank **Price** for bringing past debates about teleology and teleonomy into the conversation. These debates took place against the background of the Modern Synthesis and its emphasis on Mendelian genetics. At that time, it was important to reject certain notions of directed evolution, just as it remains important for us to reject them today (as emphasized by **Vidal**). Everyone agreed (how could they not?) that "blind" evolution resulted in purposeful organisms. A question that I have for scholars of the period is why the Baldwin effect (Baldwin, 1903) didn't feature more prominently in these discussions. In the Baldwin effect, the actions of purposeful organisms alter genetic selection pressures and thereby influence "blind" evolution (Scheiner, 2014). The concept was widely celebrated in the early twentieth century as a form of Lamarckian inheritance compatible

with Darwinian evolution, but it was largely left out of the Modern Synthesis as far as I can tell. It wasn't until the so-called "Extended Synthesis" (Pigliucci & Muller, 2010; Laland et al., 2015), including concepts such as niche construction (Odling-Smee et al., 2003; Laland et al., 2000), that the importance of the Baldwin Effect was acknowledged and further refined.

Price cites authorities such as Rose (2007) and Dawkins (2000), who were highly dismissive of Teilhard. I began my target article by observing that Teilhard was largely forgotten by "hard" evolutionary scientists. It should surprise no one that Dawkins would regard Teilhard's work as "the quintessence of bad poetic science," when Dawkins' own idea of good poetic science asserts that "The universe that we observe has precisely the properties we should expect if there is, at bottom, no design, no purpose, no evil, no good, nothing but pitiless indifference (Dawkins, 2014, p. 132)."

Clearly, the reason that Teilhard was scorned and forgotten during this period was not because his ideas are objectively wrong, but because they were mismatched to the tide of reductionism and individualism that swept over western culture during the 2nd half of the twentieth century, including economics and the social sciences in addition to evolutionary biology. Now that this tide is thankfully receding, Teilhard's ideas can be seen in a new light.

I will end my response to the commentaries with some thoughts on moving forward. As a person, Teilhard should have the same kind of status as Darwin and other major figures in the history of evolutionary thought. None of them were infallible or clairvoyant. All of them made errors and in some respects could not see past the assumptions of their cultures. Nevertheless, they deserve to be closely studied for their pioneering ideas that proved to be foundational and also for the scholarly study of the history of evolutionary thought.

I hope that the conversation between evolutionary scientists and theologists such as **Deane-Drummond** and **Delio** will continue. These individuals and many of their colleagues are highly literate about evolutionary, environmental, and complex systems science. More scientists need to realize the importance of what they bring to the conversation with their knowledge of theology.

I hope that eusocial symbolic systems become more widely studied in the same way as genetically evolved eusocial systems. These should be regarded as Noöspheres that have already evolved at intermediate scales. They exist in the thousands, once we know how to look for them.

Most of all, I hope that the construction of eusocial symbolic systems for ourselves becomes seen as one of the most important applications of scientific knowledge that can be imagined, which scientists can engage in, without reservations, alongside spiritual seekers.

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