Reintroducing Pierre Teilhard de Chardin to Modern Evolutionary Science

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Abstract

Pierre Teilhard 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 working paper examines the major tenets of Teilhard's vision from a modern evolutionary perspective in an effort to integrate "hard" evolutionary science with conscious efforts to manage cultural change.

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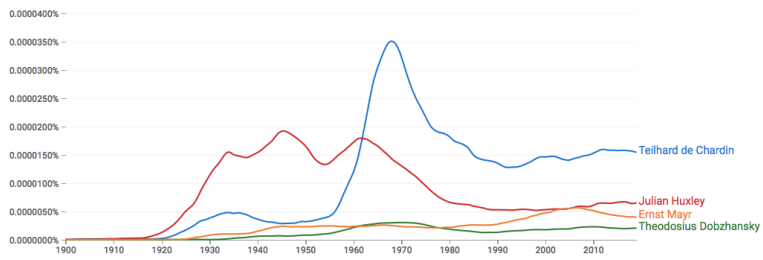
Pierre Teilhard de Chardin (1881-1955) was a Jesuit Priest and paleontologist who was part of the team that unearthed the skull that became known as Peking Man (now classified as *Homo erectus*) in 1929[1]. The Catholic Church has long acted as a patron of science in addition to a censor when its dogma 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 1930's, was not published until after his death. The English translation of this book, titled *The Phenomenon of Man*[2], 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. I will show that he anticipated developments which did not take place until the closing decades of the 20th 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. If Teilhard's view of evolution is scientifically legitimate, then it can be a breakthrough in how evolution is presented to the general public.

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*[3], titled "The Formation of the Noosphere". 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 purely naturalistic view of evolution. Given Teilhard's religious upbringing and status as a Jesuit Priest, it is remarkable that his evolutionary worldview is entirely naturalistic. He avoids invoking any kind of 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[4]. 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[5]."

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 20th 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 1980's, with books such as *Culture and the Evolutionary Process*[6], which began to construct mathematical models of cultural evolution patterned after population genetics models developed 50 years earlier.

Today, the study of human cultural evolution is thankfully experiencing a renaissance, although largely without acknowledging Teilhard's contribution. For example, a 2004 article published in *Nature* magazine titled "The Cultural Wealth of Nations[7]" 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[8] 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[9]. 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[10]".

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[11]. 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 "noosphere" to describe the impact of other lifeforms and humans, respectively, on earth processes. The noosphere 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 20th 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[12]. 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[13].

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 20th century[14], 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[15]. Social learning provides another mechanism for information learned in one generation to be passed to the offspring generation. A 2020 article in Science magazine titled "The Burgeoning Reach of Animal Culture[16]" shows how much cultural evolution in nonhuman species of all sorts—not just the so-called "higher" primates—has been underappreciated until recently[17].

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[18] 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 passed down by tradition in native American cultures without any causal awareness of how they worked. When maize was introduced to Europe in the 16th 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 20th century and even that required decades to become established[19].

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 and the comparative success of Calvinism was based largely on the contingencies of history[20]. In one of the best studied examples of cultural replacement in the anthropological literature, an African pastoralist tribe called the Nuer were in the process of slowly replacing a neighboring tribe called the Dinka when contacted 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 or the underlying factors[21].

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 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)."

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 Noosphere 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 20th century, when virtually all adaptations were interpreted as for the good of individuals and their selfish genes[22]. 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 20th Century[23].

Another factor, more closely related to evolutionary theory, is the failure to distinguish between proximate and ultimate causation in Ernst Mayr's terminology[24], or the "Mechanism" and Development" compared to the "Function" and "History" questions in Niko Tinbergen's terminology[25]. 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[26]" and it provides a rock-solid foundation for the holistic claim "the parts permit but do not cause the properties of the whole[27]".

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[28]. Higher-level selection is a significant evolutionary force in many species and especially in the case of human cultural evolution, as elaborated in more detail below[29]. Social insect colonies and a growing list of other animal societies are studied as superorganisms, complete with social physiologies and groups minds[30].

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 Noosphere 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[31]. 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[32] 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[33], 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[34]. 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 conscious evolution is restricted to humans.

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 Noosphere (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 elite. 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 in his 2012 book *Evolutionaries: Unlocking the Spiritual and Cultural Potential of Science's Greatest Idea*[35], which fittingly begins with the words "We are moving!" from Teilhard's *Future of Man.* Carter 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 Carter, "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, Carter 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[36], whose purpose is to "collectively inspire, support, and serve conscious evolution." While the EL's are highly science-oriented 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. 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*[37] by Terrence Deacon 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[38]. 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[39].

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[40]. 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[41]—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, a course in meditation, which alters your state of mind, up-regulates or down-regulates a substantial fraction of your genes[42].

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 20th 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[43]. 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—once it becomes our symbotype—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, 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[44] in 2009 and its spinoff organization Prosocial World[45] 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[46]. 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 against 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.

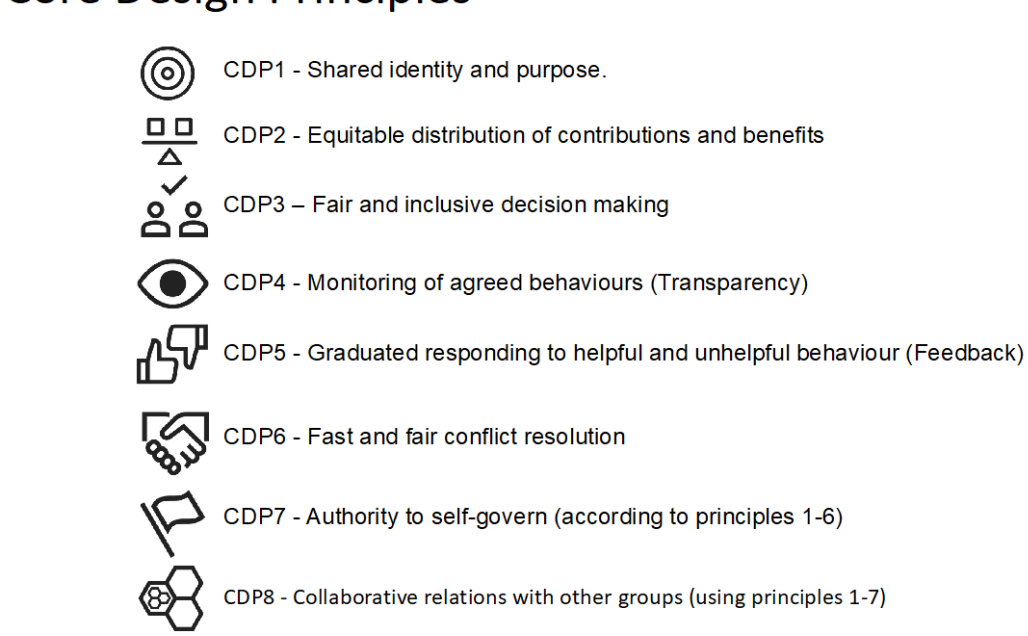
Cancer researchers refer to cancer cells as cheaters. This is more than a poetic metaphor. Once we see multicellular organisms as highly cooperative societies of cells, then cancer cells really are cheaters in the same sense that we call a self-serving individual a cheater in a human social group. In 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[47]. 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 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[48]. 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 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 to 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 21st 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 is better for all. Teilhard will be acknowledged as one of the giants upon whose shoulders we are standing.

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ENDNOTES

[1] Two biographies are Amir (2007) and King (2015).

[2] Teilhard de Chardin(1959).

[3] Teilhard de Chardin (1946/1969). The essay was originally published in the Revue des Questios Scientifiques, (Louvain) January 1947

[4] https://en.wikipedia.org/wiki/Evolution_and_the_Catholic_Church

[5] 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.

[6] Richerson and Boyd (1985); see also Cavalli-Sforza and Feldman (1981), Lumsden and Wilson (1981)

[7] Pagel and Mace (2004)

[8] Richerson and Boyd (2005); Richerson (2017)

[9]Whiten (2021)

[10] Henrich 2016

[11] 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 and 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 noosphere.

[12] A special issue of Prosocial World's online magazine This View of Life is devoted to the question "Can Evolution Be Conscious?"

[13] Wrangham (2019); Hare and Woods (2020)

[14] Baldwin (1903); Schneider (2014)

[15] Jablonka and Lamb (2006); Gissis and Jablonka (2011)

[16] Whiten(2021)

[17] See also Laland (2017)

[18] Skinner (1981)

[19] Katz (1990); see also the Wikipedia entry on pellagra: https://en.wikipedia.org/wiki/Pellagra#History

[20] Wilson (2002 Ch. 3)

[21] Kelly (1985); discussed in Sober and Wilson (1998; p 186-191)

[22] Williams (1966), Dawkins (1976); see Sober and Wilson (1998) and Wilson (2015) for analysis.

[23] Gleick (1987) aptly recounts how computer simulation modelers had to struggle against the hubris of formal mathematical modelers in their study of complex systems dynamics.

[24] Mayr (1961)

[25] Tinbergen (1963)

[26] Campbell (1990)

[27] Wilson (1988)

[28] Wilson (2915; Okasha (2006)

[29] Richerson and Boyd (2005); Henrich (2015)

[30] Seeley (2005, 2010); Holldobler and Wilson (2008)

[31] Maynard Smith and Szathmary (1995, 1999); Calcott and Sterelny (2011)

[32] Turchin (2005, 2010, 2015)

[33] Margulis (1970)

[34] Maynard Smith and Szathmary (1999)

[35] Phipps (2012)

[36] https://us02web.zoom.us/j/5095088454

[37] Deacon (1998); see also Jablonka and Lamb (2006)

[38] Wrangham (2019)

[39] Boehm (1993, 1999, 2011)

[40] Hayes and Sanford (2014)

[41] Wilson et al. (2014)

[42] Ref needed

[43] See Bellah (2011), Hoyer and Reddish (2019)

[44] http://evolution-institute.org

[45] www.prosocial.world

[46] Aktipis (2020)

[47] Ostrom (1990, 2010a,b)

[48] Wilson, Ostrom, and Cox (2013)