

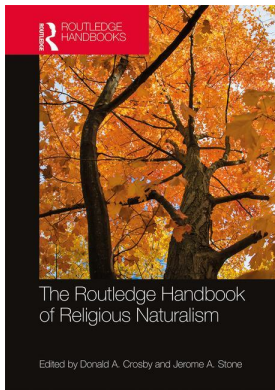
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3

ERNST HAECKEL'S CREATION

Developing a non-reductive religious naturalism

Whitney Bauman

Triune monism: the problems with dualism, idealism, and materialism

The whole marvelous panorama of life that spreads over the surface of our globe is, in the last analysis, transformed sunlight.

(Haeckel 1900: 139)

I begin my reflections with this widely cited quote from Ernst Haeckel to help ward off accusations by many that Ernst Haeckel was merely a reductive materialist. Quite often philosophical monism gets lumped in with the reductive variety of monism, when in actuality there were many different types of monism ranging from materialistic to idealistic to pluralistic (Holt 1967). I would argue that Haeckel's monism is of the pluralistic variety in part because he outlines a triune structure of substance that includes material, energy, and experience "all the way down" (Haeckel 2008: 69). One of his final books was, after all, *Krystal Souls*, in which he argues that even the forms of crystals display some sort of continuity with biotic life (both plant and animal) (Haeckel 1917). In fact, the difference for Haeckel between biotic and abiotic life is that the internalization of "experience," which happens in the cell, leads to some sort of interiority that abiotic life does not have (Weber 2000a: 91). Though this may sound like vitalism or spiritualism at some level, Haeckel also fought against these notions as they were found in the works of Bergson and in Theosophy (Weber 2000b: 6–7). He thought such works turned everything that is real and of value into the ideal or spiritual. In other words, he neither wanted to move too far in the direction of reductive materialism or reductive idealism, but rather wanted to give full reality to all life: ideal/material, mind/body, energy/matter, culture/nature. At the same time, he wanted to avoid what he saw as the largest philosophical mistake in Western thought: ontological dualism. It was in articulating his position against dualism that Haeckel managed to construct a triune version of monism, which angered both scientists (mostly materialists) and theologians (mostly idealists or dualists). Here I want to focus on his construction of triune monism as form of ontological pluralism (which later would be articulated by the likes of American Pragmatists), a monism that was much more based in aesthetics than metaphysics. Then, I will move to some of the implications of what placing humans in an evolutionary context meant for Haeckel in

terms of ethics and values. Finally, I will end with some lessons we might learn from Haeckel's version of Non-Reductive Religious Naturalism, particularly from within our planetary context in the twenty-first century.

For Haeckel the worst philosophical sin was that of assuming some form of ontological dualism, and he thought the church was the worst offender and propagator of this mistake. He couched his own work around evolutionary thinking and its implications in a long line of shifts toward immanent ways of thinking including those shifts made by Copernicus, Galileo, Spinoza, and later Goethe, and von Humboldt (Haeckel 1905: 53–57). As he understood it, all of human knowledge had been sidetracked as a result of dualistic thinking, whether in the form of God and the world, energy and matter, soul and body, or even self and other. It was Darwin's theory of evolution that finally enabled him to promote a form of philosophical monism in which all things could be made intelligible within an immanent, emergent framework. In doing so, he managed to attack dualism in any form that he found it, and Kantian thought was one of his primary targets.

For Haeckel there was much to be commended in Kant's thought, especially the very notion that we can never escape hermeneutics to reach some sort of "bare facts" about the world. In other words, Haeckel would agree that there are no un-interpreted facts, much to the dismay of many materialist scientists of his time (e.g. Haeckel 1905: 5–6). Kant, however, made two related wrong turns in which dualism, Haeckel thought, slipped back into his otherwise sound philosophy. First was Kant's assumption of the *ding an sich*. This assumption meant, according to Haeckel, that there was something outside of relationality and thus meant that there was some sort of dualism, or space of removal in which some sort of essence of the "other" could not be known. This essence, for Haeckel, was impossible from an evolutionary perspective in which biotic life emerges from abiotic life, animal life from plant life, and human life from animal life. There simply is no room for any type of essentialist understanding of self and other, and no hard separation between the different categories of life that scientists use.

Kant's second mistake, according to Haeckel, was his insistence on *a priori* statements in the form of categorical imperatives (Haeckel 1905: 10–11, 69). From Haeckel's point of view Kant was right in thinking that we could never fully have an objective view of the world, but not because there was a space from which that objectivity was possible. There is no hidden "outside" of experience that we do not have access to; rather, everything is radically interrelated and evolving, and thus we are always in the midst of life. There is no way we can have a bird's-eye view of "the way things really are." For Haeckel, an evolutionary perspective meant, among other things, that anything we might think of as *a priori* must in fact be an *a posteriori* idea/fact/concept whose bio-historical construction has just been covered over by time (Haeckel 1905: 25). In this sense, Haeckel comes very close to many postmodern thinkers that follow similar arguments found in Michel Foucault. For instance in *The Order of Things*, Foucault argues that what seems to be "given" or "natural" is, rather, historically constructed and shifts over time (Foucault 1970). Similarly, despite Haeckel's rhetoric in the *Riddle of the Universe*, which insists that one day science will solve all of life's riddles, the conclusions of his triune Monistic way of thinking do not bear out this possibility (Haeckel 1900). Haeckel argues, in my view correctly according to his assumptions about placing humans into an evolutionary framework, that there are no bare, un-interpreted facts. Such an assumption opens the door to the perspectivism and contextual assumptions that are at the heart of what Foucault (and other postmodern thinkers) are arguing.

At the risk of taking responsibility and agency away from Haeckel, which I certainly do not want to do, I do argue that his overconfidence in the scientific ability to one day overcome these epistemic uncertainties stems from his overzealousness in stamping out theological dualisms. In creating his "anti" position, he mirrors the structure of authority that he is fighting against.

Whereas priests and the church once had authority in metaphysics, science will now have authority in all things: from educational reform, to aesthetics, to “spiritual” matters and the ethics surrounding life and death (Haeckel 1895; Weber & Breidbach 2006: 161–174). His zeal for arguing against theology and his inflammatory comments about the God of Christianity, which Haeckel often publicly declared was nothing more than a “vertebrate gas bag,” brought him scorn not just from the Church and some protestant theologians, but also from Darwin himself (Weber 2000b: 14; Krauß 1987: 116). In one letter from Darwin to Haeckel, Darwin begged Haeckel to tone down his rhetoric against theology so that people would listen to his evolutionary ideas more. In other words, Darwin knew that the radical implications of evolutionary theory could fall on deaf ears, so it was better to stick with the more strictly “scientific” side of things (Wuketits 2006: 19). Indeed it was largely the rhetoric of Haeckel and Huxley that led to huge rifts between proponents of evolutionary theory and those that positioned themselves against these theories who would later become known as creationists. This constructed rift between an evolutionary understanding of the world and a religious understanding of the world has had grave consequences for the world I do not need to rehash here. Instead, I turn now to some other implications of Haeckel’s placing humans within an evolutionary context, that have consequences not only for later emergence theory and religious naturalisms, but also for post-modern thought. In doing so, I would argue that Haeckel represents much less of a “warfare” model between science and religion than he does a “dialogical” or “disputational” approach (Stenmark 2013). His religious naturalism is a hybrid, then, of scientific and religious ideas.

Human thought and history in an evolutionary context

My argument in this section is not that Haeckel himself or any other nineteenth-century scientist of his time was post-modern. Rather, my argument is that some of the tenets of post-modernity—all reality is interpreted, identities are non-essential and fluid, and values are co-constructed over time—depend in large part upon humans being placed within an evolutionary context. In other words, if human identity, values, and histories emerge out of the common planetary context as does all other life, then human knowledge of the world is also emergent. Haeckel understood this emergent nature of human identities, histories, and values in several ways.

First, and as I already mentioned, Haeckel the scientist argued that there are no bare facts in nature; rather, all understandings of nature involve interpretation. Put another way, all knowledge is a *posteriori* knowledge; hence, one of his major disagreements with Kant and neo-Kantians. For Haeckel, this conviction made developing a naturalistic worldview all the more important. He was flustered by the fragmentation of chemical, biological, and physical sciences in the nineteenth century and understood evolutionary theory as a way to finally bring these multiple perspectives on “nature” together into a single worldview. He understood this worldview as a form of monism, but again, a pluralistic form of monism. For Haeckel, multiple perspectives from the various sciences would give us a much better understanding of the world in which we live than any single science could (Haeckel 1895). Again, this “better” understanding for Haeckel was not based upon objective retrieval of bare facts, but upon the collaboration between perspectives that made better sense of the phenomena of life than any one science could provide.

In addition to the role of the sciences in understanding the world, nature aesthetics was equally important. Haeckel’s *Kunstformen der Natur* and other sketches of abiotic and biotic life, in addition to his studies on embryos, looked for common patterns from crystals, to plants, to animals, and humans (Haeckel 1904; Haeckel 1917; Haeckel 1874). Indeed, he even made statements suggesting that human and dog embryos were virtually the same, but that the context (the ecology, biology, and even culture and education) leads to two quite different organisms

(Haeckel 1900: 65–66). His point was that knowledge of the world and our interrelatedness with it could only come about with the help of a nature aesthetic in which we could witness the evolution and emergence of forms, rather than assume that forms were imposed upon nature *ex nihilo* in some cosmic beginning.

Second, this loosening of forms from transcendent foundations (in a creator God or some other antecedent fixer of forms) meant that the world was much more diverse than humans could previously have imagined. Placing us in an evolutionary context was more than just re-thinking what it means to be human vis-à-vis other animals, or what this meant for one's religious understanding of the world, as important as these things were and are; it also meant tracing how such things as thought, ideas, and values, emerged from a long line of evolutionary developments. Rather than a "top down" approach to knowledge, this new way of thinking about the world and what it means to be human required a bottom-up way of thinking about the world, and with that an understanding that the forms we once held to be stable, actually change over time (Haeckel 1904: 9–18). What does this mean for "the human?" What does this mean for "male" and "female?" What does this mean for "beauty?" These are the types of question that an evolutionary context required new methods for answering, and Haeckel realized this. Part of his vehemence against theological dualisms, idealisms and reductive materialisms was that he understood these as old ways of thinking from within a pre-evolutionary context.

One example of this new way of thinking about the world and the proliferation of possibilities for what life could become was Haeckel's support of Magnus Hirschfeld in the late nineteenth and early twentieth century (Jacobson 2005: 208; Richards 2008: 275). Hirschfeld, a renowned sexologist of the time, founded the Institute for Sexual Research in Berlin in 1919. Prior to that time, he admired the work of and found support from Haeckel, particularly in his studies surrounding the evolution of forms in nature. Haeckel and he understood that once humans were placed into an evolutionary context, the idea of gender and sexual dimorphism, and even heteronormativity would give way to a diverse number of ways in which human beings could develop. Human sexuality, then, would naturally be just as diverse as the forms of sex and sexuality found throughout the natural world. The evolutionary context was essential to this type of scientific normalization of diversity in sex and sexuality.

Carl Linnaeus only a century earlier, for instance, had no real concept of the evolution of all of life, and this fact is apparent in the way he transposed human relationships to his description of the plant world. Plants were male and female, and had children, much like a human Victorian model of the family (Schiebinger 1993: 1–40). I argue that the lack of a strong form of evolutionary theory helped to enable Linnaeus to impose his cultural forms for thinking about sex and sexuality onto the world of plants, as if they were merely "natural." In other words, because he didn't have a concept of humans being placed within an evolutionary context (and thus human language, ideas, and forms), he was able to project his own understanding onto the world as if that was merely evident and natural. Of course, Haeckel too had his own cultural location that he imposed upon evolution in that he argued that European humans, and particularly Germans, were at the "top" of the evolutionary tree (Marks 2010). This idea fueled his more racist, nationalist, and anti-Semitic views of the human world. More will be said about this fact. However, his deep observation of the diversity of sexuality in nature and his placing humans into an evolutionary context meant that there could be no more understanding of God creating forms "in the beginning," nor an original creation of humans as male and female. Rather, the forms of organisms, including humans, evolve and emerge out of natural processes in which organisms interact with other organisms. The interactions of organisms within nature, according to Haeckel, fueled evolutionary changes. In other words the context or environment were

very important for shaping the evolution of the organism and for this reason Haeckel coined the term “ecology” (Richards 2008: 409). So from the very beginning the idea of ecology is linked with diversity and change. Put into a contemporary context we might say the queerness of nature has everything to do with the queerness of human forms as well: evolutionarily, biologically, and psychologically, forms of life interact and shift over time to such an extent that naming one life form this or that is a heuristic device that scientists use to understand the world. The same would be true of Haeckel's understanding of aesthetics and ethics.

According to Haeckel, and again contrary to Kant, Beauty, Truth, and Goodness and all such ideals and forms emerge out of a continuous process of evolution. His work on the *Soul Life of Crystals*, Art Forms of Nature, Gustav Fechner's work on *The Soul Life of Plants*, and Wilhelm Bölsche's *Love Life in Nature*, were all nineteenth-century attempts to describe how some type of value or ensoulment was present in life “all the way down” (Haeckel 1917; Haeckel 1904; Fechner 1848; Bölsche 1926). It was not just that Beauty, Goodness, and Truth appeared on the scene with the first self-reflective *Homo sapiens*; rather, these things must have emerged from the evolution of earlier forms one can find throughout the natural world. For Haeckel, the source for such values in biotic life was to be found in the protoplasm of the cell, which he thought to be the unit of internalized “memory” of living cells. But even in abiotic life such as crystals, the world displayed forms of beauty and pattern in the ways that rocks and other things were shaped by the world around them. There is, in this sense, intelligence to life, but not of a teleological variety. Rather, it is an emergent form of intelligence, or an intelligence that is not predictive “from the beginning” of what and how the process of life will unfold, but rather may develop in many different directions that could not and cannot be anticipated. Nature, for Haeckel, was poesis and Art (Larson & Brauer 2009). Humans were not imposing these traits upon the world; they were “fine-tuned” over millions of years of evolution to make possible the perception of the beauty of the natural world.

According to Haeckel, religions (and philosophies) served an evolutionary purpose in as much as they helped human beings to become more aware of beauty, goodness, and truth. However, he argued, the arrival of the natural sciences and particularly the arrival of evolutionary theory, which would put into context all sciences and humanities, meant that old religions should be replaced by some form of what we might call religious naturalism, which he referred to as *monism*. Haeckel was certain that all peoples would benefit from close observation and study of the rest of the natural world from which they came, rather than reflecting merely on words, books, and ideas. It was this reason that he and the *Monistbund* in general (which he founded) argued vehemently for education reform that would lead to more study of the natural world, and why he fought so vehemently against what he perceived as the ignorance of theological and religious education. For Haeckel, promoting an evolutionary worldview was more than just a scientific necessity; it was also a religious duty. The religiosity with which Haeckel pursued a Monistic worldview in his arguments against dualists, idealists, and reductive materialists is evident in that his argumentation often is reminiscent of someone like Tertullian arguing against the Gnostics, or Augustine arguing against the Pagans. This religious fervor also might help explain some of his more short-sighted, nationalistic, and xenophobic understandings of the human world. I think we can learn from Haeckel's mistakes in this regard, and we should pay attention to his failures as a cautionary tale for anyone who seeks to develop a religious outlook based upon the evolving natural world of which we are a part. What Haeckel lacked, namely a bit of humility and an apophatic understanding of the natural world, I think we can embrace in our planetary context, a context in which we are globalized, understand ourselves as part of a larger community of evolving life, and recognize just how much scientific findings shift from one decade to the next.

Haeckel's non-reductive religious naturalism for a planetary context

As older generations can attest, there is really nothing certain except change. Scientific, political, social and economic realities are constantly changing, as are ideas about religion and the role religion plays in the lives of individuals, in politics, and in culture writ large. Yet, there still seem to be those who, in any given generation, lay claim to having arrived at a more stable version of the truth. I am reminded of thinkers such as Richard Dawkins, or any number of less-evangelical people who hold to “scientism” and truly believe the science of today gives us the correct understanding of every aspect of the world. This is not to deny that science may have an understanding of the world that takes into account many more embodied realities than other understandings of the world (past and present), but it cannot be the final word.

Haeckel also thought that the end of the nineteenth century was going to give way to the era of evolution, and that the natural sciences would solve all the riddles of the world (Haeckel 1900). This type of certainty and sense of arriving at the truth of things flies in the face of his own understanding of all ideas and values being *a posteriori*, and that there are no bare facts, but rather all facts must be interpreted as such. Such certainty also flies in the face of an evolutionary perspective of the world. If indeed we are part of an evolving planet, and our bodies and minds are evolving along with it, then our knowledge of the world will change along with the world. Finally, this type of certainty seems to go against the scientific method in which hypotheses are tested through experimentation and validated/invalidated in terms of how adequately they can explain the data. There are always “remainders” or data that fall outside of a theory or even a law, and these “remainders” may eventually shift us toward a different understanding with new lines of experimentation.

It seems to me that Haeckel's largest mistakes, and the largest mistakes of most scientists, come from not being able to recognize even their most powerful insights as coming from a particular perspective on the world. In other words, denying partiality and contextuality can lead to projecting one's own cultural-social-biological location onto nature. One example of this would be the way in which Haeckel projects his own ethnocentrism and racialized understanding of the world onto a hierarchical understanding of evolution that leads from the lowest and darkest peoples right up to the height of European (and even German) cultures and peoples (e.g. Haeckel 1905: 74–77). Though he thought these “lower” cultures could be “taught” through a “good” Monist oriented education that included a great deal of natural sciences and observation of nature, he nonetheless thought of European cultures as superior (Richards 2008: 245–276). He, like many others of his time, also read into the history of religions an evolutionary perspective on religious ideas. Like so many nineteenth-century religious scholars who were beginning to compare religions, he too thought some forms of “animism” were more primitive than the supposed highly developed forms of “monotheism” (Haeckel 1905: 53). Monism and his naturalistic worldview based upon evolutionary theory was for him just the next step in evolutionary progress; and this progress, according to Haeckel, called for us to take some responsibility for the future of humanity in the form of eugenics (Weir 2012: 6). This colonial so-called scientific approach to comparing differences was itself uncritically adopted from the preceding theological forms of colonialism: just as Christianity was bringing its alleged light to the assumed darkness found in the rest of the world, so now would science. These ways of thinking, whether by religious scholars, theologians, philosophers, or scientists, had and still have, as we should recognize, so many horrific consequences for humans and the rest of the natural world. One such horrific consequence during Haeckel's time was eugenics.

Haeckel was far from being the originator of eugenics, but he was a member of the Eugenics Society. He also questioned whether it was good to allow those who are born severely disabled

to continue living and questioned whether it was immoral to allow someone who was severely depressed or mentally ill to end their own lives (Haeckel 1905: 101). These are questions that many still ponder today, and questions of *in utero* genetic testing, abortion, and designer babies bring all of this up. In some ways the conversation has not advanced beyond some of Haeckel's musings, but in other ways they have changed drastically.

First of all, the racial aspects of Haeckel's thought and the ethnocentrism of his thought would and should be roundly rejected by most scientists today (not to mention most educated people). The horrors of WWII revealed the worst of the technologies of eugenics and that line of thinking. Though I do not think Haeckel's ideas lead in a direct line to the Holocaust, as Daniel Gasman argues, I do think that placing humanity in an evolutionary context and then ranking different cultures in a hierarchy helped feed into that way of thinking (Gasman 1971).

Second of all, the Modern synthesis, the mechanism by which we now understand evolution to work, places the responsibility on genetic selection and variation, not on Haeckel's understanding of the protoplasm of the cell and recapitulation. For Haeckel, remember, information was "remembered" by a given cell's protoplasm. Within an organism, these cells made up societies, which were more democratic in things like plants and more monarchical in animals as you moved up the chain to human beings. His idea of recapitulation, that ontogeny recapitulates phylogeny, was that every individual organism went through the history of the whole course of evolutionary development. The developing organisms' environment—including the mother's womb, the environment/ecosystem, and education—led to the "higher" or "lower" developing of that given organism (Haeckel 1913; Brain 2009: 92–115; Haeckel 1898: 42). Thus, for Haeckel, science and medicine could intervene more easily and directly in the future of evolution than we would now think possible. The complexity of genetic selection, genetic variation, and evolutionary drift; our lack of understanding of the complexity of the genome and the role of epigenetics; and a non-hierarchical and non-progressive understanding of evolution today help to guard against the types of societal eugenic programs that were popular at the beginning of the twentieth century.

Third and perhaps foremost, we have had women's suffrage, civil rights movements, workers' rights movements, and a huge advance in communication and transportation technologies that allow us to see a pluralistic planet in a way that was not quite possible during Haeckel's time. None of what I say here is meant to excuse Haeckel from his racist and xenophobic interpretations of evolutionary history. Not all scientists of the time were ranking the races and cultures in terms of a progressive evolutionary scale. For instance, Virchow, one of the founders of ethnology argued vehemently against this approach to the point of rejecting the evolution of humans from primates. He maintained a separate and unified evolutionary history for human beings in order to combat the racist assumptions he saw being drawn from evolutionary theory. He argued for a monogenic origin of the human species, whereas Haeckel argued for a polygenic origin (Marks 2010). My question is why, at that time, "mono" and "sameness" were equated with equality, and "poly" and "difference" were equated with inequality? I argue that this has in part to do with the adoption of some lingering quality of monotheism into the very "scientific" worldview these scientists were beginning to construct. In other words, the monism proffered by Haeckel against dualism, idealism, and reductionism, even though it was a "triune" and what I might call a pluralistic monism, still had a strong understanding of the oneness and unity of ultimate truth.

Accordingly, differences had to be rank-ordered according to their value and/or veracity. This was as true for differences in hypotheses as it was for visible differences among cultures and races. Whereas Virchow rejected the evolution of *Homo sapiens* from primates in order to maintain the unity of (and thus not rank the differences among) *Homo sapiens* cultures, Haeckel

assumed that if humans evolved from the rest of the natural world, there were probably different primates from which extant humans evolved (a polygenic origin), and thus these differences could be ranked.

The tension here is not really, in my mind, unity vs. diversity, but the way in which one values and accounts for differences. In a monotheistic view of truth—which was assumed by the Natural Sciences in terms of Natural Laws that could be discovered, objectively via Reason—multiple truths about a set of given facts can be problematic. Objectivity, under such a system, calls for conformity; otherwise, objectivity gives way to relativism. This false binary between objectivity and relativity has plagued Western religious, philosophical, and scientific thinking because of its equation of objectivity at some level with unity.

However, I would argue that such thinking goes against the grain of Haeckel's own understanding of a triune monism in which there are no "bare" facts, there is no "thing in itself" removed from relations, and in which all ideas and values are "a posteriori." In other words, there is no logical reason why differences must be ranked in the way that Haeckel ranked them. His ranking was simply a cultural bias that he was unable to see as such and which had racist and xenophobic implications. It is not uncommon for scientists breaking into new territory to allow their own biases to prevent them from following through with the conclusions of their own thinking: Darwin himself did not want to suggest that humans were evolved from primates, and even Einstein in the twentieth century did not want to admit that his mathematical conclusions suggested that the universe was expanding (he wanted it to remain constant). Though not all biases have immediate and negative social consequences, they are biases nonetheless.

We must learn from these mistakes. From where we stand in a pluralistic, globalized world, within a 4.5 billion-year-old understanding of planetary evolution, and a 13.8-billion-year-old understanding of universal expansion, our entangled reality can be entangled without being unified under one truth. In other words, perhaps because we are multiply embodied creatures, none of whom can escape that entangled embodiment and achieve a "god's eye" view of the world, the manifold, multiple perspectives on reality are what give us a sense of what Sandra Harding calls "strong objectivity" (Harding 1993). Strong objectivity simply means that if we are really going to take seriously our embodiment, the subjectivity of the observer must be taken into any accounting of the facts. Furthermore, it means that different embodiments will likely see different aspects of the world and have different accounts of the same phenomena or event. We gain "better" understandings of the world the more perspectives we can listen to and include. Rather than orthodoxy, we might be in a place in our planetary journey where polydoxy suits us much better. Polydoxy is, however, much messier and requires that we allow for some type of uncertainty in our own understanding of the world so that we can let other understandings in and seriously entertain them as well. This is not unlike what Haeckel and the Romantics were doing in their own time. Thus I end with a brief spiraling back to the nineteenth century in order to make sense of our own context.

Conclusion

Although there are many differences between nineteenth-century Germany and our own era, such as the fact that we are now living in a much more globalized and hyper-connected world, thanks to the speed of advances in communications, transportation, and production technologies, there is also much we might learn from that era. As stated earlier, in the nineteenth century there was not yet a decided upon, single methodological foundation and worldview for the

natural sciences. Some argued for idealism or materialism, others dualism, and still others for some combination that was pluralistic and/or non-reductive. This methodological/epistemological/ontological pluralism is something that might benefit us today as we navigate the multiperspectival planet of which we are a part. One type of explanation does not fit all (despite the hope of most of these nineteenth-century scientists). For instance, despite Haeckel's focus on what I would call perspectivism (that there are no bare uninterpreted facts and that all ideas are a posteriori), he still concluded that the emerging natural sciences (and especially evolutionary theory) would one day solve all of the world's riddles. Where single explanations still ruled the imagination among nineteenth-century scientists, perhaps a hangover from a monotheistic worldview, multiple methods, explanations, and causality can and perhaps should be embraced within the sciences (broadly conceived) today.

It is also, finally, important to remember that many nineteenth-century scientists, especially of the romantic stripe such as Haeckel, were already beginning to struggle with the problems of the Industrial Revolution. Goethe, von Humboldt, Bölsche, Fechner, and Haeckel, among others, were in part seeking a naturalistic worldview that would take account of all of nature, in light of a world that was rapidly being changed through the instrumental assumptions about nature during the Industrial Revolution. Forests were disappearing, pollution was becoming a problem in cities, and already societies concerned about the preservation of animals were beginning to appear. It is not too much of a stretch to see the parallel with our own situation today, even though our changes are happening at a much more rapid pace.

The non-reductive models for understanding a naturalistic worldview, and thus for providing a non-reductive basis for the natural sciences, were all but swept away by the demands of the War Industry in the two World Wars in the twentieth century. Scientists were coopted by a technology transfer model (one in which science became reduced to technological outcomes), which is based upon an instrumental, reductive, and productive model: first for war technologies, then for agriculture in the so-called green revolution, and later for continued advances in transportation, communication, health, and production technologies in general. This "development" model for science, though it has brought humans many benefits, began to clearly buckle around the late 1960s/early 1970s with the publication of Rachel Carson's *Silent Spring*, and the beginning of the modern environmental movement (Carson 1962). In other words, science has again begun to question models that are reductive and begun to throw chaos, complexity, probability, and emergence into the analysis of natural phenomena and events. It may be time to critically retrieve some of these nineteenth-century models for the future of a planetary community: one which may come to see reductive materialism as a 40-year blip within the history of the natural sciences rather than as the normative basis for a naturalistic worldview.

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