

Religion and the Environment

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The Revolution of Evolution¹

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Introduction

[1] Although I studied and worked in the area of theology and ecology, and was conversant with myriad environmental theories and religious approaches to ecological issues, it took many years to recognize that I knew little science. I was aware of the politics of water, but knew nothing about the molecular dynamics of water or the hydrologic cycle. I knew something about biotechnology, but not about evolutionary genetics. Deforestation was evident, but how does an acorn become a tree? With some shock, I realized that I was ecologically illiterate. Thus, I began to study Earth sciences in general, and evolution in particular.

[2] Turning my attention to these fields has propelled a shift in perspective. To engage with evolutionary thinking is to take the Earth seriously in ways that were previously unfamiliar. Moreover, addressing evolution in the context of ecological concerns contributes new challenges to the field of religion and ecology. This field is indirectly tied to the debates surrounding evolution and creationism: debates that are of particular concern from the viewpoint of mobilizing religions in the face of ecological peril.

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[3] This article offers some preliminary associations between evolution and the field of religion and ecology. The first section is a brief summary of aspects of evolutionary processes, including a glance at creationism and intelligent design. The second section addresses evolution in the context of current ecological problems. The final section suggests various ways in which religion, the ecological crisis, and evolution could be brought to intersect. For those well-versed in evolution, the descriptions will be introductory. I hope to persuade those who, like myself, labor in the fields of religion and ecology, of the need to attend to evolutionary processes, and to experience this “revolution of evolution.”

The Evolutionary Process: An Outline

What is Evolution? Evolution is not merely an idea, a theory or a concept, but is the name of a process of nature (Ernst Mayr).

[4] Evolution describes the processes of the natural world, from the origins of life to the present. It addresses the dynamics between a common genetic base of life and the mechanisms of population changes over generations: or descent with modification. While seemingly simple, contemporary notions of evolution refer to a synthesis, consensus, or mosaic, building on but far beyond Darwin or neo-Darwinian notions of natural selection.² The evolutionary synthesis comes from dozens of disciplines: paleontology, genetics, biology, botany, embryology, genetics, biochemistry, taxonomy, geology, ecology, and natural history. Evolutionary data includes research on specific relations between amino acids, proteins, cell structures, genetic sequencing, gene flow and drift, and mutations. This is combined with analyses of morphology, radioisotope-dating, environmental stress, and extinctions. Each part is precise and technical.

[5] Evolution has micro mechanisms of change, such as phenotype and genotype relationships, and macro mechanisms related to changes in ecological niche and inter or extra-species stress. The process of evolution is non-sequential, nonlinear, and uneven, leading to terms such as punctuated equilibrium, and emergent or developmental evolution. Just one evolutionary process – natural selection – is itself a composite of dynamics, adaptations, genetic transformations, speciation, opportunities, and environmental and population changes. Evolution delineates complex processes of multiple and intricate mechanisms. It represents the gathering of data from distinct methods and ongoing changes in theories, resulting in a colossal amount of evidence. Really to understand the processes and mechanisms of evolution requires teams of researchers engaged in sophisticated and detailed observation, analysis, and interpretation, with an ability to suspend judgment in the face of the unexpected. The overwhelming agreement is that evolution is not a hypothesis: it is the developing descriptions of the dynamic and organic processes of life on Earth.³

² For a detailed explanation of the multiple meanings of evolution, see Meyer and Keas.

³ There are intense debates concerning which are the primary evolutionary mechanisms – for instance, concerning the role of behavioral changes or genetic mutations, and whether evolution is merely *matter in motion* or if change occurs from multiple pressures and innovations. I am not questioning the relevance of these debates; however I am presenting evolution through a wide lens, using recent interpretations suggesting that the processes are dynamic, organic, intricate, inter-related and composite.

Synopses of Evolution: A Bird's Eye View of a Few Billion Years

[6] The earth is approximately 4.6 billion years old. Early Earth was turbulent beyond the imaginable. The stabilization of a planetary atmosphere took a billion years. There are ongoing debates about the processes: the concentrations of carbon dioxide, hydrogen, and nitrogen; the progression of heating and cooling; the solidification of the core, mantle, and crust; the pervasive volcanic activity, and the rate of gasses escaping the atmosphere. The debates are significant because the clues to the origins of life are buried in this era. The emergence of life depended on the surface and atmospheric conditions. For example, if early Earth had a carbon dioxide-dominated atmosphere, then it is possible that life originated in hydrothermal vents in the sea. But if the hydrogen concentrations were high, then amino acids – that likely formed from organic materials in the hydrogen-rich environment – may have accumulated in the oceans, lakes, and swamps, enhancing potential birthplaces for life (see Tian et al. for a sample of these discussions).

[7] A hydrologic cycle, an extraordinary feat of engineering, was formed over millions of years. Life, as we define it, existed approximately 3.8 billion years ago. Initially there were prokaryote cells – various bacteria reproducing by binary fission. A billion years later there were eukaryotes with nucleated cells, chromosomes, proteins, mitochondria, sexual reproduction, and aerobic metabolism.⁴ This is the beginning of the basic structures common to all life: ribonucleic acid and later deoxyribonucleic acid. These processes are studied extensively, but it is widely accepted that the processes are earlier than the first cells, and the conditions and mechanisms of the emergence of life are obscure to human scrutiny.

[8] As photosynthetic life increased, it reduced the carbon dioxide content of the atmosphere and produced oxygen. This oxygen was first absorbed by continental rock beds, and remains embedded in these ancient structures. When the atmospheric oxygen accumulated, the ultraviolet light in the atmosphere split the oxygen molecules, producing an ozone ultraviolet shield. Only at this point did life move out of the oceans. For the next 2.5 billion years life emerged, developed, complexified, diversified, and evolved, but little is known of these life forms.

[9] By 500 million years ago vertebrates were established, beginning an extensive fossil record and providing crucial contributions to the evolutionary synthesis. From about 570 to 530 million years ago an evolutionary burst of life forms occurred, referred to as the Cambrian Explosion. This era began a drama like no other: life colonized Earth's surface for 249 million years. Vertebrae, respiration, photosynthesis, photosensitive eyes, complex reproduction processes, and internal organs evolved. Fish dominated the waters, followed by the development of limb structures; there were arthropods and amphibians, and the beginnings of care of the young and memory.⁵ Plants colonized the land. The variety of life

⁴ This is the conventional view. However there is much discussion about early processes between prokaryotes and eukaryotes. Did prokaryotes absorb alien bacteria? Did temperatures increase allowing for greater variations of molecular dynamics? Did these two basic cell structures co-exist in the emergence of life? See Chin et al.

⁵ The evolution of memory is an important area of research, ranging from cell memory and immunology to the care of offspring. I am referring to life forms that attended to their young, even minimally. However it is likely

forms – now extinct – staggers the imagination. The origins of the major lineages of most organisms are here.

[10] For over 200 million years life flourished and expanded, in spite of two extinction periods (439 and 364 million years ago). And then, 251 million years ago, from the bowels of the Earth, major volcanic activity shook Pangaea, the only continent. Tremendous eruptions, lasting 600,000 years, spewed basaltic lava onto the Earth's surface and carbon dioxide emissions into the atmosphere. The biological extinction was the most serious ever. It is estimated that between 80% and 90% of marine and terrestrial organisms were gone.

[11] Meanwhile, plate tectonics shifted, transforming one land mass into several continents. It was another 100 million years before the biodiversity recovered to anything like previous levels. Again life came from the sea. Again, time, in millions of years, was needed for the establishment of diverse sea life, reptiles, insect and plant linkages,⁶ and a few mammals. But in this era there were mammoth and daunting sea creatures, and on land, the dinosaurs. I often ruminate that various dinosaur species were the dominant creatures for one hundred and seventy million years; an impressive track record. (*Homo sapiens* has existed for fewer than half a million). This age of the reptiles was truly fantastic. It is unfortunate that few humans over five years old know or care much about the dinosaurs. The fate of these formidable creatures, along with 47% of marine genera and 18% of land vertebrate families, was likely sealed by a meteorite and the ensuing climate change: a fluke occurrence really, and perhaps the only reason we are here.

[12] Evolutionary processes generated life again, but the recovery of biodiversity was chaotic, according to paleontologists. New fossil evidence shows that at certain times and places, plant and insect diversity were not linked as they are now (see Wilf et al.). Millions of years were needed to regenerate and innovate pathways for the emergence of life and the egression of our era, the Cenozoic, or the age of birds, fish, flowers, and mammals. Mammals thrived, developing hooves or pads, composite vision, placenta, grinding teeth, and herbivore and carnivore digestive tracts. Many animals existed in familial structures and/or bonding patterns: pods, herds, packs, flocks, colonies, hives, prides, gaggles. Diversity and complexity are characteristics of the Cenozoic.

[13] From mammals emerged multiple species of squirrel size, then primates, monkeys, proto-primates, and apes. From 23 million years ago there is evidence of the first hominids, likely from bonobos and chimpanzees (98.77% of DNA base pairs are identical between humans and chimpanzees.) This animal was bipedal four million years ago, with a shift from *homo erectus* to *homo sapiens* four to three hundred thousand years ago. Here is a creature with technological savvy, greater memory, elaborate brain functions, symbolic representation, culture, language, and consciousness, loosely defined.

there is a connection between cell and tissue memory and the emergent forms of sophisticated memory. The relationship between consciousness and memory is a distinct terrain, not explored here.

⁶ The evolution of plants and insects are often considered together, and it is widely thought that plant/insect relationships have some stability in evolutionary time. Further, it is evident that the evolution of new insect groups was driven by the evolution of new plant groups. This has repercussions in eras of extinctions, as plant-insect linkages are one of the engines of evolution.

[14] This tale is told with reference to linear time, but this process is not linear in any conventional way. It is living and dynamic, not orderly or mechanistic, not random nor determined. It is patterned but not predictable. To understand evolution fully is impossible. The level of precision is astonishing. Each aspect mentioned has volumes of evidence and publications attesting to it. Data cross numerous disciplines from geology and plate tectonics to particular amino acid reactions in biochemistry. The terms “evolutionary mosaic” or “synthesis” represent the combination and assimilation of an immense quantity of data. The synopsis above is generally agreed, although some of the mechanisms of transformations are deliberated. And it represents a droplet in a sea of data.

[15] Why is this relevant to religion and ecology? There are at least two reasons. The first, less significant but more immediate, concerns the opposition to evolution from some religious – most often Christian – quarters. The second, and central, reason is that to take evolution seriously is to change reference points. It means genuinely situating ourselves within, not apart from or as the final note of, a compelling, ever-changing symphony of life. This change in reference points has implications for the way in which we think about ecological concerns in the context of religion. But first, I offer a glimpse at the opposition to evolution.

When Debates Become Controversies: Creation, Intelligent Design, and Evolution

[16] The first controversy surrounds the claim that *evolution is a theory, not a fact*. Theory is juxtaposed to fact. Theories are usually seen to be provisional, hypothetical, substantiated [or not] by facts. However, in science a theory is neither a hunch nor a hypothesis. It is a systematic expression of data (Mayr). It is predictive, logical and testable.⁷ In science, a body of knowledge is called a theory only if it has a firm empirical basis, supported by many strands of evidence rather than a single foundation. A scientific theory is correctable with new data and is empirically testable. For science, evolution is a theory, meaning it best represents the facts. Evolution is not a hypothesis, a guess, an idea, or an ideology. It is the name of foundational processes and patterns of life. While evolution is overwhelmingly accepted by the scientific community, there are debates and knowledge gaps. Among scientists the debates center on the processes and mechanisms of evolution, not its validity. But those who oppose evolution use these internal debates to discredit the deductions. The main players in these controversies are those espousing creationism or proposing Intelligent Design.

[17] Although there are many versions of *creationism*, the following is a summary of shared oppositions to evolution. The starting point is most often, as suggested above, that *evolution is just a theory, not a fact*. Creationism is then presented as an alternative or counter theory. As such, neither evolution nor creationism can offer proof or facts. Therefore they must be treated equally.

⁷ Science is, of course, dependent on variable theories that contain assumptions, biases, and values that influence the data. There is no direct access to the facts. What is relevant here is that the habitual division between theory and fact, as adopted by creationists, is not the customary approach in the sciences.

[18] Creationism provides two bases from which to refute evolution: biblical and scientific. The primary reference is the Bible (with little or no discussion about historical analyses, epistemology, hermeneutics, or critical/political theories). Evolution is opposed because it is not in the Bible, and the Genesis account is perceived to be the alternative and more genuine creation account. Evolution is dismissed because it is in opposition to faith, characterized by the mantra “I choose to believe in God rather than evolution.” Many creationists are young Earth theorists, who claim that the Earth is between four and ten thousand years old. A common belief is that humans are not primates, and that ontological divisions exist between humans and the rest of creation. Creationists’ scientific objections to evolution are less homogenous, and here I will address only a few, as they arise more particularly in work on Intelligent Design.

[19] *Intelligent design* is significantly more complex, diverse, and intellectually compelling than creationism. For example, generally speaking, intelligent design advocates accept aspects of evolution and scientific methods. They agree that the Earth is 4.4 billion years or so old (thus conflicting with young Earth creationists) and frequently accept much of the evolutionary synthesis. The intelligent design and evolution debates usually focus on scientific data, although most Intelligent Design campaigners are not scientifically trained.⁸

[20] Proponents of Intelligent Design (ID) hold the view that:

. . . certain features of the universe and of living things are best explained by an intelligent cause rather than an undirected process such as natural selection. In a broader sense, ID is simply the science of design detection – how to recognize patterns arranged by an intelligent cause for a purpose (Intelligent Design Network).

The modest versions of Intelligent Design claim to be an intellectual movement that includes scientific research, and investigates intelligent causes or design. The purpose is to detect or discover intelligence and design within natural processes. They challenge naturalistic or happenstance explanations of life origins, evolution, systems complexity, emergence of consciousness, and intelligence. Further, they see the implications of intelligent design and purpose within the scientific data.

[21] Intelligent Design positions are in “scientific disagreement with the core claim of evolutionary theory that the apparent design of living systems is an illusion” (Intelligent Design Network). Here is where intelligent design is controversial. On the one hand, intelligent design is a theory presupposing design and purpose. It focuses on patterns and systems interpreted from scientific data. On the other hand, Intelligent Design supporters do not make overt the claim that disagreement with evolutionary science is more philosophical than scientific. Thus many evolutionary scientists reject the science, the implications, or both.

⁸ There are vitriolic exchanges about intelligent design and its use of science. Intelligent Design is frequently criticized for its lack of scientific merits, including scientific training, methods, results, and self-reviewed rather than peer-reviewed publications.

[22] There is much discussion about intelligent design and its relationship to religion. Most Intelligent Design advocates claim that theirs is not a religious position, and distance themselves from religion or evolutionary theists. Design inferences can be compatible with religious views, but Intelligent Design, strictly speaking, is not a religious stance. However, other Intelligent Design positions do conflate design and designer, hence lean towards or explicitly hold a religious position. In addition, some Christian theologians use the work of Intelligent Design to make theological claims, further confusing the issues.

[23] The relationship between intelligent design and creationism is not straightforward, and is tangential to this discussion. However, even when the distinctions are blurred, there are irreconcilable differences between the best of Intelligent Design (tentative implications, acceptable scientific methods, a few peer-reviewed publications) and the worst of creationism (biblical literalism, scientific illiteracy, dogma passing for factual truths, etc.).

[24] Creationists and Intelligent Design proponents challenge the evolutionary synthesis on specific grounds, though their reasoning differs. I will outline a sample of three challenges that expose how each considers evolution (for more precision and further debate, see the American Museum of Natural History). The bulk of the creationist arguments and the scientific data are omitted here, but there are innumerable discussions and publications, and literally millions of web sites to turn to for further information.

[25] *Origins of life.* What conditions, processes, combinations of proteins, nutrients, and RNA were necessary for the first forms of life? Neither the first emergence of life, nor the appearance or development of eukaryote cell structures, are fully understood. Life cannot be reproduced in a lab, and the actual materialization of life has never been witnessed. For creationists, evolution offers no valid explanation. From an Intelligent Design viewpoint, the odds against life coming from non-life are insurmountable, and there is insufficient science to substantiate the claim that such a thing could happen. While life may have emerged according to natural processes, intelligent causes and design and/or a designer are involved. The origins of life were not random, directionless, or chance.

[26] *Speciation.* This branch of macro evolution is about the emergence of new species. There are different rates and processes involved in the evolutionary changes of species (Eldridge and Gould). Gradualism and punctuated equilibrium are two ways in which the evolution of a species can occur: by only one of these, or by both. From the perspective of evolutionary science the emergence of new species is unquestioned. Thousands have been documented, but the mechanisms of speciation are not fully known, and there are numerous gaps in the fossil record. For creationists, new species cannot emerge from existing ones; the gaps in fossil records are evidence of this. Evolution and the mechanisms of species change, according to creationists, occur due to direct and directional divine intervention. Intelligent Design accepts some speciation, but Intelligent Design advocates take different views on this. For example, some argue that speciation cannot explain the emergence of consciousness; others argue that it cannot explain the appearance of *homo sapiens*.

[27] *Natural selection.* This field of study represents combined processes of micro and macro evolution, genetic dynamics, and population and environmental pressures. In evolutionary science, the debates focus on which processes are primary or secondary. Nonetheless, most agree that natural selection seems to favour development, diversity, and complexification. A

central, defining question is: are the processes of evolution random, determined, or directional? Much depends on the answer. Some scientific views lean towards materialist reductionism and happenstance: the emergence of complexification is no more than the best survival strategy. There is no directionality, meaning, or purpose that can be determined from within these processes. Richard Dawkins, Stephen Jay Gould, and Daniel Dennett are proponents of this view, although they put forward different forms of it. Other scientists, such as Ernst Mayr, claim that while evolution can be appreciated as a mixture of determined, random, and open-ended processes, the processes seem to be oriented towards complexity and diversity, even consciousness: a kind of *directional groping*. This may be a valid interpretation of the repetition of emergent complexities after extinctions. For creationists and advocates of Intelligent Design, life processes are, overall, not random. The sheer complexity and diversity of life cannot be explained by natural processes. It is purposeful, designed for the complexifications we observe. Without intelligent cause and design, life would not go in this complex, diverse, and indeed intelligent direction.

[28] There are two infamous disputes between Intelligent Design and other evolutionary theorists. One is that of *irreducible complexity*, a term originating from biochemist Michael Behe. He argues that biological systems are irreducibly complex at the molecular level. Irreducible complexity is defined as: “A single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning” (39). Behe presents immunity, blood clotting, and the evolution of bacterial flagellum as examples. Others refute these examples vigorously, and contest that they are neither irreducible nor evolved as a single system.

[29] Intelligent Design icon William Dembski,⁹ promoter of the idea of *specified complexity*, or complex specified information, notes that evolutionary patterns of life are complex and specified, and at times are both. Dembski suggests that DNA is a prime example. It is unlikely, on his argument, that specification and complexity would combine by chance, and thus is a clear marker of design. Dembski claims that contingency can explain complexity but not specification, and certain scientific laws can explain specification (as in crystals, for example) but not complexity. Specified complexity is difficult to interpret, and thus Dembski argues that design is embedded within natural processes and produced by an intelligent agent. While current scientific approaches may be inadequate to explain specified complexity, the scientific and at times theological opposition to Dembski’s Intelligent Design interpretation is pervasive and persuasive.

[30] The major difference between creationists and Intelligent Design proponents lies in their grasp of science. Creation science is intellectually incoherent, and scientifically illiterate. It ignores vast quantities of data and masks scientific intricacies. Creationism is a religious ideology, and is religiously and scientifically reductionist. Intelligent Design may be a sophisticated version of creationism, but its proponents have a better understanding of scientific issues. In one sense Intelligent Design is a counter hypothesis to the materialist reductionist scientific worldviews and commitments to a meaningless universe and random

⁹ William Dembski is a key developer of the scientific merits of intelligent design. He is a mathematician, philosopher and a conservative theologian.

life processes. For Intelligent Design, evolution has considerable but insufficient explanatory power: some Intelligent Design proponents borrow notions of an anthropic principle (Barrow and Tipler: 21) and a fine-tuned universe from which to make a case for intelligent design. Their chief argument is that intelligence, and hence design, is evident in evolutionary science. However, Intelligent Design fails to meet conventional scientific standards. Thus, the Intelligent Design conclusions are either scientifically implausible or are moving within a level of meaning that cannot be derived from science.

[31] Most theologians who take evolutionary science seriously, and believe that God, providence, or even directionality is at work within evolution, reject Intelligent Design. This includes a range of scholars working at the intersection of religion/theology and evolutionary science, such as John Haught, Anne Primavesi, George Coyne, William Stoeger, and Ian Barbour (see Russell et al.). They maintain that evolution best represents Earth's processes. They are careful as to what one can extrapolate from science, and where religious reflection begins. For these theologians, God's divine action is embedded in evolutionary dynamics, not extraneous to it. Natural processes have sufficient explanatory powers. They are adamant that there is no direct, "special" divine intervention at any time within evolutionary processes. From religion they use multiple metaphors – kin to Teilhard de Chardin's idea of the *divine milieu* – to claim that we are "in God," within Divine consciousness, or enfolded within a process of Divine revelation. These theologians adopt varying positions on questions such as the significance of the human species, theistic evolution, and the relationship between religion and science. They do not, however, diverge on their commitment to understanding evolution on scientific terms. Further, they do not waver in a commitment to accepting the world as they find it, and in acknowledging that what is there has primacy over what is believed to be there.

[32] Evolution is the umbrella term for the dynamics of emergent life. Nonetheless, there are many intriguing questions surrounding evolution. Is life just random experiments and waste? After all, most creatures have become extinct. Or is it about abundance? Is the Earth self-organizing, even alive? Why, for example, is the basic morphology of vertebrates the same? Is this an evolutionary prototype? Are evolutionary options limited? What about the evolution, extinction, and re-evolution of photo-sensitive eyes? It is curious that such an eye has evolved independently in at least forty autonomous evolutions, with at least nine distinct design principles (Nilsson and Pelger: 53-58). Is there a direction to evolution? The patterns of emergence, the self-organization of vital systems, or the advancement of consciousness evoke engaging questions of evolutionary orientation, or even teleology. The answers are tentative. What is certain is when evolution is considered seriously, it is impossible to take humans to be the reference point: either in time, in the process, or as an end point. Humans are emergent from dynamic processes, not – in any way – central to them.

[33] The debates from creationism and Intelligent Design focus attention, absorb energy, and oblige responses (for discussion and bibliography, see Crouch et al.). In North America, evolution is on trial, again, and is being contested in courts and in several educational and religious institutions. Removing evolution from science curricula, including in universities, is occurring; there is already considerable illiteracy in Earth sciences and evolution. In a Gallup poll conducted in 2006, almost half of Americans questioned stated their view that human beings have not evolved, but were created by God in their present form within the last

10,000 years or so (Newton). This is not just an American phenomenon: over 30% of UK students reported believing in Intelligent Design and creationism rather than evolution (*Guardian*). In addition, the Gallup poll revealed that religion is the greatest determiner of how evolution is understood.

[34] I am persuaded that our lack of attention to and understanding of basic evolutionary dynamics limits our capacity to respond to the ecological crisis. The next section presents a few ways in which addressing the ecological crisis from an evolutionary vantage point alters one's viewpoint.

Evolution and the Ecological Crisis

[35] What of the ecological crisis? It is scandalous, and staggering. It is of a magnitude comparable to two previous eras of massive extinction and ecological disruption: 280 and 65 million years ago. There is an immense amount of data about current ecological stresses. One only has to attend briefly to see crisis: immanent, unpredictable, and consequential. Yet it remains arduous to awaken to the depths of this crisis.

[36] How does understanding evolution influence responses to the ecological crisis? I will outline four ways in which addressing the ecological crisis in light of evolution could alter one's perspective.

Evolution, Extinctions, and Deep Time

[37] To integrate evolution into our worldview we must expand our notions of time. Evolution requires, and brings to awareness, a sense of geological or deep time. Although we can measure deep time, it is difficult to think habitually in these terms. In addition, while the contemporary crisis is acute, it is not the first severe ecological calamity. Evolution reveals that the capacity for life regeneration is formidable and that it can and has regenerated, albeit with new variations. Such a view is not meant to induce apathy about present ecological concerns, but rather to give some perspective.

Evolution Changes the Reference Points

[38] This change, or revolution, is kin to but more extreme than the Copernican revolution. The necessary shift in Western worldviews from anthropocentrism to geocentrism is massive. It is startling to notice to what degree humans are self referencing and self absorbed: our lives, cultures, worldviews, habits, cities. We are ever creating more theories about ourselves. We teach children about the world of humans, attending only to the past few thousand years. Maybe this is unavoidable, and is a necessary form of species myopia or honed survival strategy. But it is odd that education for most urban Euro-western children is a diet of diverse concepts and theories about ourselves and "our world," but not, for example, about how to grow food! The natural world continues to be depicted in reductionist and mechanistic terms. Any history prior to the human presence is considered irrelevant.

[39] Regardless of our ignorance, we are embedded in and surrounded by immense life-projects. We are the only species to develop a particular conscious awareness of the

emergent process whence we came. Consideration of evolution invites attentiveness to processes of emergence, complexity, diversity, patterns, ingenuity, and inter-relations. It serves as a constant reminder that we are not the reference point. We can understand and experience our kinship with other animals. Evolution provides us with a time line, of histories that do not involve us, and of seeing our radical dependency on hundreds of other organisms for basic survival. Evolution bends the mind, expands the horizon, and reverses the reference points. Earth is not our context, it is our source.¹⁰ Such a view has not been integrated into any western discipline except evolutionary studies, and that is under siege. Evolution beckons us to become scientifically literate, and to situate ourselves in a larger physical reality, in a larger horizon of meaning. Evolution changes our reference point from ourselves to Earth.

Evolutionary Recovery: Or Not?

[40] Some researchers have been looking specifically at the ecological crisis in relation to its impact on the regenerative process of evolution.¹¹ Two concerns will be discussed.

[41] *Extinction of species and biodiversity loss.* Briefly summarized, the era of large mammals and many vertebrae is over. There are insufficient numbers and genetic diversity for the known processes of natural selection to continue (Myers and Knoll). When we add habitat and biodiversity loss, disruption of food chains, and climate change, their possibilities for survival are nil. Although the Earth has experienced massive and sudden extinctions, the conditions in the past were different, with the majority of life in the sea. Now much life is on land, and evolution is dependent on biodiversity and biomass, both of which are being rapidly destroyed. The disruption of wetlands, rain forests, coral reefs, and other engines of biodiversity are accelerating species extinction, and damaging the known building blocks, or engines, of evolution. Evolution is opportunistic, but as it is understood today, the processes depend on intact habitat, nutrient systems, symbiosis, plant-insect linkages, and other bio-systems. The predictions vary in the details, but not in the consensus that it will take the Earth at least seven to ten million years to move towards re-establishing life systems and evolutionary processes again. Conservation biologist Michael Soule poignantly summarizes the point: evolutionary death is one thing, but the end to birth is another (quoted in Myers and Knoll: 5389).

[42] *What evolutionary trajectories will be established?* There are evolutionary impacts from mass extinctions, and something about the future can be gleaned from studying the past. Predictions, based on prior extinctions, suggest that the future dominant species will be those who currently do well in human habitats: insects, rodents, viruses. Norman Myers says that while evolution is not predictable, the trajectories show little possibility of large mammals reemerging. Based on what is understood of previous recoveries, two-thirds of the

¹⁰ This awareness permeates the work of Thomas Berry, but at a cosmic level. My comment is adapted from John Haught (2003).

¹¹ I refer here to an excellent set of print and online publications from the National Academy of Sciences Colloquium on *The Future of Evolution* in which fifteen authors explore the relationship between the present ecological crisis and issues and prospects of evolution using current science.

Earth's surface need to be protected today from any human interference to allow for the evolutionary process to strengthen for a future recovery. This is much more than just the conservation of present biota. We cannot salvage this era. The question is about the future of evolutionary processes. Myers and Knoll write:

From the standpoint of future evolution, it is surely more appropriate to safeguard the main potential for diversity generation than to emphasize the primary focus of many current conservation programs viz. individual taxa and especially endemic taxa (5389).

[43] The question is about future complex life on Earth, for which we need to save the building blocks of evolution. Not enough is understood about the processes of evolution to know where and how to intervene. We may be deciding about an evolutionary future in a scientific vacuum. We have tampered with a biotic system that will have repercussions for millions of years. But we have some choices about the extent of the damage.

Evolution and Worldview

[44] Some argue, as have I, that the heart of the ecological problem is that the Earth and the natural world are seen as resources without intrinsic value. When we emphasize radical distinctions between humans and the natural world, we maintain a false and currently fateful separation (Myers and Knoll: 5389). To integrate the reality of evolution situates us in the process, countering the emphasis on radical human/nature difference. To appreciate evolution is to appreciate the human bond, indeed intimacy, with the natural world. This gives insights into evaluating the adequacy of responses to ecological issues.

[45] Evolution contributes to a new worldview. Never before have we known as much about the reality in which we live. This knowledge can inspire. To realize the import of evolution is to be dazzled by the process, to marvel at the genius of the water cycle, to be amazed at the inter-relations between proteins and amino acids, to delight in the extraordinary power of earth worms or dinosaurs, and to appreciate the sensitivity of mammals. To examine a few of Earth's biotechnology projects puts all our genetic tampering and biosystem manipulations to shame. To stand in front of this immense and intimate reality educates and expands our worldview. To sense the vastness and ingenuity of evolution awakens a psychic energy. This is, of course, an optional interpretation.¹² But even without inspiration, the ending of the Cenozoic era due chiefly to human ignorance compels responsible and intelligent actions.

[46] Given these four insights that an evolutionary horizon offers in responding to the current ecological moment – deep time, reference points, evolutionary recovery, and worldview – the next section will explore how these can assist religious efforts in response to environmental crisis. I suggest that one can only understand the implications of the ecological crisis, and thereby develop religious responses, when one has understood, at least in a broad sense, the dynamics of evolution.

¹² I am well aware that another option is to see waste and endless suffering, with an emotional response of despair and conclusions that it is pointless and meaningless. The manner in which we present evolution can lead either to this conclusion, or to mine.

Evolution, Religion, and the Ecological Crisis

[47] How do we integrate evolution into religious responses to ecological concerns? This is urgent, challenging, and fraught with hazards. Four hazards that hamper the integration of evolution will be presented, followed by three contributions, I will argue, that religion can make to the discussion.

Hazards

[48] *Ignorance of evolution.* There is an enormous need for ecological literacy: to learn Earth sciences and develop a basic understanding of the Earth's processes. Evolution is not well-integrated into Western cultural landscapes or religious horizons. This is certainly true of Christianity. Theologian John Haught argues that much of the reluctance of Christian theology to address ecological issues in depth stems from a prior reluctance to think about evolution, and its relationship to God (1993: 32). Further, it is conceivable that the absence of grounding theological precepts in evolution has caused an absence of concern for the natural world.

[49] *Interpreting evolution.* There are risks in interpreting evolutionary insights as if they are teleological claims. For example, many suggest that evolution moves towards intelligence. From science there is a shared presumption that increased intelligence has been actively selected for over evolutionary time. But the reasons for such a selection differ: passive evolution, language development, tool invention, and/or successful social navigation. If intelligence is part of brain structures, then the argument for intelligence selection is less clear. Other evolutionary options exist for brain structure and dynamics. The cetaceans, for example, have a highly elaborated brain that took a different evolutionary trajectory from a shared ancestry 85 million years ago. Thus while evolution may move towards intelligence, it is not always the case or in the same form. Nor is it self-evident how or why, and within what kinds of dynamic processes.

[50] A second interpretative danger is reductionism or simplification. Some evolutionary concepts seem transparent, yet they rarely are. The acumen of evolutionary sciences cannot be underestimated. Although there are religious intimations to some evolutionary insights, uncritical confluences of religion, spirituality, science, and philosophy without understanding the research pathway and tools of each leads to superficialities or errors. Therefore, it is important to suspend bias and delay judgment.

[51] At the same time, it is essential to affirm the bold explorations and interpretations emanating from the Earth sciences and evolutionary studies. The observations of self-organizing wholes and emergence and dynamic principles offer great insights. Ancient terrains are being re-explored with new analytic and interpretive tools and scientific acumen. It is an era of genuinely new approaches, perceptions, and intuitions. Inferences are irresistible. One can readily find extrapolations of evolution in consciousness research, theosophy, transpersonal studies, psychology, physics, and quantum holograms. It is vital not to tether new insights to certainties, or subsume them into habitual modes of reflection. We need to cultivate genuine openness to the unexpected. And it is vital to use all modes of critical appraisal.

[52] *The concept of evolution is flexible.* The meaning of evolution has sprawled far beyond any scientific parameters. It is often referred to in a quasi-scientific, spiritual manner. Often evolutionary data is ignored. Evolution is manipulated for corporate purposes. Pro-biotechnology efforts assuage concerns by saying that it is our right and duty – even that it is “in our nature” – to genetically improve life on Earth. Companies use slogans such as “giving nature a nudge towards greater efficiency,” “fighting for a better world, naturally,” or “to do better than mother nature.” Robotics, nano-technology, and genetic engineering use evolution to support their futuristic claims and current practices. Some theologians use similar arguments, notably Ted Peters:

What’s wrong with envisioning God perching on the side of a petri dish . . . ?
. . . we must also accept the divine way of improving all life forms through the divine experiments of natural selection, which at some point begins to include the human ability to become an active part of the process, a change agent, one in whom, as Teilhard de Chardin insists, evolution is becoming conscious of itself. So God is urging us to become active agents of creation and evolution (quoted in Epstein: 6-7).

Such views maintain vast separation between humans and Earth. It makes assumptions that we are knowledgeable about the Earth’s creative processes and can act as co-creators. I consider that there is greater wisdom in accepting that we are immersed in processes much larger than ourselves, and of which we know almost nothing. Given our recent track record, I think the name we gave ourselves, *homo sapiens sapiens*, is a misnomer.

[53] *Reductionist science.* Science leans towards reductionism, limiting interpretations of evolution and life to a materialist base.¹³ This certainly reins in exaggerated explanations that go beyond the sphere of scientific jurisdiction into metaphysics, philosophy, or religion. However, the reduction of an appreciation of evolutionary processes to a materialist base constrains new insights and interpretations (Barbour).

[54] Given these hazards in incorporating evolution into the field of religion and ecology, what then could be the contributions that religion brings to this three-way conversation?

Contributions in the Field of Religion, Ecology, and Evolution

[55] Extraordinary work is being done in the field of religion and ecology. There are all kinds of initiatives, methods, retrievals, reinterpretations, reconstructions, and innovations.¹⁴ Evolution is only beginning to enter the horizon of understanding. Much reassessment is needed to consider the ways in which taking evolution seriously could impact on religious thinking about ecological issues. Those working from multi-religious and cosmological horizons are aware of the challenges facing religions as they move into an ecological phase.

¹³ The public presentation of science is often reductionist to a point that it is scientifically in error, and prohibits metaphysical or religious commentary.

¹⁴ The astounding and exponential growth in work in religion and ecology testifies to the necessity and creativity in the field. One significant effort, among countless others, gives a good indication of the breadth and depth, conferences, publications, and activist and academic initiatives of these efforts: see The Forum on Religion and Ecology at <http://environment.harvard.edu/religion/>.

While efforts to reclaim, retrieve, and reconstruct are occurring, there are larger tasks of assessing religious contributions in light of the contemporary cosmological horizon. (Berry; Tucker).

[56] In a similar vein others such as Rabbi Schachter state: “Many religious structures have become ossified remnants of another time. All traditional systems – Moses, Jesus, Mohammed, Buddha – were embedded in the social and economic systems in which they arose. Their reality maps are a little obsolete” (quoted in Barasch). Schachter recognizes that humanity has arrived at an evolutionary crossroads. He insists that we need a “transmogrifications of holiness” (quoted in Barasch). Others call for meta-religious frameworks, spirituality not religion, wisdom and ethics rather than dogma, or suggest that we move towards a second axial age. In short, these and other formulations are pointing to the end of a religious era.

[57] It is an understatement to say that religions need new reality maps in light of evolution, especially in the context of the ecological crisis. But, given this, what could assist a constructive intersection of religion, ecology, and evolution? There are many possibilities here: education, ethics, public policy, and existing religious resources, to name only a few. All are necessary. However I will offer some reflections, in general terms, on three other and inter-related themes: the nature of religion, the natural world as revelatory, and Earth mysticism.

[58] *The nature of religion.* Of the many potential approaches to intersecting religion and evolution, I am privileging one that integrates religion into an evolutionary framework, rather than the reverse. The level and type of consciousness out of which religions have come should be considered as a potential within the evolutionary processes. Religions are a part of the evolutionary development of humans as a symbolic species, emergent phenomena within human consciousness, and later cultural formations. Such an approach affirms that religions, and what they represent in terms of consciousness, are more, rather than less, inherent to humans as a species. In addition, religions need to be seen as a very recent development in human history, which itself has been shortlived. Such a view also takes note of the fact that most religions no longer exist. Countless specific religions have emerged, flourished, and become extinct. Current traditions will also not endure. The fact that some religious approaches, conservative Christian theology in particular, continue to ruminate inside self-referencing boundaries and assume specific eternal truths is indicative of not grappling with the larger phenomena of the histories of religions or of an evolutionary framework.¹⁵

[59] When evolution rather than religion is the starting point, then religion is situated in much larger processes. An evolutionary perspective requires that we think more about the nature of religion, of religious consciousness, and what experiences and knowledge are represented by religious sensibilities. What religion brings to the evolution and ecology

¹⁵ A similar comparison can be made between how religions encounter each other. From a Christian viewpoint, there are approaches that emphasize a theology of world religions, and others that are inter- or multi-religious approaches. My interest here is in the second type of approach: that of inserting religion into an evolutionary framework, not evolution into an existing religious one. Thus I am not proposing a theology of creation.

discussions, therefore, is the importance and vitality of religious consciousness. It affirms that this dimension of the human is as real and valid as scientific knowing; a vital mode of knowing. To bring this dimension forward, religions must address the larger contexts and sources of human life, and thus understand something of evolution as well as religious consciousness.

[60] *The natural world is revelatory.* Relationships between religious experiences and the natural world are fundamental to most religions and many cultures. They are powerful, animating, orienting experiences. Classical approaches to religious experiences affirm these primal and formative states of awareness, often expressed as wonder and awe. When we learn something of evolution, these sensibilities are engaged. How can we not marvel? Evolution tells tales beyond our wildest fantasies: sea creatures as large as elephants become a type of amphibian, then wolf-like, and then return to the sea as a mammal, i.e. the contemporary whales (Gingerich). To understand, even minimally, the immense and elaborate planetary hydrologic cycle is stunning and breath-taking. What little we know of Earth's intricacies dazzles the human imagination. From the microbiotic and genetic levels to the dinosaurs, the processes and life-forms are incredible. If we attend, even momentarily, to the elegance of birds, the ingenuity of insect communication, and the emotions of mammals, how is it possible not to be thrilled and overwhelmed by the creativity, diversity, power, and beauty? Religions affirm such experiences of wonder and awe.

[61] In human lives, these moments are deeply compelling and often life-orienting, yet are regularly dismissed as romantic, idealistic, likely not religious, and certainly not scientific. The field of religion and ecology would be strengthened by concentrating on and articulating the validity of such experiences, not only with respect to their power but also with regard to their transformative capacity. The aesthetic and emotional capacities of humans are more than adaptive. We do respond to life emotionally, intuitively, with revulsion and attraction, and with wonder and awe. We are moved by beauty and by ruin. These are not superfluous, but rather are foundational, functional energies. Some scholars are re-examining religious experiences through the lens of an aesthetic dimension. Perhaps this is one, among other, critical element religions can bring to the discussions on evolution and the ecological crisis. Earth life and processes have been, and are, a primary source of inspiration, aesthetics, ethics, and sources of religious imagination. The natural world has and does reveal something in human consciousness: something vital.

[62] Unfortunately, such responses to Earth are not privileged over utilitarian ones in science, nor dogmatic/textual ones in some religions. Many scientists working in evolution are not inspired: they are trained to see a mechanistic world. Religions can offer a compelling view that nature is revelatory. This can counter scientific reductionism. When we experience the Earth in its awesome immensities and ingenuity, we are moved to resist its demise.

[63] *Earth mysticism.* Evolution can open up the possibility of profound religious experiences. We are moved, like Teilhard de Chardin, to claim we live in a divine milieu and that matter, spirit, and life are intertwined in a sacred process. We can "see" a deeper reality: one that kindles the religious imagination, awakens us to the Earth, and ignites a fire to sustain life. Evolution can open awareness or consciousness to an Earth mysticism, a blend of the best of science and religion. A renewed form of Earth mysticism is needed to counter ecological

and evolutionary ruin. It is needed to provide sufficient psychic energy to attend to the tasks of this era, and to avoid a crippling despair. To have a religious experience of the Earth is not new, but desperately needed today.

[64] Within the field of religion and ecology, work in cosmology and religious experience is emphasizing the inter-relationships among these three areas: developing a larger horizon of understanding for the phenomena of religion, rethinking religious imagination and experiences, and interpreting the insights that we are emergent from and integral to a dynamic universe. I am accentuating a similar approach to evolution, and as such it dovetails with the work in cosmology, religion, and ecology. The recent understandings of cosmological and evolutionary dynamics are revolutionary, and are only beginning to be appreciated for the depth of transformations they elicit. It is possible that only from this depth will we find sufficient energy to respond to the ecological crisis. To allow the reality of evolution to take root within human consciousness signals both an evolutionary crisis and an opportunity. Evolution awakens the religious imagination beyond belief.

Conclusion: The Revolution of Evolution

Problems cannot be solved at the level of consciousness in which they were created. We shall require a substantially new manner of thinking if human kind is to survive (Albert Einstein).

[65] The reality of evolution and the severity of the ecological crisis are only beginning to impact western consciousness. Yet we live, move, and have our being within Earth's evolutionary and ecological processes. We are entering an era of an ecological crisis far beyond what we can manage, let alone understand. We do have agency, but not control. We are on the threshold of levels of the unknown.

[66] I have argued that we need to reconsider religion in light of evolution, hence the *revolution of evolution*. I have also argued that taking evolution seriously deepens and challenges our understanding of the ecological crisis, as well as the responses to this crisis from within religions. For some, this approach may not be sufficiently religious and not adequately theological. However and in contrast, to engage with evolution is to move towards novel modes of understanding, including that of religion. Understanding evolution can strengthen, rather than diminish, the role religious consciousness plays. However, religions in their current form may not be equipped to respond either to the ecological crisis or to accept the phenomenon of evolution.

[67] Nonetheless, we are reminded that humans are but a moment of Earth, maybe even a glorious one, in a drama of four and one-half billion years. And Earth is but one planet, in one galaxy, within one solar system, within six million others galaxies. And all this is in a universe dominated by dark matter and dark energy, within an expanding fabric of space and time, of approximately thirteen billion years and counting. Is it possible to think that our religious traditions are the reference points for all this reality?

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