

EVOLUTION, THEOLOGY, AND METHOD, PART 2: SCIENTIFIC METHOD AND EVOLUTION¹

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Introduction

Is the epistemological certainty of evolutionary theory so absolute that Christian theologians should feel rationally compelled to accept its conclusions even if they explicitly contradict the teachings of biblical revelation on the origin of life on our planet? To answer this question we need to turn our attention to the scientific method employed in the formation of evolutionary theory. Specifically, we need to become aware of the concrete form in which the empirical method described in the previous article is shaped when scientists use it to explain the origins of life on earth.

In the first article of this series, our brief epistemological analysis of the scientific method in the empirical sciences reveals at least two main characteristics of scientific knowledge. First, scientific methodology is able to produce only hypothetical results. In other words, by applying scientific methodology scientists arrive at tentative, conjectural, hypothetical explanations—never at final absolute truth. Second, scientific hypotheses can only reach a limited and relative certainty—never absolute truth. Scientific knowledge is always relative to the presupposed theories from related fields and the macro-hermeneutical metaphysical presuppositions scientists assume to interpret their data and construct their explanations. We need to ask whether the evolutionary theory results from the application of the scientific method described above and, therefore, inherits its characteristics and limitations or whether it results from the application of a different sort of scientific methodology.

The fact is, however, that “not all sciences are created equal.”² Differences between sciences are determined by the object of study they attempt to clarify (teleological condition). Due to the object it attempts to explain and the data from which it draws its conclusion, evolutionism works with a method that is substantially different from the method of the empirical sciences described above. In this article, then, I will begin by describing the difference between empirical and evolutionary methodologies. Then I will consider the conditions and procedures under and through which the method operates. Finally, I will reflect on the corroboration and epistemological status of evolutionary theory.

¹Fernando Canale, “Evolution, Theology and Method Part I: Outline and Limits of Scientific Methodology,” *AUSS* 41 (2003): 65-100 is the first of a series of three articles.

²David L. Hull, “The Particular-Circumstance Model of Scientific Explanation,” in *History and Evolution*, ed. Matthew H. Nitecki and Doris V. Nitecki (Albany: State University of New York Press, 1992), 70.

Historical Nature

“What we are doing when teaching Darwin’s biotic history to our biology students is pure history,”³ writes M. H. Nitecki. This is so because evolution in general focuses “on the interpretation of individual historical events—events destined never to be repeated as time marches on.”⁴ There is a distinction between nonhistorical sciences such as physics and chemistry, which focus on the immutable laws of nature, and historical sciences such as geology, paleontology, and evolutionary biology, which attempt to reconstruct the physical and biological history of our planet. Epistemologists of evolutionary science are aware of this distinction and the problems it poses to the scientific status of evolution.⁵

The scientific status of evolution becomes problematic because the myth of science and the more modest description of the scientific method described above have been modeled after the likeness of nonhistorical disciplines such as physics and chemistry.⁶ For this reason, evolutionists recognize that “the study of history is a discipline seemingly in search of, so far, very elusive theories or law.”⁷ They are forced to answer Popper’s view that history is not a science because it is not interested in finding universal laws but in knowing concrete realities,⁸ and his conviction that Darwinism is metaphysics.⁹ Robert J. Richards recognizes that “evolutionary biology still does not meet the logical criteria that Popper proposed for science. That is because it is historical and suffers from the presumed disabilities of all history attempting to pass as science.”¹⁰ The question about the scientific status of the historical sciences, vis-à-vis the nonhistorical ones, such as the social sciences, arises.¹¹

Not surprisingly, evolutionists strongly defend the scientific status of

³Matthew H. Nitecki, “History: La Grande Illusion,” in *History and Evolution*, ed. Matthew H. Nitecki and Doris V. Nitecki (Albany: State University of New York Press, 1992), 5.

⁴Niles Eldredge, *The Pattern of Evolution* (New York: Freeman, 1999), 8.

⁵For a discussion of the way evolutionists attempt to solve the challenges presented by the historical nature of their investigation, see Marc Ereshefsky, “The Historical Nature of Evolutionary Theory,” in *History and Evolution*, ed. Matthew H. Nitecki and Doris V. Nitecki (Albany: State University of New York Press, 1992), 81-99.

⁶Robert J. Richards, “The Structure of Narrative Explanation in History and Biology,” in *History and Evolution*, ed. Matthew H. Nitecki and Doris V. Nitecki (Albany: State University of New York Press, 1992), 19.

⁷Nitecki, 5.

⁸David B. Kitts, “The Conditions for a Nomothetic Paleontology,” in *History and Evolution*, ed. Matthew H. Nitecki and Doris V. Nitecki (Albany: State University of New York Press, 1992), 131-145.

⁹Richards, 20.

¹⁰Ibid.

¹¹Nitecki, 8.

historical disciplines;¹² note that physical data are not ahistorical;¹³ argue that historical explanations are the most fundamental explanations we find in science;¹⁴ draw parallels between science in the history of human events and science in the history of geological and biological events; and discard criticisms that historical sciences are “anecdotal,” while the phenomena of physics are “the keys” that unlock the universe.¹⁵ The general conviction, then, is that history is or should be scientific.¹⁶ Rachel Laudan observes that in both biology and history “historical explanations are similar and either none is, or both are, equally ‘good science,’ and the methodologies of general history and evolutionary biology are homologous.”¹⁷

These affirmations of the scientific status of historical science, however, miss the main difference that exists between historical sciences such as geology and paleontology, and empirical sciences such as physics and chemistry. The difference appears when one compares the teleological condition in empirical and historical sciences, i.e., what each attempts to explain. Succinctly put, empirical sciences explain *present* and *future* realities, while historical sciences explain *absent* and *past* realities. Moreover, empirical sciences attempt to discover general patterns in *cyclical recurrent events*, while historical sciences attempt to reconstruct, interpret, and discover general patterns in *linear unique events*.

Empirical sciences explain the present by searching for sameness, and by finding repetitive patterns in nature they can predict the future. Their celebrated successes depend on the cyclical-repetitive nature of the subject matter they study (the teleological condition they embrace). The description of the empirical scientific method we studied in the first article of this series is tailored to research repetitive cyclical realities in nature.¹⁸

Historical sciences attempt to reconstruct the past—not explain general recurrent patterns. This difference in the teleological condition of method determines that historical sciences reach a lower level of reliability and corroboration than physical sciences studying repetitive cycles of nature. Thus,

¹²“Marc Ereshefsky argues that the distinction between evolutionary biology and such nonhistorical sciences as physics and chemistry are [*sic*] not clear, and that in both evolutionary biology and experimental sciences there is a temporal ordering of events, the use of how-possibility explanations, the uniqueness of events, and the reliance on particular-circumstance explanations” (ibid., 7).

¹³“Yet it does not follow that the data of physics are ahistorical. It is obvious that all phenomena, however brief, have a temporal component and that it is the behavior of entities of the material universe over stretches of time—be they nanoseconds or billions of years—that provides the human mind with an opportunity to grapple with the *furniture* of the universe” (Eldredge, 12, emphasis original)

¹⁴Nitecki, 6-7.

¹⁵Richards, 21.

¹⁶Rachel Laudan, “What’s so special about the past?,” in *History and Evolution*, ed. Matthew H. Nitecki and Doris V. Nitecki (Albany: State University of New York Press, 1992), 57.

¹⁷Nitecki, 6.

¹⁸Canale, 73-91.

physicists reconstructing the first seconds in the history of our universe face the same problems and limitations that evolutionists do in reconstructing the history of life. What results in both cases are explanatory theories inferred from present knowledge. But, by projecting inferences from the present to the unavailable past, scientific method can attain only *probable results*—falling far short of the relative certainty of present cyclical events.

The scientific reconstruction of the past results from combined contributions of several scientific disciplines, notably, physics, geology, paleontology, and biology. Of these four, the method in paleontological studies replicates more closely methodologies used in the reconstruction and interpretation of human events.¹⁹ The difference between human history and biological history is the types of documents available and the different character of the causes: “genetics, interaction of species, geological changes, and so on.”²⁰

Finally, because evolution is a historical science, its method and outcome take the form of narrative. This means that “all explanations of events in time are ultimately narrative in structure.”²¹ Narratives explain by ordering “events along a temporal dimension, so that prior events are understood to have given rise to subsequent events and thereby to explain them—that, in brief, is what narratives do.”²² Evolution, thus, is properly a cosmogonic metanarrative explaining the origin and history of life’s development on planet Earth. Let us turn our attention now to the conditions operating in the scientific method applied to the study of the physical, geological, and biological history of our world.

Teleological Condition

Evolutionary theory aims to understand and explain the historical process through which the present came into existence. Evolutionists attempt to understand past events that explain the present. The heart of historical explanation is to follow the order of causes behind present realities, thereby allowing humans to understand the world and themselves. We must distinguish, then, between events and their interpretations. When paleontologists speak of “facts” they mean that a past event actually took place.²³ By speaking about past events as “facts” many evolutionists “may be implying, or at least be forgetting to avoid assuming, that the events of the past not only actually occurred, but that they are the irreducible raw material with which all higher inferential operations in history begin.”²⁴ To assume that past events caused present events is an acceptable general assumption. After all, since Aristotle we

¹⁹Kitts, 133.

²⁰Nitecki, 6.

²¹Richards, 23.

²²Ibid.

²³Kitts, 132.

²⁴Ibid.

recognize that we know by identifying “certain causes and principles.”²⁵ Because evolutionists start by accepting evolution as metanarrative, they run the risk of confusing the narrated events with the data from which those events are inferred. Yet, as Kitts reminds us, “historical events, however familiar they may become, and however routine the inferences that support them may seem to be, lie not at the beginning of our quest for synthesis and historical understanding, but somewhere along the way.”²⁶

To avoid this confusion, evolutionists should distinguish between their object of study (teleological condition) and the data they study (material condition). Though past events properly play the role of teleological condition of method, they cannot offer data from which to study them simply because they are not available to the scientists for observation and experiment. Past events, then, are not the data, but rather are questions facing evolutionist theory.

The nonavailability of evolutionary events is different from the nonavailability, for instance, of the atom. The unavailability of the latter is due to the size of a *present* reality, while the unavailability of the former is due to the *total absence* of the object, event, or causes the evolutionary theory attempts to explain. Thus, evolutionary theory is forced to explain by producing a metanarrative that creates past events through “scientifically controlled” inferences and imagination. This method of metaphysical construction is similar to the one followed when pre-Socratic philosophers constructed their cosmogonies. They also used “controlled speculation” from what was then “firm” scientific knowledge to them. We have made progress in the amount and precision of what we today consider “firm” scientific knowledge of the world but still face the same methodological difficulty confronted by the early Greek philosophers: the events that caused our present world no longer exist.

The data of paleontology are the fossils, not the historical events they once were. Fossils are not historical events, but historical artifacts—the remains of life. In order to explain fossils’ existence, paleontologists must first “imagine” events as possible causes of the fossil record. In the process, they “create” events of which we have no historical evidence. Macroevolutionary events belong to this category. Fossils, as the remains of life, testify to their past existence but say little about history, i.e., about the causal sequence that originated the existence of such remains. There is also a distinction between the existence and the nature of the remains. Fossils testify to the existence of living organisms but apparently say little about the cause of their existence or about the nature of the individual to which each fossil testifies. Reconstruction of life is very difficult because of its complexity. Science is good at learning by isolating factors. It is difficult to see how science would be able to know by considering all factors at the same time, especially when one has no possible way to know all the ecological conditions that could have been present billions of years ago.

²⁵Aristotle, *Metaphysics*, I.1 (982a, 2).

²⁶Kitts, 132-133.

Material Condition

What sources of data do scientists have to work with to produce the evolutionist metanarrative? Basically they have two sources, the present patterns of life studied by biologists,²⁷ and the remains of death studied by paleontology. But biological data do not reveal directly the macroevolutionary patterns required by evolutionary theory; and paleontological data, being controversial, spark disagreement among evolutionists about how to reconstruct the past and tell the "story" of evolution.²⁸ Thus, evolutionists warn us not to confuse specific models of evolution with its reality.²⁹

"It is not the case that biologists discovered evolution in observable facts, and then proceeded to explain it."³⁰ Biologists have discovered only microevolutionary patterns that fall far short of the macroevolutionary progress essential to evolutionary theory. Thus, biological studies help only partially to reconstruct an already assumed evolutionary history by providing a basis from which to draw indirect inferences. By themselves, biological data do not testify to macroevolution. It is only when evolutionary macro-hermeneutical presuppositions are applied that biological data become the launching pad from which inferences can be projected to the past to reconstruct and flesh out evolutionary history in some detail.

The "fact" of the evolutionary narrative is established by paleontological studies. What data do paleontologists examine that tell them that life as we know it today came into existence through an unbelievably lengthy process of evolution? The fossil record is the silent witness from past life, which we encounter in our present. As a messenger from the past, the fossil record calls for rational explanation. Evolutionists claim evolution is the rational explanation for the origin of life and is, then, a better explanation of the fossil record.

However, the fossil record is not "raw data," unambiguously pointing to evolution. "The fact that evolutionary paleontologists and biblical creationists invoke it with equal facility is testimony to the ambiguities surrounding the very notion of a fossil record."³¹ Of course, for evolutionists such as David B. Kitts

²⁷"My training in evolutionary theory, as for many organismal biologists of my generation, came from reading the works of the victors in the Evolutionary Synthesis, and through their students and followers. We learned that among the achievements of the Synthesis was the reconciliation between the genetical theory of evolutionary processes and the inferences of evolutionary history that emerge from the work of paleontologists, comparative morphologists, and systematists. That is, microevolutionary processes, suitably extrapolated through time, were sufficient to account for macroevolutionary histories of change. There have always been those who did not accept this conclusion, however, and in recent years the tension between students of evolutionary history and of evolutionary processes has become considerably more palpable" (Douglas J. Futuyma, "History and Evolutionary Process," in *History and Evolution*, ed. Matthew H. Nitecki and Doris V. Nitecki [Albany: State University of New York Press, 1992], 103).

²⁸Nitecki, 4

²⁹Ibid., 5.

³⁰Kitts, 141.

³¹Ibid., 140.

these “ambiguities” are minor and do not preclude evolution—only its fine tuning. Their disagreements are not about whether evolution took place, but about how to better reconstruct the process through which it took place. What makes the difference between the creationist and evolutionist readings of the fossil record? Why are evolutionists so certain that evolution took place? The different interpretation of the fossil record produced by creationists and evolutionists is determined by the different sets of presuppositions used to interpret the data and deal with the data’s ambiguities. This brings us to the core of evolutionary methodology, namely, the a priori hermeneutical conditions that make evolutionary theory possible.

Hermeneutical Conditions

Since evolutionary theory came into existence by the combined interdisciplinary connections of geology, paleontology, and biology, we need to briefly consider their relation and the hermeneutical conditions under which they operate. My goal in this section is only to indicate some of the most influential conditions that make evolutionary theory possible. At the same time, the reader should bear in mind that if these conditions are challenged or defined in different ways, evolutionary theory must give way to an alternative explanation.

By interpreting the crust of our planet and the fossil record, geology and paleontology have established a long chronological sequence for the history of life. Accepting this historical time table, biological evolution explains how life came into existence and developed into its present form by way of a metanarrative. In so doing,

geologists and paleontologists escape almost entirely the suspicion of any intent to distort history. When they rewrite history, as they do from time to time, it is not likely to be seen as the result of a change of opinion, but rather of an advance in knowledge. Scientists, by and large, regard themselves and are regarded by others as people who settle the issues which divide them by an appeal to facts.³²

Yet, before geologists and paleontologists “begin their search for the past,” they already “are committed to the view that whatever events they may propose as antecedents in explanations of the present, these events will be those that do not violate certain deeply held and widely shared theoretical notions.”³³ That evolutionary methodology stands on a priori and hermeneutical conditions cannot be denied.³⁴ To understand the process through which evolution is conceived and formulated, we need to consider at least some of the “theoretical notions” on which it stands.

In what follows, I will deal with some of the a priori presuppositions

³²Ibid., 134.

³³Ibid., 133.

³⁴“Both evolutionary biology and history are equally subjective activities because both are influenced by the training and social standing of their respective practitioners; yet both claim to reach beyond their immediate circumstances” (Nitecki, 4-5).

operative in the construction of the evolutionary theory. By "a priori" I mean a theory that has been formulated previously and independently from evolutionary theory and that stands without scientific testing (what Popper calls "metaphysical standing" because such theories have no physical corroboration). The macro-hermeneutical presuppositions under which theologians operate are basically the same ones assumed by scientists. We can summarize them in two main kinds, presuppositions about reality (the object to be studied) and presuppositions about the subject developing scientific theories (reason). Since I am leading with scientific methodology as used in the construction of evolutionary theory in this article, I will concentrate on ontological presuppositions. I will begin with the ontological macro-hermeneutical presuppositions at the basis of all the sciences and will continue with the meso-hermeneutical presuppositions that derive from the various disciplines involved in the formulation of evolutionary theory.

Ontological Macro-hermeneutical Presuppositions:
A Priori Index of Reality: The Limits of
Scientific Imagination

Science studies reality. The first and broader assumptions that science originates from are about the nature and general extension of the reality that scientists research. Scientists assume two primary interrelated ontological notions. First, they assume reality to be spatiotemporal. This presupposition may appear obvious to scientists today, but in reality it represents a huge paradigmatic change from the classical notion of timeless science that started with Greek philosophy. The notion that reality is spatiotemporal left God out of philosophical and scientific knowledge because philosophers and theologians had defined God's reality as timeless science. A science that studies what is temporal and spatial cannot accommodate the study of a timeless God. When evolutionists search for the biological history of the past, they leave God out because they do not find God in space and time today. However, neither do they find the events of evolution they so confidently consider "factual." The reason why God is left out is more than his objective absence from our present spatiotemporal causal order. It involves also the conviction that God could not have intervened within the spatiotemporal continuum at any time in the past. This conviction is grounded in the metaphysical assumption that God is timeless and therefore cannot act within the spatiotemporal continuum. Because of their commitment to the biblical view of God, Adventists do not assume the timeless view of God and therefore cannot displace God's historical causality as described in Scripture out of the realm of scientific research. Here Seventh-day Adventist theology radically departs from the presuppositions of science and most Christian theologies.

Because God is left behind by scientific methodology, evolutionists beginning with Darwin are forced to solve not only issues such as the geographical distributions of species, or the geologic column, but the

metaphysical question about the origin of life itself, an issue that falls far beyond the reach of science. One assumption in science is that nothing comes out of nothing. In its present state, scientists have a hard time accepting this assumption about origins. Either the world is eternal or it had a beginning.³⁵ If it had a beginning, then the God hypothesis disturbs the otherwise tranquil waters of scientific assumptions. If it did not have a beginning, the question of origin, which the big-bang theory and evolution attempt to answer, is irrelevant.

Evolutionary scientists recognize the existence and operation of macro-hermeneutical ontological presuppositions only indirectly. For instance, Kitts says that "the study of history can be a rational enterprise only if some restriction is placed upon what we *may suppose* to have occurred. In what may be considered the mainstream of historical studies we are not, as James Hutton put it (1795:547), '... to make nature act in violation of that order which we actually observe.'"³⁶ Speaking about the credibility of historical evolutionary narratives, Robert J. Richards tells us that they must adjust to the "index of reality," which, among other things, includes the "grain of the reader's firm knowledge."³⁷ As we will see below, the reader's "firm knowledge" is determined from the present by the scientific community. The notion that divine causation in history is real falls outside the "index of reality" from which scientists have chosen to build their cosmogony. Leaving God outside science's horizon results from the acceptance of a naturalistic philosophical ontology without scientific corroboration. This assumption leaves out divine interventions in creation and the flood. This is a methodological decision which not only stands on philosophical rather than scientific grounds, but may actually guide scientists astray in the case that reality is not reduced to naturalistic causes, as they dogmatically assume. We now turn our attention to the micro-hermeneutical (disciplinary) presuppositions operating in evolutionary theory.

Geology Assumes Physics

Geology is the paradigm science responsible for drawing the broad outline of earth history on which paleontology and evolutionary theory build.³⁸ Thus, the hermeneutical presuppositions guiding geological theories also become presuppositions of evolutionary theory. Among some of the micro-hermeneutical presuppositions leading geological research are the theories of physics, the science

³⁵This is a limit of human reason we cannot overcome that Kant already recognized as the fourth antinomy of pure reason (see his *Critique of Pure Reason*, trans. J. M. D. Meiklejohn [Buffalo, NY: Prometheus, 1990], 257-258 [third conflict of transcendental ideas]).

³⁶Kitts, 132.

³⁷Richards, 24.

³⁸"Geology is the paradigm historical science. Its goal has been the discovery of events and relationships among events that, being beyond the range of observation, can only be reached in historical inferences, albeit inferences subject to the prior external constraint of physical theory" (Kitts, 138).

that studies the most general aspects of natural reality. Kitts explicitly recognizes the hermeneutical role of physical theory in evolution in the following way:

Physical theory does not serve as a set of axioms by which all geological knowledge must be validated. It serves rather as a source of guiding principles for historical research, and a limit *permitting us to choose among all the accounts of the past which are consistent with the present state of the earth*. And in any quest for a nomothetic geology it would serve as a source of justification for claims that some geological hypotheses are to be accorded theoretical status (emphasis supplied).³⁹

Notice the hermeneutical role played by physics. It guides in choosing among several theories that are consistent with the present state of the earth. In other words, reason and scientific methodology allow geologists to deal with the evidence in several ways. In order to select from among them, geologists use the guidance of physical theories. Assumed physical theories, in turn, have been conceived by bracketing out divine causality from the spatiohistorical continuum as required by ontological presuppositions. Let us now consider some specific assumptions from which geologists reconstruct the history of our planet.

Geology Assumes that the Present is the Key to the Past

In geological studies, we find a micro-hermeneutical expression of the ontological macro-hermeneutical assumption that nature embraces all reality and causes. Causes in geology “can be understood in large measure through observation of the world in which we now live.”⁴⁰ If this is so, studying the present allows scientists to determine what could have taken place in the past, i.e., scientists may determine the precise shape of the “index” of reality to guide their extrapolations of present geological events to the past.⁴¹ In geology, the assumption that the present becomes our key to the past became embodied in uniformitarianism and gradualism. Hutton, the father of geology, formulated uniformitarianism as the assumption standing behind the notion that the present is the key to the past.

Methodological uniformitarianism is the essence of Hutton’s gift to history. Gould notes that it amounts to nothing more, or less, than inductive reasoning: We make an underlying ontological assumption that physical processes operating in the material universe remain the same, from the earliest appearance of particular classes of material furniture, up through the present momentum, and continuing for as long as such classes of *furniture* continue to exist (emphasis original).⁴²

³⁹Ibid., 139.

⁴⁰Eldredge, 33.

⁴¹Theologians should notice that this principle is also at the center of the analogy principle on which the historical critical method of Bible interpretation stands; see Ernst Troeltsch, *Religion in History* (Minneapolis, MN: Fortress, 1991), 13-14. In geology, this notion was articulated by Charles Lyell; see Eldredge, 34.

⁴²Eldredge, 34.

Another assumption on which geology builds its reconstruction of the past is the principle of gradualism, according to which “no additional processes *not* observable in the present underlie elements of earth and evolutionary history. Melded with methodological uniformitarianism, gradualism accounted for many of the early triumphs of geology and biology” (emphasis original).⁴³

From the paleontological perspective, Niles Eldredge has perceived the inconsistency of these principles with the fossil record and has challenged them;⁴⁴ yet he continues to apply the results to which paleontology and evolutionary theory have arrived. Of course, due to the combined effect of the object they have set themselves to study—the origin of life on our planet—and the ontological constraints of naturalism, there are not many options available to explore. Besides, since geologists, paleontologists, and evolutionary biologists study the past—a nonexistent reality—they can hardly dispense with the principle of uniformitarianism which grounds the analogy between the two poles within which their methodological extrapolations take place. Without methodological uniformitarianism, evolutionary theory could not exist. Adventist scientists, on the other hand, cannot accept the naturalistic assumption, and are free to explore other possibilities.⁴⁵

Geology Assumes Deep Time

By applying the presuppositions described above, geology arrived at the conclusion that to properly account for the history of our planet, deep time was necessary.⁴⁶ Methodologically speaking, a main foundation on which the evolutionary theory of the origin of life stands is the notion of deep time, which grows out of geological studies. The notion of deep time (i.e., long periods of time measured in billions of years) started as a working hypothesis that today is considered a proven fact because of absolute time measurements. Deep time was first deduced (1820-1870) as a condition of observations of sedimentation-erosion to explain geological observations⁴⁷ by determining “what is older than what.”⁴⁸ Since 1905, technology measuring radioactivity was used to establish absolute time calculations in contrast with the old comparative methodology.⁴⁹ These methods obviously are not theory- or presupposition-free. They operate

⁴³Ibid., 37.

⁴⁴Ibid., 39.

⁴⁵Naturalistic ontology denies the existence of God or his involvement in our universe and its history, notions which are necessary hermeneutical conditions of Adventist beliefs. If Adventist scientists accept naturalistic ontology, then they cease to think as Adventists. They may relate to the community at a social level but no longer at the level of its message and mission.

⁴⁶For an overview of deep time see Verne Grant, *The Evolutionary Process: A Critical Review of Evolutionary Process* (New York: Columbia University Press, 1985), 275-283.

⁴⁷Eldredge, 46.

⁴⁸Ibid., 53.

⁴⁹Ibid., 56-57.

within the general hermeneutical matrix that supports evolutionary theory.

Deep-time measurement is a complex issue that needs to be investigated at the theoretical and procedural levels. Adventist thought has room for deep time due to the existence of the conflict between God and evil before creation week.⁵⁰ Thus, Scripture allows for deep time in the material components of our planet but not in the life forms existing on it.

Paleontology Assumes Geology

Once deep time was established, geology generated a general chronology of events.⁵¹ While studying sedimentary strata geologists found fossils, which are studied by paleontologists. Unlike geology, paleontology cannot have direct, but only indirect, access to past biological events through the fossil record. In so doing, paleontologists assume the chronology and geologic column constructed by geologists. For Hutton and Darwin, the history of earth was written in the rocks of its crust.⁵² The sequence of fossils in general is invariably repeated. Darwin's evolutionary hypothesis made it possible to understand the fossil record and the deep-time chronology set out by geology.⁵³

Evolutionary Biology Assumes Evolutionary Paleontology

The study of evolution assumes the history of evolution reconstructed by paleontologists by drawing inferences from the fossil record, whose chronology is drawn by assuming biological evolution.⁵⁴ So biological evolution assumes paleontology, and paleontology assumes geology and biological evolution.

This brief sample of macro- and micro-hermeneutical presuppositions and the interdisciplinary effort necessary to support biological evolution suggests the theoretical complexity on which evolutionary theory stands.

Methodological Procedure

As we explained earlier, method is basically an action. What is the rational "action" scientists perform when building the theory of evolution? The major

⁵⁰See Richard M. Davidson, "The Biblical Account of Origins," *JATS* 14/1 (2003): 4-43; and Randall W. Younker, "Understanding Genesis 1 and 2: A Look at Some Current Issues," unpublished paper delivered at the International Faith and Science Conference sponsored by the General Conference of Seventh-day Adventists (Ogden, UT: General Conference of Seventh-day Adventists, August 25, 2002).

⁵¹Eldredge, 47.

⁵²Ibid., 46.

⁵³Ibid., 49.

⁵⁴"The study of evolution is fundamentally a study of history. The patterns of diversity that ultimately motivate most of us to study evolution cannot be understood without reference to this history, whether it be glimpsed through paleontology or phylogenetic analysis; and the evolutionary mechanisms that act on any population do so within bounds set by the population's history" (Futuyama, 123).

methodological procedure involved in the construction of evolutionary history is empirical inference.⁵⁵ Geologists infer from the rocks,⁵⁶ paleontologists infer from the fossil record interpreted from the background of geological time and chronology,⁵⁷ biologists infer from their observation of present biological processes.⁵⁸ The present is not only the key to the past, but the springboard from which the past is reconstructed by literally imagining large events not present to the scientists.⁵⁹ Thus, the rational procedure through which the evolutionary metanarrative is constructed is inference.

What do scientists do when they infer the past from the present? What is an inference? The dictionary tells us that to infer is the act of passing from one statement to another or of deriving conclusions from facts or premises. But how do scientists derive their conclusions from their present facts to reconstruct the absent past? They do not draw wild conclusions such as guessing in the dark, as, for instance, we do when brainstorming. What makes an inference scientific is that it takes place within an assumed theoretical context or "scenario" within which it "makes sense" and gains its "rationality."⁶⁰ Scientific inference, then,

⁵⁵Empirical inference differs from logical inference in that empirical inference starts from a spatiotemporal experience while logical inference starts with the meaning of statements.

⁵⁶"Geology is the paradigm historical science. Its goal has been the discovery of events and relationships among events that, being beyond the range of observation, can only be reached in historical inferences, albeit inferences subject to the prior external constraint of physical theory" (Kitts, 138). Moreover, "the significant principles of physical theories can be directly instantiated by the objects with which geologists begin their inferences and, consequently, more or less directly by the antecedent events meant to explain them" (ibid., 139). The first part of Kitts's statement is true, but to say that physical principles may be directly instantiated by the historical reconstruction of causes (theory of the earth) is not correct. Instantiation takes place through experiment or direct observation, which is impossible in the case of historical events.

⁵⁷"Secondary historical events are, on the other hand, uniquely historical. They have no counterpart in the present. They are composed of primary events related in a spatial and temporal nexus. Some of the temporal relationships among the primary events composing a secondary event are secured by causal generalization linking events of certain kinds, but others are related by noncausal ordering principles [chronological dating from geology and paleontology]" (ibid., 137).

⁵⁸Kitts, 137, calls the events that result from this kind of inference "primary historical events," which are based on researching present events available within the life span of the observer (136-137). "The question of whether or not such an event could occur or has occurred can, in principle, be settled by observation and experiment. Historical events of this kind differ from events we encounter in the present only by virtue of having occurred in the past. They are reached in primary historical inferences" (ibid., 137).

⁵⁹"The properties which biology identifies as theoretically significant, such as genetic variability, community structure and energy requirements are simply not to be instantiated *in* fossils nor are they in any direct and straightforward way to be inferred *from* fossils. There is no mystery about this contrast between geology and paleontology. It is the result of the obvious fact that the living bodies and the remains of living bodies, which are the subject matter of biology, do not keep very well" (ibid., 139-140, emphasis original).

⁶⁰"In the primary historical inference it is supposed that certain states and events in the present are to be explained by linking them with certain states and events in the past. Because events do not point intrinsically beyond themselves to other events, causal connections between past and present must be justified by reference to universal laws or, more commonly, to less comprehensive and formal generalizations. A generalization plainly cannot be tested by the

requires the hermeneutical condition of method for its very existence; and, thus, scientific inferences cannot be tested. If we could test them, they would no longer be inferences but experiments or observations. When private investigators and lawyers attempt to reconstruct a crime, they use inferences from the "evidence" of the crime that remains in the present. Inferences require evidence (data) and an assumed scenario (hermeneutical conditions).⁶¹ Circumstantial evidence is weak because it does not spring directly from the act one is trying to reconstruct. Juries find it difficult to arrive at unanimous verdicts on the basis of circumstantial evidence. That is to say, evidence and scenario allow for various contradictory interpretations of the same act. Something similar takes place when scientists attempt to reconstruct the geological and biological histories of our planet. We have no direct evidence of macroevolution. Therefore, geological, paleontological, and biological data can construct only a *circumstantial* case in favor of evolution that depends more on the a priori scenario than on the evidence.⁶²

The absence of evidence corroborating macroevolution is a difficult problem facing evolutionists. To be persuasive, inference must not depart from the premise or fact from which a prediction or projection is made. In other words, the nature and extension of the conclusion cannot exceed or substantially differ from the inferential basis. So, how can a macroevolutionary history be developed from a nonmacroevolutionary basis? Eldredge suggests that evolutionism extrapolates.⁶³ It is not exactly clear what Eldredge means by "extrapolation" and in what way it differs from inference. If we understand "extrapolation" as the act through which we "project, extend, or expand (known data or experience) into an area not known or experienced so as to arrive at a usually conjectural knowledge of the unknown area,"⁶⁴ then the problem is solved, but the price may be higher than evolutionists are willing to pay. That is to say, if macroevolution is built by extrapolation from evidence, then evolutionary theory is mere conjecture, supposition, and guesswork.

explanatory inference in which it is presupposed, and there is good reason why attempts are seldom made to test universal laws in any historical context whatever. Physical and biological laws, and even the less rigorous generalizations which are often directly invoked in historical inferences, are tested under the most controlled and circumscribed conditions" (ibid., 133).

⁶¹"There are no theory-free events nor any uninterpreted chronicle composed of them" (ibid., 134). Kitts says this while dealing with the role of theory in the construction of past natural history. This is not justifying knowledge, but projecting knowledge to the past by way of inference. What paleontologists do here is to build a history justifying it with generalizations from other sciences and from generalizations created from the study of the fossil record itself.

⁶²"Writing history consists of identifying from among all the possible worlds permitted by some presupposed theory, the actual world. This involves describing the actual world in terms of the initial and boundary conditions which some theory identifies as relevant" (ibid., 135).

⁶³"So a connection had to be forged between uniformitarianism, gradualism, and reductionism: *extrapolationism*, the projection of commonly observed rates and processes as a prediction of what history ought to look like" (Eldredge, 40).

⁶⁴See *Merriam-Webster Collegiate Dictionary*, 10th ed. (Springfield, MA: Merriam-Webster, 1993), s.v. "extrapolation."

Corroboration

By hearing the news, watching scientific documentaries on TV, and listening to scientists speak, one gets the impression that evolution is a fact.⁶⁵ By reading what evolutionary epistemologists say about the epistemological status of evolution, one gets the impression that, while not everything is crystal clear and there are still some rough edges to polish in evolutionary theorizing,⁶⁶ evolution is a fact as certain as the fact that I am writing this article. For them, doubting evolution seems unthinkable. One assumes that conclusive proof of evolution exists. Otherwise, scientists and the general public would not be so sure about it.

The brief epistemological analysis of the scientific method in empirical and evolutionary sciences has shown they do not produce absolute certainties, but only working possibilities in search of understanding. Moreover, we have discovered that due to the historical nature of the object it attempts to understand, evolutionary science has difficulties of its own that place its outcomes at a lower level than the outcomes of the ahistorical sciences, which study present repetitive natural phenomena. On the other hand, we have learned that scientists build theories to tear them down. Yet, that critical spirit mysteriously disappears when scientists speak about evolution and the history of the universe. Suddenly, absolute certainty appears out of nowhere. Is corroboration of evolution so strong that it is able to secure such a high level of rational certainty? How do we explain the absolute certainty scientists have about the "fact" that life on our planet evolved from nonexistence to the astonishing variety and complexity that exist today? It seems to me that evolutionary certainty is not empirical, but rational.

In the first article of this series, we learned that scientific theories cannot be corroborated directly, but only indirectly.⁶⁷ By deducing some empirical consequences from a theory, scientists place them under experiment to see if it reveals what the theory affirms. This testing obviously requires that the empirical consequences of the theory become directly available, in the present, to the researcher. But in the case of evolutionism this can only be done partially because past events which the theory is all about cannot be placed under testing or experiment.

Evolutionary biologists have tried to test the basic evolutionary notion, according to which higher forms of life appear from lower forms. The process of life, as biologists well know, is highly complex and sophisticated. Speciation,⁶⁸ i.e., the appearance of new sexually reproducing organisms, requires "from several hundred to several thousand years to complete. To an

⁶⁵"Paleontologists seem to have expected something even more distinctly nomothetic to emerge from their own historical studies. Beginning with the claim that they had proved that evolution had occurred, they have turned to the past with the confidence that it would yield theoretical illumination as well as historical chronicle" (Kitts, 139); see also Futuyma, 102.

⁶⁶Futuyma, 108-119; Laudan, 58-59.

⁶⁷Canale, 89-91.

⁶⁸For an introduction to the process of speciation, see Grant, 191-272.

experimental biologist, the process is hopelessly slow. After all, no utterly convincing case of true speciation (that is, involving sexually reproducing organisms) has as yet emanated from a genetics lab.⁶⁹ It seems, then, that there is no test as yet corroborating the mechanism of macroevolution.⁷⁰ In other words, the certainty about evolution does not stand on empirical test, experiment or observation. It stands in its “rationality” or explanatory power.⁷¹

What is the “rationality” or explanatory power of the evolutionary theory? Bunge summarizes what evolutionary theory does by remarking that the fact that

most scientific hypotheses are stated in a categorical mode should not mislead us. When the biologist states that life emerged 2 billion years ago, that the first terrestrial organisms were lichens, that plants synthesize carbohydrates out of carbon dioxide and water, that oxygen is indispensable for animal life, or that all mammals are homeothermal, *he is not conveying information about experience* but is stating hypotheses by means of which *certain chunks of experience can be interpreted*: his assumptions, being hypotheses, are not about experience but about nonexperiential facts, and he will employ them in order to explain his biological experience (emphasis supplied).⁷²

The “power” by which evolution grips scientists and society rests on its coherent account of a considerable amount of what scientists consider “firm” knowledge, acquired by many sciences through a long period of time, by way of a single metanarrative explanation.⁷³ So, the more evolution matches the index of reality⁷⁴ of our culture, the less scientists and the general public may consider

⁶⁹Eldredge, 37.

⁷⁰Microevolution, i.e., changes within a species, has been discovered and tested by biologists.

⁷¹In his apology of evolution against creationism, *Abusing Science: The Case against Creationism*, evolutionist epistemologist Philip Kitcher makes considerable effort to counteract the creationist claim that evolution is not a science because it cannot be falsified (Cambridge, MA: MIT Press, 1982], 30-49). My point here is not that evolutionism is not a science—it obviously is—but that the certainty of its results is not rationally compulsive even by scientific standards. When it comes to scientific criteria, however, even scientists do not agree, and each one applies what works in his or her field and specific research project. Kitcher explicitly recognizes that evolutionary theory has not been corroborated by stating that “if one accepts the idea that science requires proof, or if one adopts the naïve falsificationist criterion, then the theory of evolution—and every other scientific theory—will turn out not to be a part of science” (ibid., 49).

⁷²Mario Bunge, *Scientific Research I: The Search for System* (Berlin: Springer-Verlag, 1967), 225.

⁷³“What, in the end, drives evolution? As the answers to these and many other questions unfold, we begin to converge on a coherent theory that links the evolution of life with the physical history of the planet—not as a long series of isolated events, but in regular, repeated, law like patterns that can be generalized into a coherent theory of physical and organic evolutionary process. Along the way, we also see how process is inferred from pattern—the fundamental ingredient of genuine scientific discovery” (Eldredge, 7).

⁷⁴“Narratives derive their authority from two different sources: from the text and from the author. The authority of the text is simply a function of the index of reality that it manifests. The higher the index, the more authority we grant it. But text with a low index might yet be given greater authority because of the author” (Richards, 30); “Darwin’s implicit strategy, though, was to blur the distinction between narratives of an imaginative character that expressly made the case he wanted to advance but having a low index of reality, with those of higher index” (ibid., 26).

corroboration or testing necessary to accept it.⁷⁵ It just makes too much sense to be wrong.⁷⁶ The corroboration, then, is rational because the theory stands on its inner consistency and outer coherence within the general “web” of “firm” knowledge accepted by Western culture.⁷⁷ In the corroboration of macroevolutionary theory, the “web of belief” replaces empirical testability.

But the rationality or inner consistency of evolutionary theory, with data such as the fossil record, is still in the making.⁷⁸ One could have assumed that if inconsistencies arise then the theory could be falsified. When inconsistencies arise in evolutionary theory, however, scientists do not abandon the theory, but patch it up by producing other hypotheses and theories that might smooth them out. This being the case, we need to ask whether evolutionary theory is falsifiable. According to Popper,

a system must be described as *complex of the highest degree* if, in accordance with conventionalist practice, one holds fast to it as a system established forever which one is determined to rescue, whenever it is in danger, by the introduction of auxiliary hypotheses. For the degree of falsifiability of a system thus protected is equal to *zero* (emphasis original).⁷⁹

It seems, then, that the inner consistency and explanatory power of a theory justify it. The higher its power, the less likely it is to be rejected by the scientific community and the general public. The explanatory power of evolutionary theory accounts for its hold on contemporary scientists and society. Even though all theories are revisable, not all theories are equal, argues Kitcher. “Even though our present evidence does not prove that evolutionary biology—or quantum physics, or plate tectonics, or any other theory—is true—evolutionary biologists will maintain that the present evidence is overwhelmingly in favor of their theory and overwhelmingly against its

⁷⁵For instance, commenting on Gould’s proposal for fine-tuning evolutionary theory, Kitts, 143, affirms that “there is a significant way in which macro-evolutionary theories must be dependent. Paleontology can provide knowledge not only of events, but of patterns and trends among events. It cannot provide justification for the claim that any of its generalizations have explanatory efficacy; that they are, among other things, projected. The justification must come, as it does in geology, from showing that the generalizations are comprehended by theories which, by common consent, have such efficacy.”

⁷⁶“The higher the index of reality, the more the readers are invited to step beyond the particular history text to test the adequacy of its claims. Though, paradoxically, the higher the index the more the text suggests that readers need not accept the invitation, for a high index also brings greater authority and confidence in the truths of the narrative” (Richards, 25).

⁷⁷Kitcher, 48-49, 130, attempts to salvage the scientific status of evolution by calling on its power of explanation and its comprehensive theoretical reach and complexity; for a summary of the explanatory power of evolution, see Tim Berra, *Evolution and the Myth of Creationism: A Basic Guide to the Facts in the Evolution Debate* (Stanford, CA: Stanford University Press, 1990), 52-69.

⁷⁸Consider, for instance, that “although each side in the notorious dispute between those who subscribe to punctuated equilibrium and those who subscribe to gradualism points to paleontology in support of their position, there are enormous contingent barriers which stand in the way of resolving the issue on evidence provided by the fossil record” (Kitts, 142).

⁷⁹Karl R. Popper, *The Logic of Scientific Discovery*, rev. ed. (London: Hutchinson, 1959), 145.

supposed rivals.”⁸⁰ We should not understand Kitcher’s phrase “present evidence” as a reference to experimentation or observation, but to the general status of our not-so-firm, scientific, theoretical, revisable knowledge. Moreover, the explanatory power and rationality of evolution do not corroborate it or make it true; they only make it persuasive.

It is obvious that creationism finds the same limitations about corroboration and falsifiability. Will we reach a point in which the controversy about the understanding of origins will be solved?

Believing the Myth (Metanarrative)

That evolution’s hold on the scientific community stems from its explanatory power is only part of the equation. We need to consider also that the issues evolution explains are necessary for our human experience. In other words, we need to have an answer to the cosmogony question in order to understand our world and our own beings. This has always been so. Religion and philosophy deal with cosmogonies and cosmologies, and the output that comes from religious and philosophical discussion is referred to as worldviews.⁸¹ Our understanding of the origination of the world and its nature are part of the macro-hermeneutical assumptions that guide our understanding of human affairs, the operation of human reason,⁸² and even the construction of Christian theology.

Since both evolution and creation are commensurable, underdetermined theories attempting to explain the history of our planet,⁸³ we should not use them as presuppositions when considering other issues—theoretical or practical. We should not use them because we have no certainty about their truthfulness. Yet, we are forced to choose and in practice accept one of the competing theories as absolutely true. This acceptance is not based on reason or method, but on faith, i.e., on the relative confidence we personally place on the theory we adopt as being the most persuasive explanation of reality.

Epistemologically speaking, then, the basic difference between creation and evolution is not rational, but methodological. Methodologically, creation and evolution differ in the source producing the metanarrative about the origins of the

⁸⁰Kitcher, 34.

⁸¹For a detailed conceptual and historical analysis of the notion of worldview, see David K. Naugle, *Worldview: The History of a Concept* (Grand Rapids: Eerdmans, 2002).

⁸²See, for instance, how the acceptance of evolution makes an evolutionary approach to epistemology possible in Gerard Radnitzky and W. W. Bartley III, eds., *Evolutionary Epistemology, Rationality, and the Sociology of Knowledge* (La Salle, IL: Open Court, 1987).

⁸³“But it is only on the basis of an agreed-upon external constraint that we can engage in rational debate about what the fossil record tells us. Of course, there may be perfectly legitimate disagreements about the character and extent of the restriction to be applied, but they are prior to an assessment of the fossil record. The dispute between evolutionists and biblical creationists is only the most incoherent of all of those about the meaning of the fossil record that have arisen outside the boundaries of an agreed-upon external constraint” (Kitts, 140-141). The incoherence of the debate comes from the macro-hermeneutical presuppositions and the index of reality derived from them that each party brings to the table. In short, they approach the issue with different rational and methodological a priories.

universe. Evolution's source is natural, our interpretation from the scattered traces of the past. Creation springs from divine revelation, God's summary account of his handiwork.⁸⁴ Both work on tacit metaphysical and theoretical macro- and meso-presuppositions. Both attempt to understand the same subject matter or reality. Both use rational procedures in reading the scattered traces from the past. The difference boils down to a different "index of reality." Creationists have a broader index of reality than evolutionists. The former includes God and his revelation, while the latter excludes them. No wonder the interpretations are different. This divergence about the index of reality becomes the leading macro-hermeneutical difference between the two conflicting metanarratives.

When evolutionism becomes a presupposition to explain other areas of reality, it ceases to be a scientific theory and becomes a metaphysical or religious belief we accept by a leap of faith. To criticize theories becomes increasingly difficult when we use them as presuppositions to interpret other fields of reality because we have made them the foundation of our entire intellectual position. When we use them in this way, they become absolute truth for us. Of course, when we speak of faith, theologians are on their own turf, while scientists have left theirs behind. The sooner scientists and theologians understand the macro-hermeneutical role of cosmology, and that faith, not reason, is required for its application, the sooner the far-reaching consequences of the creation-evolution debate will be understood. Creation and evolution are not only competing in the scientific attempt to interpret the history of our planet, but as they elicit our assent, they become metanarratives we accept by faith and use to build our understanding of the world and of Christian theology. Each alternative generates conflicting views of the entire world of human experience.

Creation and evolution are metanarratives in conflict. In classical times we would have seen them as conflicting metaphysical teachings. Neither is irrational, because each makes sense of the same broad chunks of reality. Each has been produced by appropriate methodological procedures accepted in its own field of research. Only by making the scientific a priori absolute can we say that creation and the metanarrative it elicits are not scientific. But the scientific absolute stands only on the consensus of the scientific community, not on the absolute dictates of reason or scientific methodology. The truth is that each is an equally persuasive account of reality as a whole. The conflict between them, then, will never be solved rationally, only eschatologically.⁸⁵

Conclusion

The power and reliability of science stands on its method. From our brief analysis of scientific methodology in general (Part 1), we have discovered that

⁸⁴This makes biblical creation substantially different from Plato's account of creation. The former claims to originate in God, the latter in Plato's scientific explanation.

⁸⁵It seems to me this issue will be eschatologically decided. If the God of Scripture is God he will manifest himself in space and time at the end of human history to fulfill his promises and renew our planet with the creative power by which he brought it into existence. At that time the creation theory will be corroborated and verified.

scientific method reaches its highest level of reliability and predictability when it is applied to the present, repetitive phenomena of nature. Yet even at its highest level of certainty scientific methodology is always an interpretation dependent on hermeneutical a-priories that prevent it from discovering absolute inerrant truth from empirically generated data. Scientific methodology applied to recurrent natural processes produces tentative explanations of reality, which should not be accepted dogmatically, but be critically examined, modified, rejected, and replaced.⁸⁶

From the concise analysis of the way in which scientific methodology is used to build evolutionary theory the epistemological limitations become more prominent. Among others, a main limitation springs from the absence of the object of study, which, being past, stands beyond observation and experimentation. The historicity of its object forces scientists to rely heavily on inferences from what is accessible to them in the present (fossils, rocks, live organisms). From these empirically accessible sources of data scientists reconstruct the natural history of our planet in the form of a secular metanarrative. Such reconstruction has a very low level of rational certainty based on empirical evidence. For secular society, however, scientists play the role of prophets, and evolutionary metanarrative is received as cultural dogma imbued with a degree of certainty alien to scientific methodology. Evolution becomes a myth, scientific theory a fact. When evolution becomes dogma, faith replaces reason and science turns into religion.

We are now in a position to answer the question proposed at the beginning of this article: Is the epistemological certainty of evolutionary theory so absolute that Christian theologians should feel rationally compelled to accept its conclusions even if they explicitly contradict the teachings of biblical revelation on the origin of life on our planet?⁸⁷ The answer is clear: Scientific methodology and rationality do not reach a degree of certainty that compels Christian theologians to accept evolutionary theory as a fact to which biblical teachings should be accommodated.⁸⁸ The rationality of scientific methodology has the power to claim evolutionary theory as a possible explanation of the highly complex question of origins. Yet, it clearly falls short of making its explanation absolutely certain, thereby necessitating the assent of all rational beings. Why, then, should Christian and Adventist theologians feel compelled to accommodate Scripture to the parameters dictated by the evolutionary metanarrative?

⁸⁶See Canale, 98-99.

⁸⁷In this article, we are considering the science-theology relation only in regard to the cosmological questions of origins. However, the answer given to this relation extends to all issues on which science and Scripture have parallel pronouncements.

⁸⁸Fritz Guy represents a sector of Adventist theologians and scientists convinced that evolution is a fact and that we should interpret Scripture and Christian doctrine accordingly ("Interpreting Genesis One in the Twenty-first Century," *Spectrum* 31, no. 2 [2003]: 5-16).