

Origins of Life

Biblical and Evolutionary models face off

By: Fazale Rana & Hugh Ross

Part I: The Mystery Unfolds

Chapter 1: Questions, Questions— Always Questions

- Can evolution's theory of abiogenesis (the birth of life from nonlife) be demonstrated as true? If abiogenesis lacks scientific support, then evolutionary theory stands by blind faith alone. For biology to be framed in naturalistic terms, scientists must demonstrate the continuum from a prebiotic mixture of chemicals through the most complex life-forms. However, if something beyond nature, namely the supernatural, was involved in life's origin, then the door is open for viewing biological phenomena from a creation perspective. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 217-220). RTB Press. Kindle Edition.]
- Scientific explanations for the origin of life have a colorful history over the last 150 years. [One of the best scholarly treatments on the history and philosophy of origin-of-life research is Iris Fry, *The Emergence of Life on Earth: A Historical and Scientific Overview* (New Brunswick, NJ: Rutgers University Press, 2000), 54–88.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 222-223). RTB Press. Kindle Edition.]
- Darwinism. Biology moved with full force into the materialistic arena in the late 1850s with the publication of Charles Darwin's *The Origin of Species*. Darwin and those who accepted the essence of his ideas no longer regarded species as the fixed product of divine creative activity. Rather, Darwinists viewed species as evolving from one form into the next strictly through

natural mechanisms—inheritable variation operated on by natural selection. They believed that all life throughout Earth’s history stemmed from a single life-form or a few original life-forms. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 224-228). RTB Press. Kindle Edition.]

- Panspermia. In the late nineteenth century, an entirely different approach to the origin-of-life question became popular. Many scientists began to regard life, like matter, as eternal. This idea left no room for a creator. It embraced materialism and circumvented the question of a beginning by regarding life as always present in the universe. Scientists referred to this concept as panspermia—“everywhere life’s seeds.” [Fry, *Emergence of Life on Earth*, 59–62.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 248-251). RTB Press. Kindle Edition.]
- Panspermia lost its appeal in the early twentieth century as cosmologists began to recognize from Einstein’s theory of general relativity and Edwin Hubble’s observations of space’s expansion that the universe had a beginning. Other experiments showed that ultraviolet radiation kills bacterial spores. Because this deadly ultraviolet radiation permeates interstellar space, bacteria could not have survived interstellar journeys. The evidence seemed to be turning against panspermia. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 259-263). RTB Press. Kindle Edition.]
- Neovitalism. Given the vast complexity of life and the complicated problems with abiogenesis and panspermia, most scientists of the early 1900s gave up trying to discover how life originated. Life’s beginning was considered a profound mystery. Other scientists began to argue for a special “life force.” A scientific minority emerged that gave attention to this concept, termed neovitalism. One leading proponent, Hans Driesch, argued that the hypothesized life force mysteriously propagated from one generation to the next and that the origin-of-life question stood beyond reach. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 263-267). RTB Press. Kindle Edition.]
- The Oparin-Haldane hypothesis. Reacting to this neovitalism, Russian biochemist Alexander I. Oparin and British geneticist J. B. S. Haldane

independently provided a detailed hypothesis for abiogenesis in the 1920s. Though initially rejected by much of the scientific community, the Oparin-Haldane hypothesis became the chief organizing principle in origin-of-life research through the 1970s, and in some form it persists today. Oparin and Haldane were the first to propose the mechanism for life's origin as part of a detailed scientific model. That model presented stepwise pathways from inorganic systems on primordial Earth to the emergence of Earth's first living entities. They postulated an early atmosphere devoid of oxygen and dominated by reducing gases—hydrogen, ammonia, methane, and water vapor. Within this gas mix, energy discharges formed prebiotic molecules that accumulated in Earth's oceans to form a primordial soup. Chemical reactions then led step-by-step to the first life-forms. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 268-275). RTB Press. Kindle Edition.]

- Best-selling author Paul Davies makes this point in his book *The Fifth Miracle*: When I set out to write this book, I was convinced that science was close to wrapping up the mystery of life's origin. . . . Having spent a year or two researching the field, I am now of the opinion that there remains a huge gulf in our understanding. . . . This gulf in understanding is not merely ignorance about certain technical details; it is a major conceptual lacuna. [Paul Davies, *The Fifth Miracle: The Search for the Origin and Meaning of Life* (New York: Simon & Schuster, 1999), 17–18.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 300-304). RTB Press. Kindle Edition.]
- Davies explains why this mismatch persists between public perception and stark reality: Many investigators feel uneasy about stating in public that the origin of life is a mystery, even though behind closed doors they freely admit that they are baffled. There seems to be two reasons for their unease. First, they feel it opens the door to religious fundamentalists and their god-of-the-gaps pseudoexplanations. Second, they worry that a frank admission of ignorance will undermine funding. [Paul Davies, *The Fifth Miracle: The Search for the Origin and Meaning of Life* (New York: Simon & Schuster, 1999), 17–18.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 306-310). RTB Press. Kindle Edition.]

- Recognizing the problems with origin-of-life scenarios on Earth and with both interplanetary and interstellar panspermia, some scientists have begun to espouse a radical version of the concept—directed panspermia. First suggested by Nobel laureate Sir Francis Crick and origin-of-life researcher Leslie Orgel, this approach explains life’s first occurrence on Earth as the work of aliens who sent an unmanned ship to Earth, seeding it with life. [Francis Crick and Leslie E. Orgel, “Directed Panspermia,” *Icarus* 19 (1973): 341–46.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 346-350). RTB Press. Kindle Edition.]

Chapter 2: Are There Any Answers?

- Most investigators would rather confront the problems and frustrations of naturalistic models than consider any explanation for life’s start that lacks scientific credibility, especially when it involves a divine Creator. Both Nobel laureate Sir Francis Crick and physicist and bestselling author Paul Davies make this point. In *The Fifth Miracle* (1999), Davies concedes “science rejects true miracles. Although biogenesis strikes many as virtually miraculous, the starting point of any scientific investigation must be the assumption that life emerged naturally, via a sequence of normal physical processes.” [Paul Davies, *The Fifth Miracle: The Search for the Origin and Meaning of Life* (New York: Simon & Schuster, 1999), 81–82.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 371-376). RTB Press. Kindle Edition.]
- Nearly twenty years earlier, Sir Francis Crick made the identical point. He asserted in his book *Life Itself* that an honest man recognizes that life’s origin appears to be “almost a miracle, so many are the conditions which would have had to be satisfied to get it going.” [Francis Crick, *Life Itself: Its Origin and Nature* (New York: Simon & Schuster, 1981), 88.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 376-378). RTB Press. Kindle Edition.]
- Yet Crick rejects consideration of any supernatural basis. Rather, as one of the originators of directed panspermia (the theory of the seeding of life on Earth by an alien intelligence), Crick prefers to consider life’s birth as a lucky accident in which the virtually miraculous did occur, if not on Earth, then somewhere in the universe. [Hugh Ross. *Origins of Life: Biblical and*

Evolutionary Models Face Off (Kindle Locations 378-381). RTB Press. Kindle Edition.]

- Philosophical reasons strengthen the resistance to considering life's origin through creation. In *The Triumph of Evolution and the Failure of Creationism*, well-known paleontologist Niles Eldredge captures this concern: We humans can directly experience that material world only through our senses, and there is no way we can directly experience the supernatural. Thus, in the enterprise that is science, it isn't an ontological claim that a God . . . does not exist, but rather an epistemological recognition that even if such a God did exist, there would be no way to experience that God given the impressive, but still limited, means afforded by science. And that is true by definition. [In this work, Eldredge fails to convincingly demonstrate evolution's triumph and only demonstrates the failure of young-earth creationism. See a book review by Fazale R. Rana in *Facts for Faith* 3 (Q3 2000), 60–61.] [Niles Eldredge, *The Triumph of Evolution and the Failure of Creationism* (New York: Freeman, 2000), 13.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 383-389). RTB Press. Kindle Edition.]
- Eldredge adds to the explanation of why religion does not belong at the table: Creation science isn't science at all. Creation scientists have not managed to come up with even a single intellectually compelling, scientifically testable statement about the natural world. . . . Creation science has precious few ideas of its own—positive ideas that stand on their own, independent of, and opposed to, counter opinions of normal science. [Niles Eldredge, *The Triumph of Evolution and the Failure of Creationism* (New York: Freeman, 2000), 91.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 401-405). RTB Press. Kindle Edition.]
- He extends this line of reasoning: There is as little substance in scientific creationists' treatment of the origin and diversification of life as there is in their treatment of cosmological time. They pose no novel testable hypotheses and make no predictions or observations worthy of the name. They devote the vast bulk of their ponderous efforts to attacking orthodox science in the mistaken and utterly fallacious belief that in discrediting science . . . they have thereby established the truth of their own position. . . . [T]hey impugn

the integrity and intelligence of thousands of honest souls who have had the temerity to believe that it is both fitting and proper to try to understand the universe, the Earth, and all its life in naturalistic terms using only the evidence of our senses to evaluate how truthful an idea might be. [Niles Eldredge, *The Triumph of Evolution and the Failure of Creationism* (New York: Freeman, 2000), 146, 147.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 407-413). RTB Press. Kindle Edition.]

- Philosopher Stephen C. Meyer points out that science frequently engages in this type of investigation. Science routinely deals with phenomena that are not directly observable, such as forces, fields, and subatomic particles. Scientists infer the properties and monitor the effects of unobservables indirectly by examining observable macroscopic phenomena and effects directly with their senses. [Stephen C. Meyer, “The Methodological Equivalence of Design and Descent: Can There Be a Scientific ‘Theory of Creation’?” in *The Creation Hypothesis: Scientific Evidence for an Intelligent Designer*, ed. J. P. Moreland (Downers Grove, IL: InterVarsity, 1994), 67–112.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 433-436). RTB Press. Kindle Edition.]

Chapter 3: Putting Creation To The Test

- Developing a more comprehensive understanding of a biblical passage requires disciplined application of hermeneutical principles—rules that govern Bible study. The scholar and layperson alike receive a tremendous return when they focus detailed attention on: the original language, carefully weighing the meaning of words and phrases the immediate as well as the wider context of the passage, imagery and symbolism, the literary genre of the text in question, information and insight from other biblical passages and from non-biblical sources, historical circumstances. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 484-490). RTB Press. Kindle Edition.]
- Theologians call this the historical-grammatical method. [See Gordon D. Fee and Douglas Stuart, *How to Read the Bible for All Its Worth*, 2nd ed. (Grand Rapids, MI: Zondervan, 1993); See Robert H. Stein, *A Basic Guide to Interpreting the Bible: Playing by the Rules* (Grand Rapids, MI: Baker

Academic, 1994); See Grant R. Osbourne, *The Hermeneutical Spiral: A Comprehensive Introduction to Biblical Interpretation* (Downers Grove, IL: InterVarsity, 1991); See William W. Klein, Craig L. Blomberg, and Robert L. Hubbard, Jr., *Introduction to Biblical Interpretation* (Dallas: Word, 1993).] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 490-491). RTB Press. Kindle Edition.]

- A testable creation model for the origin of life requires answers to these questions. A superficial glance at Genesis 1 seems to place life's first appearance on day three. Genesis 1:11 describes God as commanding the land to produce vegetation. Prior to day three, God's creative activity apparently focused on transforming Earth from its primordial state into a planet ready to receive the animal and human life to be introduced on days five and six. This understanding of Genesis 1 is widespread. In fact, Paul Davies used this interpretation to title his book *The Fifth Miracle*. Davies enumerates the appearance of vegetation on the land as the fifth miracle in Genesis 1, with the creation of the universe, light, atmosphere, and dry land as the first four miracles. [Paul Davies, *The Fifth Miracle: The Search for the Origin and Meaning of Life* (New York: Simon & Schuster, 1999), 22.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 497-503). RTB Press. Kindle Edition.]
- The first testable assertions with respect to life appear in this verse, as the author describes early Earth's initial conditions. The New International Version translation says that primordial Earth was "formless and empty." In English, and to some extent in the original Hebrew, these words indicate that the early earth awaited God's transforming work, the time when it would be fit for life and filled with life. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 515-517). RTB Press. Kindle Edition.]
- Genesis 1:2 indicates that an observer, if located on Earth's surface, would also experience darkness as one of Earth's initial conditions. Scientists agree. Both theoretical and observational research done by astronomers indicates that any planetary system forming in the Milky Way Galaxy would have possessed large quantities of gas, dust, and debris in its interplanetary space as its planets coalesced. These same studies also show that when the planets

were forming, opaque (or nearly opaque) atmospheres shrouded them. The early solar-system debris, together with Earth's dense atmosphere, would have blocked the Sun's light from reaching early Earth's surface. Science confirms that an observer on early Earth would be confronted with darkness in every direction. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 546-552). RTB Press. Kindle Edition.]

- Scientific orthodoxy holds that early Earth's oceans became permanent around 3.9 billion years ago, and for the first third of Earth's history thereafter, oceans dominated its surface. During this time, if any land existed, it would have been sparsely distributed, limited to volcanic islands that protruded from beneath Earth's oceans. Then about 3 billion years ago, driven by tectonic activity and volcanism, significant continent building began. Over the course of the next 500 million years, exposed landmass dramatically increased from less than 3 percent of Earth's surface area to about 29 percent. At this time continental land growth slowed, due to decreases in erosion and tectonic and volcanic activity. Currently, the land on Earth's surface remains steady at this level as land formation and erosion forces roughly balance. [Peter D. Ward and Donald Brownlee, *Rare Earth: Why Complex Life Is Uncommon in the Universe* (New York: Springer-Verlag, 2000), 202.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 563-569). RTB Press. Kindle Edition.]
- 1. Life appeared early in Earth's history, while the planet was still in its primordial state. The backdrop for the origin of life in Genesis 1:2 was an early Earth enveloped entirely in water and as yet untransformed by tectonic and volcanic activity. This tenet anticipates the discovery of life's remains in the part of the geological column that corresponds to early Earth. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 626-628). RTB Press. Kindle Edition.]
- 2. Life originated in and persisted through the hostile conditions of early Earth. Genesis 1:2 describes early Earth as *tōhû wabōhû*, an empty wasteland. This model maintains that God nurtured the seeds of Earth's first life, perhaps re-creating these seeds each time they were destroyed. This model predicts that science will discover life's first emergence under the hellish conditions of early Earth. [Hugh Ross. *Origins of Life: Biblical and*

Evolutionary Models Face Off (Kindle Locations 629-632). RTB Press. Kindle Edition.]

- 3. Life originated abruptly. If God created the first life on Earth through direct intervention, one can reasonably assume that life appeared suddenly, seemingly out of nowhere. This model predicts that the planetary and geological record will demonstrate life's emergence in a narrow, if not instantaneous, time window. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 632-634). RTB Press. Kindle Edition.]
- 4. Earth's first life displays complexity. If a Creator brought life into existence, first life should display significant complexity. Therefore, the RTB model predicts that fossil and geochemical remains will indicate that Earth's earliest life-forms display complexity. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 635-637). RTB Press. Kindle Edition.]
- 5. Life is complex in its minimal form. Life in its simplest form should also display considerable complexity. An inherent minimal complexity reasonably indicates that life has been intelligently crafted. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 637-638). RTB Press. Kindle Edition.]
- 6. Life's chemistry displays hallmark characteristics of design. Systems and structures produced by intelligent agents typically possess characteristics that distinguish them from those produced by natural processes. These properties serve as indicators of design. They will be apparent in biochemical systems of the cell if the biblical Creator is responsible for life. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 639-641). RTB Press. Kindle Edition.]
- 7. First life was qualitatively different from life that came into existence on creation days three, five, and six. The third creation day describes the creation of plants (zerá, 'ēš, and perî in the Hebrew). The fifth creation day discusses the creation of marine invertebrates and fish, marine mammals, and birds. The sixth creation day includes the creation of specialized land mammals.¹⁶ These multicellular advanced plants and animals are qualitatively different from the first life-forms created on primordial Earth.

[Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 644-649). RTB Press. Kindle Edition.]

- 8. A purpose can be postulated for life's early appearance on Earth. The RTB model bears the burden of explaining why God would create life so early in Earth's history and why (as well as when) He would create the specific types of life that appeared on primordial Earth. While God would be free to create life for nonutilitarian purposes, discernible reasons should exist for God's bringing life into existence under the violent conditions of early Earth—conditions under which life could not persist and would presumably need to be re-created. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 649-653). RTB Press. Kindle Edition.]

Chapter 4: The Naturalistic Approach

- These ideas for life's beginning, prolific in number and complexity, at times appear to have no relationship at all to one another. Yet, like octopus arms, regulated by the head, all naturalistic models share some “controlling” central features, including natural pathways for: • synthesis (combining) of prebiotic (pre-life) molecules • concentration of prebiotic molecules • formation of life's building blocks • assembly of building block molecules to form complex biomolecules • development of self-replication • emergence of metabolism (the physical and chemical processes continuously going on in living organisms and cells) • aggregation of biomolecules to form protocells (primitive cells) • evolution of protocells into true cells [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 693-703). RTB Press. Kindle Edition.]
- Investigators propose two forms of panspermia: nondirected and directed. Nondirected panspermia appeals to natural mechanisms to transport life (or life's molecules) to Earth once it has originated elsewhere in the universe.⁶ It falls into two categories: (1) interplanetary, which looks to bodies within Earth's solar system, such as meteorites, comets, Mars, or Europa (one of Jupiter's moons), as a source of Earth's first life; and (2) interstellar, which hypothesizes the transport of life or life molecules to Earth (and elsewhere, perhaps) from other star systems. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 740-744). RTB Press. Kindle Edition.]

- Directed panspermia is a radical form adopted by a minority of origin-of-life scientists. These scientists maintain that an intelligent alien race transported life to Earth. Proponents of directed panspermia typically express their belief that intelligent life is abundant in the universe. Based on this abundance, they infer that an alien race could have acquired the necessary technology to seed Earth with life. Both the newly launched Astrobiology Institute at NASA (National Aeronautics and Space Administration) and the Origins Program are rapidly propelling panspermia to the forefront in origin-of-life research. The two groups' shared goal is to explain life's origin, not only on Earth, but also throughout the universe. With funding from NASA, they search for life within Earth's solar system and beyond. With this financial support comes the emphasis on life's existence beyond Earth and, consequently, research that bears directly on panspermia mechanisms and models. [Francis Crick and Leslie E. Orgel, "Directed Panspermia," *Icarus* 19 (1973): 341–46; See Francis Crick, *Life Itself: Its Origin and Nature* (New York: Touchstone, 1981).] [David Darling, *The Extraterrestrial Encyclopedia: An Alphabetical Reference to All Life in the Universe* (New York: Three Rivers, 2000), 291, 311.] [The funding for NASA's exobiology program has quadrupled during the past five years.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 745-753). RTB Press. Kindle Edition.]
- Prebiotic formation. All naturalistic origin-of-life scenarios, whether extraterrestrial or terrestrial, require a source of prebiotic compounds. The Oparin-Haldane hypothesis considered chemical reactions in Earth's atmosphere as the chief way to generate prebiotic molecules. Some researchers still pursue atmospheric reactions as the source of prebiotics. Others, prompted by recent discoveries about early Earth's atmosphere, explore different mechanisms for prebiotic molecule production. [James F. Kasting and Lisa L. Brown, "The Early Atmosphere as a Source of Biogenic Compounds," in *The Molecular Origins of Life: Assembling Pieces of the Puzzle*, ed. André Brack (Cambridge: Cambridge University Press, 1998), 35–36.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 757-761). RTB Press. Kindle Edition.]
- 1. Chemical pathways produced life's building blocks. For natural processes to explain life's beginning, investigations must identify plausible chemical

routes that could generate life's building-block molecules (amino acids, purines, pyrimidines, sugars, fatty acids, and so on). [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 908-910). RTB Press. Kindle Edition.]

- 2. Chemical pathways yielded complex biomolecules. Once life's building-block molecules formed, plausible chemical routes and processes must have existed for them to condense into the molecular entities that ultimately led to the complex biomolecules central to the cell's structural and functional components. These biomolecules include DNA, RNA, proteins, and membrane and all cell-wall components. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 910-913). RTB Press. Kindle Edition.]
- 3. The chemical pathways that yielded life's building blocks and complex molecular constituents operated in early Earth's conditions. Not only must origin-of-life models identify plausible chemical routes that yielded life's molecules, but these routes also must have operated under early Earth's conditions and generated sufficient material to allow life to evolve. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 913-916). RTB Press. Kindle Edition.]
- 4. Sufficiently placid chemical and physical conditions existed on early Earth for long periods of time. This prediction is a necessary corollary to the previous one. While the production of prebiotic compounds required high-energy conditions, these conditions could not persist for long without destroying the very molecules they formed. Fragile complex biomolecules like DNA, RNA, and proteins are particularly susceptible to breakdown by water and to breakage by mechanical, shear stresses. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 916-920). RTB Press. Kindle Edition.]
- 5. Geochemical evidence for a prebiotic soup exists in Earth's oldest rocks. Regardless of the source of prebiotic compounds, if a prebiotic soup existed on early Earth as a necessary preamble to life's origin, then evidence for it should be discovered in the oldest layers of Earth's geological column. (Of course, this prediction need not be a part of models in which life originates beyond Earth.) [Hugh Ross. *Origins of Life: Biblical and Evolutionary*

Models Face Off (Kindle Locations 921-924). RTB Press. Kindle Edition.]

- 6. Life appeared gradually on Earth over a long period of time. The transition from the prebiotic starting materials thought to have been present on early Earth, through a prebiotic soup to the first cellular entities, would require many chemical steps. Some of these steps proceed slowly, while others seem highly unlikely. Given these facts, life's emergence should have required a long time to unfurl once Earth's conditions could feasibly support life. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 924-927). RTB Press. Kindle Edition.]
- 7. The origin of life occurred only once on Earth. This prediction stands as a corollary to the previous one, especially considering the number of steps required to generate first life from nonliving chemical entities and the low probability of some of the steps. In other words, it was such a lengthy, unlikely process that it could, at most, have happened just once. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 927-930). RTB Press. Kindle Edition.]
- 8. Earth's first life was simple. Given the arduous process required to generate the first life-forms, it follows that life as it first appeared on Earth must have been simple, both in terms of its chemical makeup and its morphology, or form. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 930-932). RTB Press. Kindle Edition.]
- 9. Life in its most minimal form is demonstrably simple. Life's minimal complexity describes the fewest number of different biomolecules that must have simultaneously co-occurred for life to originate. For a realistic probability of emergence through natural processes, life's most minimal form must have been relatively simple. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 932-934). RTB Press. Kindle Edition.]

Part II: The Facts of Life

Chapter 5: An Early Or Late Appearance?

- Though origin-of-life researchers readily acknowledge life's early entrance onto Earth's stage, they find it remarkable and totally unexpected. Naturalism's proponents would not have predicted the early appearance of

such complex life-forms. Origin-of-life investigator J. William Schopf makes this point quite plainly in *The Cradle of Life*, where he says, “No one had foreseen that the beginning of life occurred so astonishingly early.” [Schopf, *Cradle of Life*, 3.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1277-1281). RTB Press. Kindle Edition.]

- Elsewhere in his book, Schopf details the problem that complex early life presents for naturalistic explanations: No one has publicly disagreed with my interpretation of the Apex fossils. But privately, some would prefer I were mistaken, since they (and I, too) would prefer a simpler evolutionary story, one that told us these oldest fossil organisms were capable only of primitive ways of living and that advanced metabolic lifestyles evolved much later. But the evidence seems strong, and what one might “prefer” shouldn’t matter. [Schopf, *Cradle of Life*, 98.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1281-1286). RTB Press. Kindle Edition.]

Chapter 6: A Slow or Sudden Arrival?

- In 1966, Carl Sagan wrote a piece of evolutionary doctrine that still appears in textbooks. There is an elaborate apparatus involving messenger RNA, adapter RNA, ribosomes, and a diversity of specialized enzymes. . . . We cannot imagine these complex and specific accessory molecules to have arisen spontaneously in the primitive environment. The apparatus for the transcription of the genetic code must itself have evolved slowly, through billions of years of evolution. [I. S. Shklovskii and Carl Sagan, *Intelligent Life in the Universe* (San Francisco: Holden-Day, 1966), 237.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1291-1295). RTB Press. Kindle Edition.]
- Sagan believed that the period during which prebiotics assembled themselves into Earth’s first organism must have covered an extremely lengthy time span. While he referred to billions of years, the assemblage of prebiotics at most extended from the origin of the planet until life’s first appearance in the fossil record. In the 1960s few researchers imagined just how short this time was. Earth’s origin has since been dated to 4.566 ± 0.002 billion years ago. Fossils extend back 3.5 billion years. [C. J. Allègre, G. Manhès, and C.

Göpel, “The Age of the Earth,” *Geochemica et Cosmochemica Acta* 59 (1995): 1445–56.] [J. William Schopf, “The Oldest Known Records of Life: Early Archean Stromatolites, Microfossils, and Organic Matter,” in *Early Life on Earth*, Nobel Symposium No. 84, ed. Stefan Bengtson (New York: Columbia University Press, 1994), 193–206; J. William Schopf and Malcolm R. Walter, “Archean Microfossils: New Evidence of Ancient Microbes,” in *Earth’s Earliest Biosphere: Its Original Evolution*, ed. J. William Schopf (Princeton, NJ: Princeton University Press, 1983), 214–39.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1296-1300). RTB Press. Kindle Edition.]

- The Sun’s burning history made early Earth violently hostile to life’s origin and potential survival. The Sun formed from the gravitational collapse of a gas cloud. At times during the collapse phase, gas and dust were sucked into the Sun; at other times gas and dust escaped to outer space. Different nuclear reactions switched on and off at different times within the emerging star. During its infancy (lasting 50 million years), the Sun’s luminosity was highly unstable. For the next 500 million years, solar ionizing radiation (in particular, X-rays) persisted at a level 50 times higher than at present. [R. Kippenhahn and A. Weigert, *Stellar Structure and Evolution*, study ed. (Berlin: Springer-Verlag, 1994), 269.] [Icko Ibe Jr., “Stellar Evolution. I. The Approach to the Main Sequence,” *Astrophysical Journal* 141 (1965): 993–1018, especially p. 1000; G. Wuchteri and Ralf S. Klessen, “The First Million Years of the Sun: A Calculation of the Formation and Early Evolution of a Solar Mass Star,” *Astrophysical Journal Letters* 560 (2001): L185–L188.] [Frederick M. Walter and Don C. Barry, “Pre- and Main-Sequence Evolution of Solar Activity,” in *The Sun in Time*, ed. C. P. Sonett, M. S. Giampapa, and M. C. Matthews (Tucson: University of Arizona Press, 1991), 633–57 (note Table IV on p. 653); David R. Soderblom, Burton F. Jones, and Debra Fischer, “Rotational Studies of Late-Type Stars. VII. M34 (NGC 1039) and the Evolution of Angular Momentum and Activity in Young Solar-Type Stars,” *Astrophysical Journal* 563 (2001): 334–40.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1309-1315). RTB Press. Kindle Edition.]
- The discovery and confirmations of life on Earth as far back as 3.8 billion years shrink the maximum time window for life’s origin from 1,070 million

years to 770 million years. With at least many dozens of bombardments, or sterilization events, taking place between 4.5 and 3.9 billion years ago (the last being particularly catastrophic), the window shrinks to no more than 100 million years. The latest assessment of the date for the late heavy bombardment sets it at 3.85 billion years ago.¹⁷ This calculation closes the window for life's origin even more tightly—to less than 50 million years. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1354-1359). RTB Press. Kindle Edition.]

- Could life have survived one of the sterilization events in Earth's early history by orbiting the planet for a while before returning to Earth? It's one intriguing possibility. When a body strikes the earth with enough force to sterilize all life on the planet, some of the material in Earth's crust gets ejected into interplanetary space. Although the length of time this matter spends traveling through space ranges greatly (up to millions of years), eventually some of this matter lands on Venus, Mars, and other planets in the solar system. A significant fraction of the ejected matter returns to Earth, with return travel times measured in thousands of years. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1380-1385). RTB Press. Kindle Edition.]
- Nucleotide building blocks are known to fall apart quickly at warm temperatures. Origin-of-life specialist Matthew Levy recently demonstrated the problem. His experiments showed that all four of RNA's nucleotide building blocks degrade at warm temperatures in time periods ranging from nineteen days to twelve years.³⁶ These extremely short survival rates for the four RNA nucleotide building blocks suggest why life's origin would have to be virtually instantaneous—all the necessary RNA molecules would have to be assembled before any of the nucleotide building blocks decayed. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1458-1462). RTB Press. Kindle Edition.]
- Paleontologist Peter Ward and astronomer Donald Brownlee echoed this conclusion in their book *Rare Earth*: "Ancient life existed at Isua [Greenland], and perhaps, elsewhere on Earth, as early as 3.8 billion years ago, [sic] it leads to a striking conclusion: Life seems to have appeared simultaneously with the cessation of the heavy bombardment. . . . This seems

like an awfully short period of time for the first life to evolve.” [Peter D. Ward and Donald Brownlee, *Rare Earth: Why Complex Life Is Uncommon in the Universe* (New York: Copernicus, Springer-Verlag, 2000), 61, 66.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1478-1481). RTB Press. Kindle Edition.]

- Niles Eldredge, cofounder (along with the late Stephen Jay Gould) of the punctuated equilibria hypothesis for the evolution of life, recently wrote, “In the very oldest rocks that stand a chance of showing signs of life, we find those signs—those vestiges—of life. Life is intrinsic to the Earth!” [Niles Eldredge, *The Triumph of Evolution and the Failure of Creationism* (New York: Freeman, 2000), 36.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1482-1484). RTB Press. Kindle Edition.]
- Hubert Yockey, who founded the discipline that applies information theory to molecular biology, concluded after years of research that “life is consistent with the laws of physics and chemistry but [is] not derivable from them.” He adds, “I have no scenario to explain the origin of life.” Concerning the search for the origin of life from nonliving matter, Yockey has deduced that the persistent failures to solve the puzzle simply arise from the fact that “there is no solution.” He expresses agreement with the renowned theoretical physicist Niels Bohr that “life is to be accepted as an axiom.” [Hubert P. Yockey, *Information Theory and Molecular Biology* (New York: Cambridge University Press, 1992), 290.] [Ibid., 291.] [Ibid., 289.] [Ibid., 289; Niels Bohr, “Light and Life,” *Nature* 131 (1933): 421–23, 457–59.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1500-1506). RTB Press. Kindle Edition.]

Chapter 7: Where’s The Soup?

- Of the 112 known chemical elements, only carbon possesses a sufficiently complex chemical behavior to sustain living systems. Carbon readily assembles into stable molecules comprised of individual and fused rings and linear and branched chains. It forms single, double, and triple bonds. Carbon also strongly bonds with itself as well as with oxygen, nitrogen, sulfur, and hydrogen. In other words, life molecules must be carbon-based. [T. Graham Solomons, *Organic Chemistry*, 2nd ed. (New York: Wiley, 1980), 48–49.]

[Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1527-1530). RTB Press. Kindle Edition.]

- As one of the rarest light elements, phosphorus in the Sun measures at only 200 parts per billion!² As small as that proportion seems, it is still higher than the average abundance found anywhere else in the universe—except Earth, which is an unusually phosphorus-rich planet. The phosphorus abundance in Earth’s surface ocean waters is 1.5 parts per billion.³ However, Earth’s crust—the most phosphorus-rich source known—contains 1,000 parts per million.⁴ Still, this “high” number indicates rarity. The short supply of phosphorus poses a significant problem for a naturalistic origin of life because so much of this ingredient is required to make replicator molecules. Phosphates are part of the backbone of both DNA and RNA. A phosphate molecule must accompany every nucleoside in them. Possible precursors to DNA and RNA molecules would seem to require similar phosphate richness. Without life molecules (already assembled and operating), no known natural process can harvest the amounts of phosphorus necessary for life from the environment. All the phosphate-rich deposits on Earth are produced by life. [John Emsley, *The Elements*, 3rd ed. (Oxford: Clarendon, 1998), 153.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1532-1541). RTB Press. Kindle Edition.]
- The Oxygen-Ultraviolet Paradox Oxygen’s presence, either in the atmosphere or dissolved in oceanic or subterranean water, shuts down prebiotic chemistry pathways. Even minute amounts of oxygen will prevent prebiotic chemistry. Recent work indicates low but significant levels of molecular oxygen on early Earth. Romanian physicist Ivan Draganic points out that between 3 and 4 billion years ago the intensity of radiation from radioactive decay of uranium, thorium, and potassium-40 must have been much greater than today’s. [S. Fox and K. Dose, *Molecular Evolution and the Origin of Life* (San Francisco: Freeman, 1972), 44–45; I. S. Shklovskii and Carl Sagan, *Intelligent Life in the Universe* (San Francisco: Holden-Day, 1966), 231.] [Ivan G. Draganic, “Oxygen and Oxidizing Free-Radicals in the Hydrosphere of Early Earth,” *Book of Abstracts, ISSOL 1999*, 34; I. G. Draganic, Negrón-Mendoza, and S. I. Vujosevis, “Reduction Chemistry of Water in Chemical Evolution Emploration,” *Book of Abstracts, ISSOL 2002*, 139.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle

Locations 1683-1688). RTB Press. Kindle Edition.]

- Without oxygen in Earth's atmosphere, there would be no ozone layer, and ultraviolet radiation from the Sun, bright stars, and supernova eruptions would have penetrated to Earth's surface and through the upper ocean and lake layers. Such intense ultraviolet radiation breaks apart the chemical bonds of prebiotic molecules. Therefore, either way, in the presence of oxygen or in the absence of oxygen, the soup is ruined because prebiotic molecule formation is stymied. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1696-1699). RTB Press. Kindle Edition.]
- Origin-of-life researcher Hubert Yockey points out, "The significance of the isotopic enhancement of carbon-12 in the very old kerogen in the Isua rocks in Greenland is that there never was a primordial soup and that, nevertheless, living matter must have existed abundantly on Earth before 3.8 billion years ago." [Hubert P. Yockey, "Comments on 'Let There Be Life: Thermodynamic Reflections on Biogenesis and Evolution' by Avshalom C. Elitzur," *Journal of Theoretical Biology* 176 (1995): 351.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1754-1756). RTB Press. Kindle Edition.]

Part III: From The Bottom Up and Top Down

Chapter 8: The Search for Chemical Pathways

- To date, scientists have failed to produce cytosine in a spark-discharge experiment, nor has cytosine been recovered from meteorites or extraterrestrial sources.⁹ Because meteorites (and other extraterrestrial materials) serve as a proxy for early Earth's chemistry, the absence of cytosine in these sources would seem to affirm Shapiro's conclusion. Shapiro also critically analyzed prebiotic simulation experiments that produced the DNA and RNA component adenine.¹⁰ As with cytosine, he showed that adenine formation on early Earth (by currently recognized prebiotic routes) could not reasonably have occurred, for many of the same reasons. Recent work by James Cleaves and Stanley Miller uncovers an additional problem.¹¹ Nucleobases readily react with formaldehyde and acetaldehyde, compounds most certainly present on early Earth, to form both small

molecule derivatives and large intractable molecules. Even under mild conditions, these reactions take place so rapidly that they would preferentially occur at the expense of reactions that could lead to RNA. Thus, if nucleobases could form, competing reactions would likely consume them. [Shapiro, “Prebiotic Cytosine Synthesis,” 4396–401.] [Robert Shapiro, “The Prebiotic Role of Adenine: A Critical Analysis,” *Origin of Life and Evolution of the Biosphere* 25 (1995): 83–98.] [H. James Cleves II and Stanley C. Miller, “The Prebiotic Synthesis of Nucleoside Analogues from Mixed Formose Reactions: Implications for the First Genetic Material,” poster presented at the 13th International Conference on the Origin of Life and the 10th Meeting of the International Society for the Study of the Origin of Life (ISSOL 2002), June 30–July 5, 2002, Oaxaca, Mexico.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1852-1862). RTB Press. Kindle Edition.]

- The only known plausible prebiotic route to ribose (and all sugars) is the Butlerow reaction (also known as the formose reaction).¹² This reaction begins with the one-carbon compound formaldehyde, which readily forms in spark-discharge experiments. In the presence of an inorganic catalyst (calcium hydroxide, calcium oxide, alumina clays, and so on), formaldehyde reacts with itself and resultant products to generate sugars containing two, three, four, five, six, or more carbon atoms. Though this route to ribose and other sugars exists, most researchers question its applicability to the origin-of-life scenario.¹³ Numerous side reactions dominate formose chemistry. As a consequence, this reaction yields over forty different sugar species with ribose as a minor component. If this reaction did operate on early Earth, it could never have yielded enough ribose to support an RNA world. [Norman W. Gabel and Cyril Ponnampereuma, “Model for Origin of Monosaccharides,” *Nature* 216 (1967): 453–55; A. G. Cairns-Smith et al., “Formose Production by Minerals: Possible Relevance to the Origin of Life,” *Journal of Theoretical Biology* 35 (1972): 601–4; Alan W. Schwartz and R. M. de Graaf, “The Prebiotic Synthesis of Carbohydrates: A Reassessment,” *Journal of Molecular Evolution* 36 (1993): 101–6; Miller, 59–85.] [Schwartz and de Graaf, “Prebiotic Synthesis,” 101–6; Miller, “Endogenous Synthesis,” 59–85.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1865-1872). RTB Press. Kindle Edition.]

- Although several plausible routes to polyphosphates exist, researchers wonder if these chemical pathways have any relevance to early Earth.¹⁸ For example, to produce polyphosphates from apatite and dihydrogen phosphate, water must be completely driven from the system—an impossibility for phosphate minerals confined to rocks. Furthermore, the high temperatures needed to form polyphosphates would in turn destroy any organic material. [Keefe and Miller, “Are Polyphosphates or Phosphate Esters,” 693–702; Ramanarayanan Krishnamurthy, “Challenges in ‘Prebiotic’ Chemistry,” lecture, ISSOL 2002.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1894-1898). RTB Press. Kindle Edition.]
- The origin-of-life community widely acknowledges the prebiotic production of ribose, cytosine, and polyphosphates as painfully problematic. In fact, at the opening plenary lecture of ISSOL 2002, after summarizing these and other problems, distinguished origin-of-life researcher Leslie Orgel stated, “It would be a miracle if a strand of RNA ever appeared on the primitive Earth.”²⁰ As a preface to this conclusion, Orgel remarked that he “hoped no creationists [were] in the audience.” Laughter erupted throughout the room. Orgel did not advocate a supernatural explanation for life’s origin. Rather, he acknowledged the intractable problem of accounting for its emergence through natural processes. [Leslie Orgel, “The RNA World and the Origin of Life,” lecture, ISSOL 2002.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1908-1913). RTB Press. Kindle Edition.]
- Though at first glance seemingly plausible, metabolism-first models have only superficial merit because they appeal to unrealistic chemistry. Orgel has specifically identified a number of problems.²² He points out that cycles and networks operating on early Earth would have been highly susceptible to disruption by chemical interferences and competing side reactions. Without enzymes, protometabolic reactions cannot proceed rapidly enough to sustain a protocell unless aided by some sort of chemical accelerant.²³ [Leslie E. Orgel, “Self-Organizing Biochemical Cycles,” *Proceedings of the National Academy of Sciences, USA* 97 (2000): 12503–7. 23. Richard Wolfenden and Mark J. Snider, “The Depth of Chemical Time and the Power of Enzymes as

Catalysts,” *Accounts of Chemical Research* 34 (2001): 938–45.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1925-1930). RTB Press. Kindle Edition.]

- In Orgel’s words, metabolism-first scenarios require an “appeal to magic,” a “series of remarkable coincidences,” or a “near miracle.” [Orgel, “Self-Organizing Biochemical Cycles,” 12503–7.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 1934-1935). RTB Press. Kindle Edition.]

Chapter 9: Look! Only One Hand

- Nonbiological processes (labwork or nature) produce chiral molecules in equal proportion. These random mixtures, known as racemic, are 50 percent left-handed and 50 percent right-handed. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2053-2054). RTB Press. Kindle Edition.]
- These requirements dictate that the origin of homochirality must precede the origin of proteins, DNA, and RNA. In other words, without preexisting reservoirs of exclusively left-handed amino acids and exclusively right-handed sugars, the naturalistic assembly of proteins, DNA, and RNA is prohibited. (The exact reverse—reservoirs of exclusively right-handed amino acids and exclusively left-handed sugars—could also provide the building blocks for proteins, DNA, and RNA.) [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2060-2064). RTB Press. Kindle Edition.]
- Does any physical or chemical process in the context of early Earth drive a racemic mixture of amino acids or sugars into one handedness or the other? Chemically, the answer is no—unless the starting materials are enriched with one chiral form. All attempts to synthesize amino acids and sugars in laboratory simulation experiments produce racemic end products only.³ Prebiotic synthesis of amino acids and sugars, whether on Earth or anywhere else in the universe, would be expected to produce only racemic mixtures. Therefore, hope for a natural path toward homochirality must lie in a physical mechanism. [Jeffrey L. Bada, “Origins of Homochirality,” *Nature* 374 (1995): 594; Jeffrey L. Bada, “Extraterrestrial Handedness?” *Science* 275 (1997): 942.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models*

Face Off (Kindle Locations 2064-2068). RTB Press. Kindle Edition.]

- Other possible Earth-based mechanisms as the source of homochirality yield even more dismal prospects. Organic chemist William Bonner offered this summation: “I spent 25 years looking for terrestrial mechanisms for homochirality and trying to investigate them and didn’t find any supporting evidence. Terrestrial explanations are impotent or nonviable.”⁶ In a detailed review of homochirality’s origin, Bonner concluded that the source must be extraterrestrial.⁷ [Quoted in Cohen, 1265. Bonner made this comment at “Physical Origin of Homochirality in Life,” a conference held in Santa Monica, California, February 1995. 7. William A. Bonner, “The Origin and Amplification of Biomolecular Chirality,” *Origin of Life and Evolution of the Biosphere* 21 (1991): 59–111.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2080-2084). RTB Press. Kindle Edition.]
- Amino acids in space. So far, astronomers have failed to detect with certainty a single amino acid, nucleobase, or five- or six-carbon sugar in outer space. Searches of comets, interplanetary dust, and interstellar gas and dust clouds have all come up empty. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2163-2165). RTB Press. Kindle Edition.]
- Amino acids in meteorites. On September 28, 1969, a fireball exploded with loud bangs, hissing sounds, and smoke rings over the town of Murchison, Australia.²³ Over the next several weeks and months, more than 1,500 pounds (700 kilograms) of a carbonaceous chondrite were recovered from people’s yards and city streets. The largest piece of this meteorite weighed only 15 pounds (7 kilograms). Within a few months, organic chemist Keith Kvenvolden made the first identification ever of nonterrestrial amino acids.²⁴ A whole suite of 74 different amino acids was found in the meteorite, several of which had never been seen before on Earth.²⁵ The most amino-acid-laden meteorite in existence, the Murchison meteorite contained 60 parts per million of amino acids. Of these, nearly 15 parts per million were amino acids typically found in proteins.²⁶ [Mike D. Reynolds, *Falling Stars: A Guide to Meteors and Meteorites* (Mechanicsburg, PA: Stackpole, 2001), 141. 24. Keith A. Kvenvolden, James G. Lawless, and Cyril Ponomperuma,

“Nonprotein Amino Acids in the Murchison Meteorite,” Proceedings of the National Academy of Sciences, USA 68 (1971): 486–90. 25. J. R. Cronin, S. Pizzarello, and D. P. Cruikshank, “Organic Matter in Carbonaceous Chondrites, Planetary Satellites, Asteroids, and Comets,” in *Meteorites and the Early Solar System*, ed. J. F. Kerridge and M. S. Matthews (Tucson: University of Arizona Press, 1988), 819–57. 26. Cronin, Pizzarello, and Cruikshank, “Organic Matter,” 819–57.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2179-2187). RTB Press. Kindle Edition.]

- The homochirality problem was a major theme at ISSOL 1999. It dominated discussion in several question-and-answer sessions. At the end of one such session, a researcher expressed the collective frustration of the nearly 300 assembled scientists. Recognizing that no naturalistic explanation for the homochirality that life’s origin demands seems possible, he came to the microphone and asked, “Why do we need homochirality for life? Could not life originate without homochirality?”⁴¹ No one answered. No one doubts that homochirality is a precondition for life’s origin. Nevertheless, the intractable nature of this problem has moved a few to consider the unthinkable alternatives. [These questions were asked after the presentation of paper c2.6 on July 13 by Gyula Palyi et al., “Enantioselection through Chiral Conformations,” ISSOL 1999, 42.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2233-2238). RTB Press. Kindle Edition.]
- Putting the RTB Model to the Test The requirement of homochirality places no limitation on the RTB origin-of-life model. The naturalistic barriers to homochirality can be overcome by the direct supernatural intervention of the Creator. Evaluating the Evidence Homochirality places a demand on naturalistic origin-of-life explanations—a demand that goes beyond the production of life’s building blocks and their assembly into complex molecules. And this demand goes unmet. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2259-2263). RTB Press. Kindle Edition.]

Chapter 10: The Codes of Life

- In effect, there is no chance that even a relatively small protein made up of a

specified sequence could ever form by undirected processes. In the words of Bradley and Thaxton, If we assume that all carbon on earth exists in the form of amino acids and that the amino acids are allowed to chemically react at the maximum possible rate of $10^{12}/s$ for one billion years (the greatest possible time between the cooling of the earth and the appearance of life), we must still conclude that it is incredibly improbable ($\sim 10^{-65}$) that even one functional protein would be made. [Walter L. Bradley and Charles B. Thaxton, "Information and the Origin of Life," in *The Creation Hypothesis: Scientific Evidence for an Intelligent Designer*, ed. J. P. Moreland (Downers Grove, IL: InterVarsity, 1994), 190.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2315-2321). RTB Press. Kindle Edition.]

Chapter 11: Beneficial Boundaries

- Origin-of-life investigator Arthur Weber proposed a synthetic cycle to account for prebiotic fatty acid production.¹² This complex cycle starts with glycolaldehyde (a compound thought to have existed on early Earth) and proceeds through six steps that involve either loss of water or the addition of hydrogen. While each reaction of the cycle is feasible, the complexity of the cycle, the catalytic requirements for each step, and the need for the cycle to "turn" at least seven times to produce a fatty acid capable of forming membrane lipids call into question the relevance of the glycolaldehyde pathway as a meaningful source of prebiotic fatty acids.¹³ Once formed, fatty acids must react with glycerin and phosphate to form phospholipids. Origin-of-life researchers suggest that this reaction could have occurred on early Earth if these three compounds experienced moderate heating ($150\text{ }^{\circ}\text{F}$ or $65\text{ }^{\circ}\text{C}$) to dryness.¹⁴ The relevance of this reaction is somewhat questionable because it requires complete dehydration; it does not occur in the presence of any water. In fact, water's presence breaks down phospholipids by reversing the proposed reaction. These phospholipid-forming reactions also require reactant concentrations not likely to have occurred on early Earth. [Zubay, *Origins of Life on Earth*, 348–50; Arthur L. Weber, "Origin of Fatty Acid Synthesis: Thermodynamics and Kinetics of Reaction Pathways," *Journal of Molecular Evolution* 32 (1991): 93–100. 13. Leslie E. Orgel, "Self-Organizing Biochemical Cycles," *Proceedings of the*

National Academy of Sciences, USA 97 (2000): 12503–7. 14. Zubay, Origins of Life on Earth, 350; W. R. Hargreaves, S. Mulvihill, and D. W. Deamer, “Synthesis of Phospholipids and Membranes in Prebiotic Conditions,” Nature 266 (1977): 78–80; J. Eichberg et al., “Cyanamide Mediated Syntheses under Plausible Primitive Earth Conditions. IV. The Synthesis of Acylglycerols,” Journal of Molecular Evolution 10 (1977): 221–30; D. E. Epps et al., “Cyanamide Mediated Syntheses under Plausible Primitive Earth Conditions. V. The Synthesis of Phosphatidic Acid,” Journal of Molecular Evolution 11 (1978): 279–92; D. E. Epps et al., “Cyanamide Mediated Syntheses under Plausible Primitive Earth Conditions. VI. The Synthesis of Glycerol and Glycerolphosphates,” Journal of Molecular Evolution 14 (1979): 235–41; M. Rao et al., “Synthesis of Phosphatidylcholine under Possible Primitive Earth Conditions,” Journal of Molecular Evolution 18 (1982): 196–202; M. Rao et al., “Synthesis of Phosphatidylethanolamine under Possible Primitive Earth Conditions,” Journal of Molecular Evolution 25 (1987): 1–6.] [Hugh Ross. Origins of Life: Biblical and Evolutionary Models Face Off (Kindle Locations 2458-2468). RTB Press. Kindle Edition.]

- Chemists Thaxton, Bradley, and Olsen identified an additional problem that confounds natural-process phospholipid production.¹⁵ Two key ingredients (needed for phospholipid formation, fatty acids and phosphates) form water-insoluble complexes with calcium and magnesium ions. The tendency of these two compounds to physically associate with calcium and magnesium is so great that, once formed, fatty acids and phosphates would have precipitated out of any possible early Earth environment. The precipitation of the fatty acid and phosphate complexes, in effect, would have made these compounds unavailable for prebiotic formation of the phospholipids that are so vital to cell membranes. [Charles B. Thaxton, Walter L. Bradley, and Roger L. Olsen, The Mystery of Life’s Origin: Reassessing Current Theories (Dallas: Lewis and Stanley, 1984), 56, 177–78.] [Hugh Ross. Origins of Life: Biblical and Evolutionary Models Face Off (Kindle Locations 2468-2474). RTB Press. Kindle Edition.]

Chapter 12: Life’s Minimum Complexity

- “Today, we are learning the language in which God created life.”¹ President

Clinton spoke these dramatic words on June 26, 2000, in honor of the two men who stood beside him: Craig Venter of Celera Genomics and Francis Collins, chief of the Human Genome Project (HGP). He was lauding their completion of the human genome sequence. [Kevin Davies, *Cracking the Genome: Inside the Race to Unlock Human DNA* (New York: Simon & Schuster, 2001), 6.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2635-2638). RTB Press. Kindle Edition.]

- **Genome Size** One way to explore the minimum complexity of independent life is to survey the microbial database for the smallest genome. Table 12.1 lists the results of this survey. The data indicate that the microbes possessing the smallest known genomes and capable of living in the environment are extremophilic archaea and eubacteria. (For more details on extremophiles, see chapter 13.) These organisms also happen to represent what many scientists consider to be the oldest life on Earth.⁵ This crude estimate seems to suggest that, to exist independently, life requires a minimum genome size of about 1,500 to 1,900 gene products. (A gene product refers to proteins and functional RNAs, such as ribosomal and transfer RNA.) The late evolutionary biologist Colin Patterson acknowledges the 1,700 genes of *Methanococcus* are “perhaps close to the minimum necessary for independent life.” [Don Cowan, “Use Your Neighbor’s Genes,” *Nature* 407 (2000): 466–67; Andreas Ruepp et al., “The Genome Sequence of the Thermoacidophilic Scavenger *Thermoplasma acidophilum*,” *Nature* 407 (2000): 508–13; Gerard Deckert et al., “The Complete Genome of the Hyperthermophilic Bacterium *Aquifex aeolicus*,” *Nature* 392 (1998): 353–58; Alexei I. Slesarev et al., “The Complete Genome of Hyperthermophile *Methanopyrus kandleri* AV19 and Monophyly of Archaeal Methanogens,” *Proceedings of the National Academy of Sciences, USA* 99 (2002): 4644–49; Virginia Morell, “Life’s Last Domain,” *Science* 273 (1996): 1043–45; Carol J. Bult et al., “Complete Genome Sequence of the Methanogenic Archaeon, *Methanococcus jannaschii*,” *Science* 273 (1996): 1058–73; Elizabeth Pennisi, “Microbial Genomes Come Tumbling In,” *Science* 277 (1997): 1433; Karen E. Nelson et al., “Evidence for Lateral Gene Transfer between Archaea and Bacteria from Genome Sequence of *Thermotoga maritima*,” *Nature* 399 (1999): 323–29. 6. Colin Patterson, *Evolution*, 2nd ed. (Ithaca: Comstock, 1999), 23.] [Hugh Ross. *Origins of Life: Biblical and*

Evolutionary Models Face Off (Kindle Locations 2672-2679). RTB Press. Kindle Edition.]

- Microbiologists now recognize, however, that bacteria also display a remarkable degree of internal organization. Though this arrangement does not involve subcellular structures, it occurs at the molecular level, both spatially and temporally.²⁰ Microbiologists Lucy Shapiro (Stanford) and Richard Losick (Harvard) state their observation: “The use of immunogold electron microscopy and fluorescence microscopy to study the subcellular organization of bacterial cells has revealed a surprising extent of protein compartmentalization and localization.” [Lucy Shapiro and Richard Losick, “Protein Localization and Cell Fate in Bacteria,” *Science* 276 (1997): 712–18; Richard Losick and Lucy Shapiro, “Changing Views on the Nature of the Bacterial Cell: From Biochemistry to Cytology,” *Journal of Bacteriology* 181 (1999): 4143–45; Lucy Shapiro and Richard Losick, “Dynamic Spatial Regulation in the Bacterial Cell,” *Cell* 100 (2000): 89–98. 21. Shapiro and Losick, “Protein Localization,” 712–18.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2764-2769). RTB Press. Kindle Edition.]
- **The Synergy Problem** The problem for the origin of life extends beyond trying to account for the simultaneous occurrence of over 250 different proteins. It also demands the appearance of DNA, RNA, and complex carbohydrates to form the cell wall, plus the lipids to form the cell’s membrane. All these molecules must come together at once and operate in an orchestrated fashion for life to be possible. Herein lies the dilemma: The cell wall and membrane cannot be constructed without proteins, RNA, and DNA, and these molecules cannot achieve stability without the cell wall and membrane. There can be no proteins without DNA and RNA, and there can be no DNA and RNA without proteins. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2806-2811). RTB Press. Kindle Edition.]

Part IV: Looking for Loopholes

Chapter 13: Extreme Life

- To review briefly, advances in research during the past decade challenge the notion that life emerged from nonliving systems through strictly physical and

chemical means. Life appeared early in Earth's history. Geochemical evidence indicates life's presence at or slightly before 3.8 billion years ago. The oldest rocks date 3.9 billion years ago. Prior to this time Earth existed (with a few intermittent exceptions) in a molten state unsuitable for living organisms. Life also appeared suddenly. Between 4.5 and 3.9 billion years ago, Earth experienced numerous impact events that sterilized its surface and subsurface. These impacts—frustration events to life's origin—melted rock and volatilized oceans. Then, as soon as Earth's conditions were remotely able to support life, life appeared. The discovery of archaea (and a few eubacteria) in hostile environments suggests to some researchers that life could have arisen under the extreme conditions of early Earth prior to 3.9 billion years ago. This loophole could keep a naturalistic explanation viable.⁴ According to this view, extremophiles emerged first and paved the way for mesophiles. [Peter Gwynne, "Extremozymes: Proteins at Life's Extremes," *Chemistry* (October, 1998): 15–19; See Howland, *The Surprising Archaea*; See Gross, *Life on the Edge*.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2850-2859). RTB Press. Kindle Edition.]

- Meet the Squad—Introducing Extremophiles Extremophiles are a diverse bunch, inhabiting extreme environments for a variety of reasons.⁵ Researchers have identified the following classes of these organisms: Thermophiles love high temperatures, typically growing at temperatures between 120 and 160 °F (50 and 70 °C). These microbes thrive in hot springs and undersea vents. Hyperthermophiles are extreme heat lovers. They grow at temperatures between 176 and 235 °F (80 and 113 °C) and cannot be cultivated at temperatures below 176 °F (80 °C). *Pyrolobus fumaris* holds the thermophilic record, growing at hot locations between 194 and 235 °F (90 and 113 °C). Psychrophiles live at cold temperatures. *Polaromonas vacuolata*, recovered from the Antarctic Ocean, grows best at 39 °F (4 °C) and cannot survive at temperatures above 54 °F (12 °C). Acidophiles are acid lovers. Found in volcanic pools and hot sea vents, these organisms thrive at pHs of less than 2. (A neutral pH is 7.) Amazingly, *Picrophilus oshimae* and *Picrophilus torridus* can survive at a pH of 0—an extreme acidity. Alkalophiles require extreme alkaline conditions. Recovered in alkaline lakes and deserts, these bacteria grow at a pH greater than 10. Halophiles

make their home in salt mines and lakes. These environments contain from 20 to 30 percent salt. Barophiles need high pressures to grow. Some of these microorganisms require pressures hundreds of times greater than those found on Earth's surface. The first barophile (MT41) discovered in the Pacific Ocean's Mariana Trench (the deepest sea-floor depression in the world) grows best at 300 to 700 times sea-level air pressure. [Karl O. Stetter, "The Lesson of Archaeobacteria," in *Early Life on Earth: Nobel Symposium No. 84*, ed. Stefan Bengtson (New York: Columbia University Press, 1994), 143–51.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 2860-2874). RTB Press. Kindle Edition.]

Chapter 14: Life On Mars?

- More than thirty years ago, Carl Sagan declared that the discovery of life on Mars would prove life originated naturally and with relative ease.¹ Such a find would transform the statistics dramatically. No longer the unique treasure of one planet in a billion trillion, life would be the offspring of two planets out of nine in a single planetary system. Such a revelation would magnify the idea that life is abundant throughout the universe. [Carl Sagan developed this deduction during a lecture he gave as part of his June Institute course taught in 1969 to the faculty and graduate students of the department of astronomy at the University of Toronto.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 3042-3045). RTB Press. Kindle Edition.]
- The RTB model foresees that the search for life (or life's remains) on Mars will inevitably prove successful. It must, given the proximity of Mars to Earth. In the same manner as nearly twenty Martian rocks traveled to this planet, numerous Earth rocks have landed on Mars. This exchange of rocks resulting from impact events proceeded throughout the two planets' history. Given the abundance of life on (and in) Earth throughout the past 3.8 billion years, several million pounds, perhaps even tons, of Earth's organic material have been deposited on Mars' surface by now. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 3280-3284). RTB Press. Kindle Edition.]

Chapter 15: Europa and Beyond

- **Oxidants Paradox** Indeed, the issue of oxidants frames another origin-of-life paradox. Even more surely than the oxygen-ultraviolet paradox interferes with life's origin (see chapter 7), the presence of oxidants such as hydrogen peroxide and sulfuric acid guarantees its shutdown. These oxidants prevent the prebiotic chemical reactions that could produce life-essential molecules. Therefore, the presence of oxidants renders origin-of-life chemistry impossible. But without oxidants, no organism isolated from the surface environment could function. When taken together, the two paradoxes—the oxygen-ultraviolet paradox and the no-oxidants-versus-oxidants paradox—leave materialists from the origin-of-life research camp without a viable European model. The first paradox argues against a naturalistic explanation for the origin of surface life, while the second argues against a naturalistic explanation for even the existence of, much less the origin of, deep interior life. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 3378-3385). RTB Press. Kindle Edition.]
- **Panspermia** thus represents the end of the line for naturalists within the origin-of-life research camp. Recognizing the intractable problems for a naturalistic explanation for life's origin on Earth, many researchers turned their attention to Mars, Europa, Titan, and other possible solar system sites. Disappointed by discoveries at those sites, some have looked to the stars, specifically to interstellar grains, dust, dirt, and rocks. The determination that interstellar material cannot transport life, or even life molecules, to Earth has led to sheer frustration. At least a few scientists are beginning to consider a nonnatural explanation for life's origins on Earth. This option raises intriguing possibilities as the investigation continues. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 3456-3461). RTB Press. Kindle Edition.]

Chapter 16: Life, Seeded on Purpose

- **Directed panspermia** also ignores such practical problems as transportation. No species subject to the laws of physics and the dimensions of the universe—however intelligent, technologically advanced, and well-funded—can traverse significant interstellar distances and deposit working

sets of complex life molecules or viable life-forms on Earth. Two lines of research show that the travel problems are far beyond trivial. [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 3496-3499). RTB Press. Kindle Edition.]

- Two Kinds of Miracles Supernatural interventions, according to the Bible, are not always transcendent miracles (those explained only by a God acting independent or outside of matter, energy, space, and time). Examples of transcendent miracles are Jesus of Nazareth walking on water¹² and the creation of the universe. Far more frequent are the miracles God performs within His chosen physical laws. One example would be the perfectly fine-tuned collision Earth received from a Mars-sized planet that enabled Earth to support both primitive and advanced life. The story of Sennacherib is another. The night after he boasted that his military would destroy Jerusalem and that Jerusalem's God would be powerless to stop them, a mysterious illness killed 185,000 of Sennacherib's fighting men, thwarting his battle plans. [See Matthew 14:25–27. 13. See 2 Kings 19:9–36; 2 Chronicles 32:1–23; Isaiah 36:1–37:38.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 3521-3528). RTB Press. Kindle Edition.]

Part V: A Model for Life

Chapter 17: Solving The Mystery

- Answers to the Questions The RTB biblical creation model continues to accurately predict future scientific discoveries. It also offers answers to questions that the naturalistic models do not. For example: How life appeared early and rapidly How life originated even without a prebiotic soup How life found apparently nonexistent chemical pathways How the homochirality problem was overcome How the information problem was solved How life's essential boundaries formed How life achieved minimum complexity How life filled even the harshest niches of Earth's ecosystem Why life was so abundant and diverse for the past 3.8 billion years Why life from elsewhere within the cosmos makes no sense Why directed panspermia—supernaturally directed panspermia—does make sense [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 3759-

3769). RTB Press. Kindle Edition.]

- The faint Sun paradox by itself offers overwhelming evidence for the divine design of Earth and a solar system deliberately prepared for human life. But it is not alone. A total of more than two hundred known characteristics of the Milky Way Galaxy, the solar system, and Earth required fine-tuning to prepare the planet for the arrival and survival of life—and ultimately human life.²⁶ The infinitesimal probability of all these factors coming together goes beyond coincidence. Add the odds against their occurrence to the indicators for care involved in an origin-of-life process that protects and provides for humanity, and the answers to the origins questions become evident. [Hugh Ross, “Probability for a Life Support Body” (Covina, CA: Reasons to Believe, 2002), available from Internet, www.reasons.org, accessed March 31, 2003.] [Hugh Ross. *Origins of Life: Biblical and Evolutionary Models Face Off* (Kindle Locations 3770-3775). RTB Press. Kindle Edition.]

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