PERSPECTIVES on Science and Christian Faith

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"The fear of the Lord
is the beginning of Wisdom."
Psalm 111:10

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Stephen Contakes

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Advancing *PSCF*'s Mission by Meeting the Challenges of Interdisciplinary Scholarship

With this issue, *PSCF* returns to its prepandemic practice of publishing four issues per year. As is the case for every nonthemed issue of *PSCF*, the papers herein represent a sample of the rich conversations surrounding science and faith currently taking place both within the American Scientific Affiliation and elsewhere. Each in its own way advances *PSCF*'s mission to offer "original contributions that advance human understanding of science and Christian faith." That is to say that each article brings out something new about the relationship between Christianity and various aspects of science and technology, how they are practiced, and their effects on the world. Each also does so at a level appropriate for an academic journal, by applying the expertise of one or more recognized disciplines to clearly articulated problems in ways that other practitioners of those disciplines recognize as credible and valuable. They also engage the most-relevant scholarly voices at their most rigorous, that is to say, as far as possible, in the form of journal articles and academic books.

Among the four articles in this issue, W. Robert Wood examines physicists' longstanding efforts to explain the physical cosmos in ways that "see things whole" by thinking in terms of beautiful symmetrical states and "unreasonably effective" mathematical descriptions, an approach he calls the "unification paradigm." In particular, he argues that the success of the unification paradigm in describing nature and provoking awe and wonder points to a correspondence between the theological beauty of God, its outworking in creation and redemption, and the human search for beauty in nature as a manifestation of the true.

In the second article, two leaders within both the American Scientific Affiliation and the world of Christian higher education, Janel Curry and Dorothy Chappell, examine the spiritual and professional formation that takes place in programs for training undergraduate scientific research students at Christian institutions. As students in such programs perform research under the care of senior scientist mentors and in conversation with the wider scientific community, they are enculturated into the "traditions of science" and, distinctly, into ways for navigating their dual status as practitioners of both science and practitioners of "the Christian tradition." Drawing on the work of Étienne Wenger and Alasdair MacIntyre, Curry and Chappell note parallels between the scientific training within these programs, and the process of spiritual formation taking place in Christian communities.

William Horst's article addresses objections to "local" flood interpretations of the Genesis flood narrative, which since the nineteenth century have been proposed as ways to reconcile that narrative with the absence of geologic and archaeological evidence for a worldwide deluge. Horst argues that one common objection, that the New Testament and 2 Peter, in particular, appear to assume a worldwide flood, is not a theological defeater of local flood interpretations. While the author of 2 Peter shared the "universal" flood understanding common in second temple Judaism, Horst argues that a universal flood is not necessary to the theology, logic, and rhetorical force of the text.

Ebenezer Yaw Blasu of the Akrofi-Christaller Institute of Theology, Mission and Culture in Ghana addresses the local and cultural dimensions of human efforts to respond to global ecological problems. His article is unique for applying insights from missiology to the need for coordinated human responses to global-scale ecological crises. Blasu notes the need for the development of Christians and churches that possess a habitual and instinctive care for creation. Noting the limited ability of Western Christian ecotheologies to encourage such, particularly in global contexts where there is disjoint between those theologies and local cultures' religious conceptions, Blasu proposes that Christians in Africa Christianize existing African local cultural practices that have been traditionally used to instill ecological sensibility and regulate human engagement with nature.

May these articles inspire, encourage, and stimulate your thinking.

Stephen Contakes
Editor-in-Chief

W. Robert Wood

Article

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The Unification Paradigm in Theoretical Physics and the Beauty of God

W. Robert Wood

History provides numerous examples in which theoretical physicists have made progress in discovering new theories that provide more accurate descriptions of the physical world by intuitively relying on what is called here a unification paradigm. Some of the characteristics of this unification paradigm include an "unreasonable effectiveness" of the intimate linkage between advanced mathematics and the physical world, an ability to imagine a world of symmetrical states when the evidence at hand points to one of broken symmetries, a willingness to suspend our common sense and believe in phenomena that sit outside of normal experience, a deeply held sense of awe and wonder that comes from a focused study of the created world, and a profound sense that beauty reveals what is true. It is argued that the success of the unification paradigm is a manifestation of human efforts to grasp the beauty of God.

Keywords: theoretical physics, unification, mathematical beauty, God's beauty, faith integration

As far back as we can discern, humans have sought to understand the world. Explanations have generally involved some combination of natural and supernatural perspectives. For example, Feynman noted that at the time of Kepler, "one of the theories proposed was that the planets went around because behind them were invisible angels, beating their wings and driving the planets forward."[1] Feynman used this account to illustrate how planetary motion was understood at one time as the result of a mover (supernatural invisible angels) that was subsequently replaced by Newton's universal theory of gravitation in 1687 (which, as Feynman pointed out, is based on the concept of a gravitational force, the mediation of which is not fully explainable in physical terms).

It wasn't until Einstein's theory of general relativity in 1915 that the question of how gravitational fields influence the motion of objects in a local manner was provided. Through work undertaken in natural philosophy and then modern science, the remarkable success of our ability to describe natural phenomena in terms of physical theories has appeared to leave little room for a supernatural role in explaining the physical world around us.[2] Herein it is argued that an underlying principle that has contributed to the success of theoretical physics, what is called here the "unification paradigm,"[3] serves as a guidepost to the God of the Bible and thereby reinstates a supernatural underpinning for understanding the natural world.

The unification paradigm is rooted in a sense of awe and wonder that one can experience when considering the natural world, such as a feeling of perceiving God indirectly through a beautiful scene such as a magnificent sunset or the stunning display of the aurora borealis.[4] The beauty that is of interest in the current context is more subtle than these examples and is generally perceived only by those trained in advanced

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mathematics. In what follows, a selection of historical figures who made contributions to our understanding of the natural world by searching for theories that are mathematically "beautiful" is provided to make the case for the unification paradigm. That these historical figures span thousands of years puts the unification paradigm in a different category than typical Kuhnian scientific paradigms that are human constructs and that are prone to change from time-to-time. As such, it is argued that the underlying basis for the unification paradigm is God's eternal nature that is evident in creation.[5] This has implications for how to think about the relationship between the roles of faith and scientific reason in understanding the created world.

The Ancient World

Probably one of the earliest concepts that ultimately proved useful in providing a unifying framework was introduced in the 5th century BC when Greek philosophers proposed the concept of the "atom" as the smallest constituent of matter. Although it would take centuries before atomism's explanatory power would be realized,[6] it was a significant step that provided a means to understand a diverse array of physical phenomena in terms of the interactions of tiny indivisible particles. Also in the 5th century BC, the philosopher Empedocles advanced the idea that everything was made from at least one of the four elements: earth, water, air, and fire. Aristotle later added a fifth element, the aether (or ether), to explain the motion of the celestial bodies. In this manner, Aristotle promoted the view that all of nature could be described based on only five elements.[7]

These and many other contributions helped to lay a foundation for modern science as predicated on the view that disparate aspects of the physical world can be considered to be parts of a whole. Particularly noteworthy are the contributions of Archimedes (384–322 BC), who is generally remembered for discovering Archimedes' principle, that the buoyant force on an object in a fluid is equal to the weight of fluid displaced by the object.[8,9] Perhaps his most significant contribution was his recognition that mathematical models can be applied to the physical world.

One contribution from the Middle Ages that should be mentioned is William of Ockham's principle of parsimony, that the simplest explanations are most likely to be true. This principle, known as Ockham's razor, has provided valuable guidance in the unification paradigm. For example, parsimony provided a guiding heuristic in the principle of least action that played a foundational role in the Lagrangian and Hamiltonian formulations of modern theoretical physics. Albert Einstein's formulation of special relativity provides another example of the usage of Ockham's razor.

Scientific Revolution

During the Renaissance, much progress was made in the development of physical theories. Galileo Galilei rejected many of Aristotle's scientific explanations (e.g., that heavy objects fall faster than light objects) by conducting repeated experiments. He made significant contributions in mechanics, astronomy, engineering, and mathematics. In the words of Stephen Hawking, "Galileo, perhaps more than any other single person, was responsible for the birth of modern science."[10] Galileo put forward the invariance principle that the laws of motion are the same in all inertial frames of reference. This was an important precursor to Einstein's theory of relativity. The fact that Galileo preferred a simpler heliocentric model of the solar system, even though it didn't align well with the best empirical evidence at the time, is an early example of theoretical physicists who chose to promote a compelling theory due to its simplicity and beauty even though the theory disagreed with available experimental results.[11]

Classical Physics

In 1687, Isaac Newton published his landmark *Philosophiæ Naturalis Principia Mathematica (Principia)*, a three-volume work setting out his laws of motion and the law of universal gravitation.[12,13] The *Principia* provided the foundation for classical mechanics and was the first great step toward unification: it demonstrated that the motion of objects on Earth and the motion of celestial bodies in space can be described by the same theory. Indeed, the *Principia* provided a theoretical basis to derive the laws of planetary motion that Johannes Kepler had determined, based on the observations of Tycho Brahe. In this way, the moon's orbit around Earth is understood to be a result of the gravitational force of attraction.[14] Newton's work formed the dominant scientific viewpoint until the 20th century and played a significant role in the launch of the Enlightenment.[15] As F. J. Dyson states,

> … the very greatest scientists in each discipline are unifiers. This is especially true in Physics. Newton and Einstein were supreme unifiers. The great triumphs of Physics have been triumphs of unification.[16]

An additional contribution to classical mechanics that should be mentioned includes Joseph-Louis Lagrange's 1811 alternative formulation of mechanics, known today

as Lagrangian mechanics.[17] This formalism enables one to determine the equation of motion of a system using energies (potential and kinetic) rather than forces as in Newtonian mechanics. In some cases, this makes analysis simpler and lends itself quite naturally to analyzing symmetries associated with a system. A powerful example of this is Noether's theorem,[18] which, in simple terms, says that if a physical system has a continuous symmetry property (e.g., if the Lagrangian is symmetric under rotations), then there are corresponding quantities that are conserved in time (for the above example, the angular momentum of the system would remain constant). Sir William Rowan Hamilton provided a reformulation of Langrangian mechanics in 1833, known as Hamiltonian mechanics. This formulation, that is also based on energies, uses the Hamiltonian function that proved to be useful in the development of quantum mechanics.

The next chapter in unification involved electricity, magnetism, and light. Approximately a century after the publication of the *Principia*, Charles de Coulomb determined that the force between two charged particles is proportional to the product of their charges and inversely proportional to the square of the distance between them—the same form of equation as Newton's law of gravitation.

In 1820, Hans Christian Ørsted reported that an electric current flowing through a wire produces a circular magnetic field around the wire. This suggested a linkage between electricity and magnetism and influenced Michael Faraday, who, despite having little formal education, became one of the greatest experimental scientists of all time. Faraday's discovery that a changing magnetic field passing through a coil produces a current in the coil was an important step in the unification of electricity and magnetism, as was his iron filing experiments with magnets, which led to his proposal of lines of force. To explain how electric and magnetic forces affect objects at a distance, Faraday proposed, in 1852, that electric and magnetic forces extend into empty space (rather than through a space-filling ambient ether).[19] Unfortunately, his proposal was not accepted by the scientific community until after his death. Faraday also demonstrated that magnetic fields could affect the polarization of light; this discovery suggested an underlying relationship between light and magnetic fields. Finally, Faraday demonstrated remarkable prescience[20] in his 1851 paper, "On the Possible Relation of Gravity to Electricity":

> Under the full persuasion that all the forces of nature are mutually dependent, and often, if not always, convertible more or less into each other, the author endeavoured to connect gravity and magnetic or electric action together by experimental results, and though the conclusions were, when cleared from all error, of a negative nature, he still thinks that the principle followed and the experiments themselves deserve to be recorded.[21]

While Faraday's mathematical abilities went only as far as basic algebra, the Scottish mathematician James Clerk Maxwell was well suited for the challenge of developing a mathematical model describing the relationship between electricity and magnetism. His 1855 presentation "On Faraday's lines of force" captured the current knowledge of electricity and magnetism in a set of twenty differential equations.[22] When published in 1861, his equations included a displacement current[23] in addition to the current that results from the flow of charges in a wire (that Ampère had used). The displacement current allowed Maxwell to derive the electromagnetic wave equation directly from his differential equations, with the implication that oscillating electric and magnetic fields in vacuum can interact with one another in such a manner as to form an electromagnetic wave.[24] Maxwell calculated the speed of the wave and found that it was approximately that of the speed of light. On this basis, he proposed that light is nothing other than an electromagnetic wave. Of Maxwell's achievement in showing that light was an electromagnetic phenomenon, Einstein wrote,

> The precise formulation of the time-space laws was the work of Maxwell. Imagine his feelings when the differential equations he had formulated proved to him that electromagnetic fields spread in the form of polarized waves, and at the speed of light! To few men in the world has such an experience been vouchsafed ... it took physicists some decades to grasp the full significance of Maxwell's discovery, so bold was the leap that his genius forced upon the conceptions of his fellow workers.[25]

Modern Physics

The advances in physics that were achieved by the end of the 19th century[26] laid the foundation for unification to drive theoretical physics in the 20th century. During the early 20th century, Albert Einstein united space, time, mass, and energy in his theory of special relativity (1905), and then spacetime with gravitation in his general theory of relativity (1915). It took the genius of Einstein to imagine a world outside of everyday experience, and by using thought experiments,[27] to determine equations that would apply at speeds close to the speed of light ($c \approx 300{,}000$ km/s) and in the presence of very strong gravitational fields. Einstein's work in relativity is the next step in the unification of the forces of nature.

An interesting dilemma existed between Newton's and Maxwell's great unifications: Newtonian mechanics requires the speed of light to depend on the reference frame of the observer[28] with respect to the light's source, whereas Maxwell's equations require the speed of light to be a constant (in technical terms, Maxwell's equations are not invariant under Galilean transformations).[29] Recognizing these challenges, Einstein postulated that light moves at a constant speed in a vacuum:

> Examples of this sort, together with the unsuccessful attempts to discover any motion of the earth relatively to the "light medium," suggests that the phenomena of electrodynamics as well as of mechanics possess no properties corresponding to the idea of absolute rest … We will raise this conjecture (the purport of which will hereafter be called the "Principle of Relativity") to the status of a postulate, and also introduce another postulate, which is only apparently irreconcilable with the former, namely, that light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body.[30]

The consequences of these postulates are far reaching and include (amongst others[31]) the following.

- The Newtonian assumption that space and time are absolute no longer holds.[32]
- Space and time are interwoven in an inseparable four-dimensional continuum known as spacetime.
- No material object or information signal can travel faster than the speed of light in vacuum, ensuring that an effect cannot occur before its cause.

With a resolution to the electromagnetic wave/ether problem, Einstein generalized his special theory of relativity, with its preference of inertial motion (i.e., non-accelerating bodies) to incorporate more general motion (e.g., such as that associated with gravitational attraction). Special relativity requires that no information can travel faster than the speed of light, whereas Newton's theory of gravity depends only on the instantaneous spatial separation of two massive objects with no time-dependence in the equation or mechanism for mediating the gravitational attraction, a phenomenon referred to as "action at a distance."[33] A mechanism to mediate gravitational effects without exceeding the speed of light was needed. Einstein's theory of general relativity[34] used the fabric of spacetime as the mediator.[35] Just as Maxwell's equations give the electric and magnetic fields resulting from specified charges or currents, Einstein's field equations[36] describe the properties of the local spacetime manifold from energy and momentum specified in the form of what is called the energy momentum tensor.[37] Thus, general relativity tells us how matter causes the spacetime to curve, which, in turn, tells us how the motion of objects will follow the curvature of spacetime.[38]

Of Einstein's theory of general relativity, Paul Dirac said that it "was probably the greatest scientific discovery that was ever made."[39] Theoretical physicists speak of the "mathematical beauty" of Einstein's field equations. Dirac himself expressed the view:

> [Mathematical beauty] cannot be defined any more than beauty in art can be defined, but which people who study mathematics usually have no difficulty in appreciating.[40]

Notwithstanding Dirac's view, Subrahmanyan Chandrasekhar felt that it was possible to convey a sense of appreciation for the aesthetic appeal of general relativity:

> I shall … consider why a study of the general theory of relativity conduces in one a feeling not dissimilar to one's feelings after seeing a play of Shakespeare or hearing a symphony of Beethoven.[41]

A 2014 study[42] investigated the phenomenon described by Chandrasekhar. When fifteen mathematicians were asked to rate equations as either beautiful, neutral, or ugly, a brain scan showed that the same part of their brains activated (field A1 of the medial orbito-frontal cortex) as when people encounter visual or musical beauty. This suggests that there really is mathematical beauty akin to that of great art, or magnificent scenes in nature, or musical masterpieces.

Einstein's theory of general relativity has also played a significant role in the subsequent development of unification models in particle physics. The motion of planets, galaxies, clusters of galaxies, and the dynamics of the universe as a whole is primarily driven by gravitation. As such, general relativity provides a foundation for cosmology (the study of the universe on a large scale), as Einstein noted in his 1917 paper "Cosmological Considerations in the General Theory of Relativity."[43,44] In 1922, Alexander Friedmann calculated a solution[45] to Einstein's equations that corresponds to an expanding universe. Within five years, Georges Lemaître proposed that the observed recession of nearby galaxies would result if the universe were expanding, and in 1929, Edwin Hubble provided the first observational evidence that the universe is expanding uniformly in all directions. This led to the development of theories describing how the universe could have expanded from an initial state of extremely high density and temperature (what Fred Hoyle labelled the "big bang" in a BBC Radio broadcast in 1949). While there remains uncertainty about the details of this process, particularly in the first fraction of a second when the conditions lie outside our

experimental capacity, big bang models have provided an explanation for phenomena such as the observed expansion of the universe, the abundance of light elements, the cosmic microwave background radiation, and the age of the oldest known stars. The physics of the early universe's rapid expansion shares a remarkable consonance with high energy particle physics. For example, the conditions during this phase are precisely those required for the electroweak symmetric state, where the fundamental forces of electromagnetism and the weak nuclear force unify. However, unresolved problems in the big bang model include the fine-tuning problem,[46] and the need to propose dark energy[47] and dark matter.[48]

Particle physics is based on the theory of quantum mechanics (QM) that was developed in the 20th century and that describes the properties of nature at the atomic and subatomic level. Characteristics of QM include quantities such as energy, momentum, and angular momentum (amongst others) that can take on only discrete values (hence the use of the term "quantum"); there is a limit to the precision to which certain pairs of particle properties (e.g., position and momentum) can be determined (this is known as Heisenberg's uncertainty principle); and quantum objects (e.g., electrons) sometimes display particle properties and sometimes wave properties (wave-particle duality). See Box 1 for a brief summary of key elements of QM.

Among the equations developed to account for the wave-like properties of matter, the Dirac equation combined classical electromagnetic theory, special relativity, and quantum mechanics, and was a significant step forward in the unification of particles and fields. At the time, particles (such as electrons) were viewed as permanent entities whereas quantum fields (such as photons) were considered to be excited states of the underlying quantized electromagnetic field. In the following few years, it was realized that even particles such as electrons could be viewed as excited states of quantum fields. This paved the way for quantum field theory (QFT), in which quantum electrodynamics (QED) is a particular example of QFT.

Efforts to unify the forces of nature in grand unified theories[49] (GUTs) involve particle physics, the study of fundamental particles, and their interactions. An important aspect of the unification model in particle physics was the recognition that there are specific symmetries associated with each of the electromagnetic, weak, and strong nuclear forces, and when the transformations that reflect those symmetries are required to be local (i.e., change from point to point in keeping with the principles of relativity), a unifying approach called "gauge theory"[56] results. For electromagnetism (the simplest gauge theory), the electric and magnetic fields can be represented by a 4-dimensional potential field. In this model, the quanta of the gauge field are bosonic exchange particles. Specifically, in QED the quanta of the gauge (electromagnetic) field are photons (i.e., they "mediate" the electromagnetic force between charged particles). Thus, recasting QED as a gauge

BOX 1: A Brief Primer on QM

1900: To explain the observed spectrum of radiation that disagreed with existing theories under certain conditions, Max Planck proposed that the energy, E, of a source of electromagnetic radiation can be emitted only in quanta (E = h, where h is Planck's constant—a fundamental constant in quantum mechanics—and is the frequency of the emitted electromagnetic radiation).

1905: Einstein explained the photoelectric effect, whereby shining light on certain materials resulted in emitted electrons only if the frequency of the light exceeded a certain threshold. Einstein[50] proposed that light consists of individual quantum particles (later called "photons"), which have energies given by Planck's quantum hypothesis.

1913: To explain the atomic spectrum of hydrogen, Niels Bohr published a model of the atom in which electrons orbit the nucleus in discrete fixed orbits (similar to the planets orbiting the sun), and so can change their orbital level only by absorbing or emitting discrete amounts of electromagnetic energy (in units of h).

1924: In his PhD dissertation, Louis de Broglie explained the discrete orbits of the Bohr model by hypothesizing that particles (e.g., electrons) can display wave properties. His prediction that the wavelength of a particle is inversely proportional to its momentum (with the constant of proportionality being Planck's constant) was experimentally verified[51] in 1927.

1925–1927: Mathematical formulations of "modern" quantum mechanics quantitatively account for the wave-like behavior of matter but represent phenomena that we cannot understand based on our everyday experience. Consequently, a number of "interpretations" of quantum mechanics have been proposed.[52]

1927: Paul Dirac[53] laid the foundations for quantum electrodynamics (QED) when he established a theory that successfully explained the emission and absorption of radiation by atoms by using first-order perturbation theory.[54] His theory partially unified quantum mechanics and special relativity but higher-order corrections were plagued with problematic infinities that weren't resolved until the mid-20th century.

1928: Paul Dirac developed the Dirac equation, a relativistic quantum wave equation for the electron.[55]

theory successfully predicted the quantum mechanical properties of the photon; however, it didn't, in and of itself, further the unification of forces. Nonetheless, it served as a prototype to consider the weak and strong nuclear forces.[57] In 1954, Chen-Ning Yang and Robert L. Mills[58] proposed a gauge theory of the strong nuclear force that predicted undiscovered massless charged mediating particles. Robert Crease and Charles Mann note,

> Yang and Mills could not understand why massless charged particles, if they existed, had not already been discovered. ("That was the embarrassment of it," Glashow says. "This lovely theoretical idea ended up predicting these massless charged particles that could not possibly exist!") Even though nature didn't seem to be cooperating, Yang and Mills thought that their idea was so beautiful that they went ahead and published it.[59]

As it turned out, their "beautiful" idea ultimately proved to be successful in describing the physical world, although it took the better part of two decades' work by multiple contributors, in the face of many naysayers, before a satisfactory theory of the unification of the electromagnetic and weak nuclear (electroweak) interactions was achieved.[60] Significant milestones in the development of gauge theory[61] are provided in Box 2.

Murray Gell-Mann and George Zweig's proposal of quarks as constituent particles formed the basis of quantum chromodynamics (QCD), the QFT of the strong nuclear force. Unlike QED where the mediating photons don't carry electric charge, the mediating particles in QCD, called "gluons," do carry the "color" charge of QCD of which there are three types. Subsequently, the theory of "asymptotic freedom" was proposed, that describes how the strong force does not get weaker with increasing distance beyond a limiting distance about the size of a baryon which enabled the formal development of QCD.

By the mid-1970s, this Standard Model of particle physics had become the dominant paradigm of the electromagnetic, weak, and strong nuclear forces. It accounted for known particles and their interactions (excluding gravitation) and predicted the properties of some new particles that were subsequently discovered, including the W and Z bosons (1983), the top quark (1995), the tau neutrino (2000), and the Higgs boson (2012). It has been shown experimentally that the electromagnetic and weak nuclear interactions function as a single electroweak force at very high energy. GUTs predict that, at an even higher energy, there would be only a single electronuclear interaction. By the 1970s, both QFT and general relativity made predictions that were confirmed by experiment to an accuracy that is equivalent to knowing the distance from New York to Los Angeles to within the thickness of a human hair. There was even some minimal progress on connecting quantum theory and gravitation with the introduction of black hole thermodynamics by Jacob Bekenstein[73] and Stephen Hawking.[74]

While unification models in particle physics have had many successes, there continue to be unresolved problems. One is the experimentally unconfirmed prediction of the decay of the proton, and there are some unresolved questions related to the Standard Model, such as why there is more matter than antimatter in the universe. Attempts to include the gravitational interaction into more elaborate models of particles such as string theory have not yet been fully successful.[75] In fact, advances based on the unification paradigm have arguably stalled. This may be an indication that

Box 2: A Brief Primer on Gauge Theory

1957: Julian Schwinger presented a gauge theory model of the weak nuclear force[62] (rather than the strong nuclear force) with the photon and two hypothetical vector bosons (W+ and W-) serving as the mediating particles.[63]

1961: Murray Gell-Mann and Sheldon Glashow observed that the special unitary groups studied by the French mathematician Élie-Joseph Cartan thirty years prior (denoted by SU[n]) had a remarkable correlation with the hypothetical virtual particles in gauge theories.[64] This was an important step in connecting mathematical beauty (as manifested in group theory) with physical reality (elementary particles).

1964: Guided by the properties of the group SU(3), Gell-Mann suggested that baryons (a set of "heavy" fermionic particles including protons and neutrons) and mesons (a set of "medium weight" unstable bosonic particles including pions and kaons) were composed of smaller particles he dubbed "quarks."[65] Quarks have fractional electric charge that come in multiples of one-third of the electric charge.[66]

1967: Steven Weinberg[67] and Abdus Salam[68] independently proposed that Glashow's W and Z particles get their mass through a phenomenon called spontaneous symmetry breaking.[69] In spontaneous symmetry breaking a field existing throughout space, called the "Higgs" field,[70] experiences a phase transition at extremely high energies (i.e., at a level associated with 10^{-12} s after the big bang).[71] A scalar particle predicted to exist at high energies by this theory, called the Higgs boson,[72] was detected at CERN's Large Hadron Collider near Geneva, Switzerland, in 2012.

current theories have not found the necessary element of mathematical beauty to unlock the next chapter in the unification journey.[76] Alternatively, there are some who hold the view that the idea of chasing after beautiful theories has outlived its usefulness and that the universe is actually too messy to continue to seek out beautiful theories to describe it.[77] Notwithstanding this criticism, herein it is argued that the search for beautiful theories is still warranted.

Mathematical Beauty

Amongst the many authors who have written about mathematical beauty,[78] one of the strongest proponents of pursuing mathematical beauty as a means to unlocking the secrets of the physical world was P. A. M. Dirac. In a paper entitled "Pretty Mathematics," Dirac wrote,

> A good deal of my research work in physics has consisted in not setting out to solve some particular problem, but simply examining mathematical quantities of a kind that physicists use and trying to fit them together in an interesting way regardless of any application that the work may have. It is simply a search for pretty mathematics. It may turn out later that the work does have an application. Then one has had good luck.[79]

This naturally raises the question, why is there such remarkable efficacy of the ideas that mathematicians formulate and their manifestation in the physical world? While some developments in mathematics were motivated by physical problems, such as Newton's formulation of calculus to describe the motion of objects more accurately, others were originally limited to the domain of pure mathematics and only much later found to have an application. For example, group theory, which had its origins in early 19th-century pure mathematics, was found to have multiple applications in physics and chemistry. Einstein formulated his theory of general relativity using the non-Euclidean Riemannian geometry[80] developed by Bernhard Riemann in 1854. There are numerous other examples in physics and other fields.[81]

In an article entitled "The Unreasonable Effectiveness of Mathematics in the Natural Sciences," Eugene Wigner observes that "the miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve."[82]

From a Christian perspective, Alister McGrath offers the following:

> Sometimes abstract mathematical theories that were originally developed without any practical application in mind later turn out to be powerfully predictive physical models. Yet our familiarity with this fact has blunted our awareness that this is actually rather strange. For Polkinghorne, it was deeply puzzling that there was such a significant "congruence between our minds and the universe." Why does mathematics (a rationality we experience within ourselves) correspond so closely to the deep structures of the universe (a rationality observed beyond ourselves)? So what explanations might be offered for this strange observation? ... For many, the idea of God remains one of the simplest, most elegant, and most satisfying ways of seeing our world and understanding the place of mathematics within it.[83]

In his article entitled "Mathematics and Natural Theology," John Polkinghorne shares the following:

> Time and again it has proved to be a fertile technique of discovery in fundamental physics to seek theories that are formulated in terms of equations possessing the unmistakable character of mathematical beauty. This beauty is a rather rarefied form of aesthetic experience and, like most forms of beauty, it is easier to perceive than to describe. Nevertheless, it is a property whose presence the mathematicians are able to recognize and, significantly, to agree about … The physicists' quest for mathematical beauty is no mere aesthetic indulgence on their part, but a heuristic strategy that time and again has proved its worth in the four-century history of modern theoretical physics.[84]

A student of Dirac, Polkinghorne recalls that Dirac, "who was not a conventionally religious man, was once asked what was his fundamental belief. He strode to a blackboard and wrote that the laws of nature should be expressed in beautiful equations."[85]

When Ard Louis first encountered the Dirac equation (considered to be one of the most beautiful equations in physics) in an advanced quantum mechanics class, the equation that combined classical electromagnetism, special relativity, and quantum mechanics, and that predicted antimatter based on a new kind of symmetry in the laws of nature, he found Dirac's arguments "too fantastical to believe." Louis recounts,

> We may well ask: how does it happen that beauty in the exact sciences becomes recognizable even before it is understood in detail and before it can be rationally demonstrated? ... What I experienced was something closer to what philosophers have called the sublime. This is the sense of beauty mixed with terror that can occur when you for the first time see Mont Blanc or Mount Everest or experience a great sea-storm. I don't mean the kind of terror you feel when someone points a gun at you. Rather, it is the terror of your own finitude when confronted with something much bigger and greater than yourself. I felt like Dirac had given me an unauthorized glimpse of the transcendent; that I had gone where angels fear to tread.[86]

An important element of mathematical beauty is symmetry. Nature provides many examples of visible symmetry that instill a sense of beauty. Examples include snowflakes and sunflowers and the nautilus shell that displays a logarithmic spiral. In his book *Fearful Symmetry: The Search of Beauty in Modern Physics*, Anthony Zee discusses "the aesthetic motivations that animate twentieth-century physics." He states,

> The discovery of a symmetry is much more than the discovery of a specific phenomenon. A symmetry of spacetime, such as rotational invariance of Lorentz invariance, controls all of physics. We have seen that Lorentz invariance, born of electromagnetism, proceeds to revolutionize mechanics. And once the laws of motion of particles are revised, our conception of gravity has to be changed as well, since gravity moves particles.[87] … Today, symmetry considerations play the central role in the work of many fundamental physicists, myself included.[88]

Although the question of whether mathematics was invented or discovered has been debated since ancient times,[89] certainly a comprehensive description of the physical world requires a mix of mathematically beautiful theories and messy theories when those are the best one can do. Steven Weinberg notes the latter are needed to solve practical engineering problems while the former provide conceptual understanding:

> When the aim is not practical but conceptual, when you're trying to understand why we live in the kind of world we do, the kind of theory that is going to be useful to us would be a theory that has great mathematical beauty. Because it's only in that way that it could have explanatory power. If it's ugly, that means it has a lot of various discordant elements and you haven't really explained much because you have to say why is it that way, and not some other way. You haven't gotten very far. Whereas if it's beautiful, you have a feeling, ah, this explains it![90]

Theoretical physicists who discovered mathematical beauty in their descriptions of the universe have felt a deep sense of awe and wonder and even reverence. Shortly after his discovery of a matrix formulation of quantum mechanics, Heisenberg recalled a conversation he had with Einstein:

> If nature leads us to mathematical forms of great simplicity and beauty … we cannot help thinking that they are "true," that they reveal a genuine feature of nature … You must have felt this too: the almost frightening simplicity and wholeness of the relationships which nature suddenly spreads out before us and for which none of us was in the least prepared.[91]

On the matter of beauty, Einstein had this to say:

> The most beautiful and deepest experience a man can have is the sense of the mysterious. It is the underlying principle of religion as well as all serious endeavor in art and science. He who never had this experience seems to me, if not dead, then at least blind. To sense that behind anything that can be experienced there is something that our mind cannot grasp and whose beauty and sublimity reaches us only indirectly and as a feeble reflection, this is religiousness. In this sense I am religious. To me it suffices to wonder at these secrets and to attempt humbly to grasp with my mind a mere image of the lofty structure of all that is there.[92]

Is Unification Just a Kuhnian Scientific Paradigm?

The aesthetically guided motivation to understand nature has been in force from the time of the Greeks to the present. To appreciate just how remarkable this perennial feature of the unification paradigm is, it is necessary to consider the work of Thomas Kuhn, whose monograph *The Structure of Scientific Revolutions*[93] overturned the generally held view that progress in scientific knowledge was linear and continuous. Instead, Kuhn claimed scientific fields undergo episodic "paradigm shifts" in which "normal science," conducted within one distinct framework or paradigm of shared preconceptions, becomes increasingly plagued by discrepancies until a period of "revolutionary science" alters the paradigm. During this shift, "the scientist's perception of his environment must be re-educated—in some familiar situations he must learn to see a new gestalt."[94] Hence, science progresses through a sequence of paradigms, each characterized by a generally agreed-upon set of preconceptions that governs how the community of scientists will conduct their work until the next paradigm shift.[95]

Examples of revolutions in Kuhnian scientific paradigms referenced above include (1) the replacement of Aristotelian physics with heliocentric and classical mechanics in the Copernican and Newtonian revolutions, (2) the 19th-century replacement of caloric theories of heat with the modern laws of thermodynamics, (3) Maxwell's unification of formerly disparate ideas about electricity and magnetism, (4) the re-envisioning of matter, time, and motion in Einstein's special and general theories of relativity, (5) the replacement of classical mechanics with old quantum theory, (6) old quantum theory replaced with quantum mechanics, and (7) the unification of electromagnetic and strong and weak nuclear forces via quantum field theory. Notice that although several of these revolutions involved the unification of formerly disparate phenomena, the unification "paradigm" itself differs in several significant ways from these Kuhnian paradigms. Notably, the driving

force behind the unification paradigm for many scientists is more of an intuitive instinct than a consciously held set of axioms. Further, it has persisted from the time of the Greeks to the present day.[96]

Herein it is proposed that, while Kuhnian scientific paradigms are human constructs and, as such, are prone to change, the unification paradigm is grounded in God's eternal nature evident in creation. Further, as Einstein noted, it is "something that our mind cannot grasp and whose beauty and sublimity reaches us only indirectly and as a feeble reflection."[97] This coheres with the Pauline understanding of general revelation in Romans, where Paul writes, "Ever since the creation of the world his eternal power and divine nature, invisible though they are, have been understood and seen through the things he has made" (Rom. 1:20a, NRSVA). It also agrees with ancient Hebrew conceptions of general revelation as expressed by the writer of Psalm 19, who proclaimed, "The heavens declare the glory of God; the skies proclaim the work of his hands" (Ps. 19:1, NIV).

This proposal, that mathematically beautiful unifying descriptions of nature declare the glory and divine nature of God, provides a plausible explanation of why people who have studied natural phenomena during the span of centuries and from within a vast array of societies with their own distinct shared values, beliefs, and cultures could be drawn to the unification paradigm. Nevertheless, many theoretical physicists who encounter mathematical forms of simplicity and beauty do not associate them with God. Georges Lemaître offers this perspective:

> Both … the scientist-believer and the scientist nonbeliever attempt at decoding the palimpsest of nature with multiple imbrications in which the traces of the various stages of the world's lengthy evolution has been overlapped and blended. The believer perhaps has an advantage of knowing that the riddle possesses an intelligent being, and consequently that the problem proposed by nature has been posed in order to be solved, therefore, that its degree of difficulty is presumably commeasurable with the present and future capacities of humanity.[98]

Historically, writers such as Irenaeus of Lyon, Anselm of Canterbury, Thomas Aquinas, John Calvin, Jonathan Edwards, Herman Bavinck, and Karl Barth have reflected on the divine beauty of God, although only some of these considered how the beauty of God might be revealed in nature.[99] While theologies of beauty received scant attention during the twentieth century,[100] Hans Urs von Balthasar inspired renewed theological interest in the topic of the beauty of God through his seminal *The Glory of the Lord: A Theological Aesthetics*.[101]

In the 21st century, a number of authors have contributed to the topic of a theology of beauty.[102] In particular, Jonathan King has provided a thorough biblical-theological analysis of the theology of beauty.[103] King frames his work as follows:

> My working hypothesis is twofold: first, beauty corresponds in some way to the attributes of God; second, the theodrama of God's eternal plan in creation, redemption, and consummation entails a consistent and fitting expression and outworking of this divine beauty.[104]

King does an excellent job of integrating the contributions of the historical figures mentioned above into his analysis of the question posed by Hans Balthasar:

> … may it not be that we have a real and inescapable obligation to prove the possibility of there being a genuine relationship between theological beauty and the beauty of the world?[105]

For King, God's beauty is an inherent aspect of his triune being, and the incarnation, death, and resurrection of Jesus display God's glory and beauty in redemptive history. He argues that an integrative approach of beauty, truth, and goodness enriches our understanding of God and his work.

McGrath also considered Balthasar's question in depth in *The Open Secret: A New Vision for Natural Theology*:

> An emphatic assertion of the beauty of the world and its theological importance is found in most writers of the patristic and medieval periods, who celebrated this beauty as something that is intrinsically delightful, while at the same time affirming its potential to lead those questing for a fuller disclosure of that beauty to discover its source and culmination in God.[106]

For McGrath, "the term 'natural theology' is now widely used to designate the intuition that there is some intellectual or imaginative connection between the natural world and a transcendent reality, such as God."[107]

In the words of Paul Ewart,

> Natural theology gathers from the world evidence for the existence of God and clues to his nature. In so doing it responds to a seemingly instinctive response that ascribes the beauty, power, and majesty of the universe to the work of a creator God. We sense that beyond the natural world lies a being that is not only responsible for its existence but gives it meaning and purpose.[108]

However, with the centrality of reason that characterized the Age of Enlightenment, McGrath points out that natural theology became conceived "solely in terms of the observed rationality of the natural order."[109] In his

subsequent book *Re-Imagining Nature: The Promise of a Christian Natural Theology*, he offered a correction:

> A Christian natural theology celebrates and articulates the half-grasped rational transparency and oblique beauty of a complex and multifaceted nature, while at the same time proclaiming that a greater beauty lies beyond its horizon … A Christian natural theology is, in its own distinctive way, a theology of hope—a means of sustaining us as we travel through this sign-studded world, reassuring us that there is indeed a "big picture," which we presently grasp only in part.[110, 111]

The unification paradigm provides a fundamental connection, as viewed through the eyes of faith, between the glory of God and the mathematical beauty of those theories that best describe creation. In this regard, the unification paradigm could be viewed as an example of "a genuine relationship between theological beauty and the beauty of the world" as anticipated by Balthasar and, as such, provides an expression of faith integration.

The Unification Paradigm and the Lifelong Struggle to See Things Whole

One of the champions of the "integration of faith and learning," Arthur Holmes, referred to "faith integration" as "a lifelong struggle to see things whole, to think and become more consistently what we profess."[112] This "lifelong struggle to see things whole" is precisely the driving motivation of the unification paradigm. In turn, both the lifelong struggle and the unification paradigm cohere with the single triune God's revelation of himself through the complementary books of scripture and nature. So, it isn't a surprise that our instinct would be to adopt a unifying approach when searching for a deeper understanding of the mysteries of either the physical or theological realms. James Clerk Maxwell, one of the great unifiers in theoretical physics, viewed the study of nature as a means to strengthen human reason in God's service.

> Omnipotent God, who has created man in your image and has made him a living spirit so that he can seek and have power over your creatures, teach us to study the work of your hands in such a way that we can subject the earth to our use and strengthen our reason in your service, and receive your blessed word, so as to have faith in the one whom you have sent to give knowledge of salvation and the remission of our sins.[113]

Mark Noll similarly notes the importance of understanding the world for Christian discipleship when he describes Christ as "the Paradigm" and "the telos of all that is beautiful":

> Since the reality of Jesus Christ sustains the world and all that is in it, so too should the reality of Jesus Christ sustain the most whole-hearted, unabashed, and unembarrassed efforts to understand the world and all that is in it. The Light of the World, the Word of God, the Son of Man, the True Vine, the Bread of Life, the Bright and Morning Star—for believers, this One is the Savior, but also the Paradigm … The light of Christ illuminates the laboratory, his speech is the fount of communication, he makes possible the study of humans in all their interactions, he is the source of all life, he provides the wherewithal for every achievement of human civilization, he is the telos of all that is beautiful. He is, among his many other titles, the Christ of the Academic Road.[114]

The proposal offered here is that creation contains guideposts[115] that enable us to discover theories that are truer than their alternatives, with one example of such a guidepost being the unification paradigm that points fundamental physical theories to the beauty of God. From the vantage point of Christian natural theology, the pursuit of such theories is Christocentric and part of the Christian calling to reflect the beauty of God.

In conclusion, the unification paradigm illuminates the profound relationship between theoretical physics and the transcendent beauty of God. This paradigm, that is rooted in the mathematical elegance that has guided centuries of scientific discovery, invites us to see scientific endeavor not merely as the pursuit of knowledge of the physical world but also as a journey toward a deeper understanding of God's divine beauty. Critics may argue that the association between mathematical beauty and divine nature is misplaced. Yet, as Einstein observed, the beauty and sublimity of the natural world point beyond themselves to something mysterious and awe-inspiring. Christianity provides a compelling explanation: God's eternal power and divine nature are revealed through the things he has made.

The unification paradigm challenges us, as Holmes noted, to undertake "a lifelong struggle to see things whole."[116] The mathematical beauty that undergirds theoretical physics is not an end in itself but a guidepost to the ultimate source of all beauty—the God of creation. As such, the steady reduction in emphasis on the supernatural in science comes full circle, resulting in fundamental theoretical descriptions of the physical world that reflect God's eternal beauty and so point to God.

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Notes

[1]Richard P. Feynman, Robert B. Leighton, and Matthew Sands, *The Feynman Lectures on Physics,* New Millennium Edition, Volume I (Basic Books, 2010), 142, https://dunapress.com/wp-content/uploads/2020/04/The_Feynman_Lectures_on_Physics_-_VOL1.pdf.

[2]Many Christians who contributed to the foundation of modern science saw its laws as expressions of a manifestation of God's wisdom in creation. In this regard, see Peter Harrison, "Laws of God or Laws of Nature? Natural Order in the Early Modern Period," in Peter Harrison and Jon Roberts, ed., *Science Without God? Rethinking the History of Scientific Naturalism* (Oxford University Press, 2019), 17–35.

[3]"Unification" is used extensively in the literature, and Thomas Kuhn introduced the term "paradigm" in science in his important publication, Thomas S. Kuhn, *The Structure of Scientific Revolutions* (University of Chicago Press, 1962). The combined label "unification paradigm" is not commonly used.

[4]See, for example, Ryan West and Adam C. Pelser, "Perceiving God Through Natural Beauty," *Faith and Philosophy* 32, no. 3 (July 2015): 293–312.

[5]The author is indebted to the editor-in-chief of *Perspectives on Science and Christian Faith* for bringing to his attention the article by Tracee Hackel that proposes beauty as a common dialect of physics and Trinitarian theology. Hackel notes the work of John Philoponus, an ancient Christian natural philosopher, who anticipated the unification word of Faraday and Maxwell. Tracee Hackel, "Physics and Christian Theology: Beauty, a Common Dialect?," *In Pursuit of Truth: A Journal of Christian Scholarship* (October 31, 2007), https://www.cslewis.org/journal/physics-and-christian-theology-beauty-a-common-dialect/2/. The editor-in-chief also provided helpful references to Thomas F. Torrance, *Theological and Natural Science* (Wipf and Stock, 2002) and Ernst Peter Fischer, *Beauty and the Beast: The Aesthetic Moment in Science,* trans. Elizabeth Oehlkers (Plenum Trade, 1997).

[6]See J. R. Milton, "The Limitations of Ancient Atomism," in *Science and Mathematics in Ancient Greek Culture*, ed. Christopher Tuplin and T. E. Rihll (Oxford University Press, 2002): 178–95.

[7]While many of Aristotle's scientific proposals ultimately proved to be wrong, they were revered for many centuries until the 13th-century condemnations of Paris explicitly rejected dogmatic interpretations of Aristotelian physics.

[8]Legend has it that the king was suspicious that the goldsmith who made a crown for him had mixed in some silver, so he consulted with Archimedes, the cleverest person in the city. Archimedes, while taking a bath, noticed the displacement of the water when he got into the tub and had a revelation about how to calculate the density of the material making up the crown. The story is that he was so excited that he ran into the street naked shouting "Eureka!" or "I have found it!" Whether or not Archimedes coined the term "Eureka" in this way, it does represent the moment of inspiration that is a common thread through the journey of discovery of modern physics.

[9]In fact, it has only been since 1999 that the real depth of the contributions of Archimedes have come to light: See Reviel Netz and William Noel, *The Archimedes Codex: Revealing the Secrets of the World's Greatest Palimpsest* (Da Capo Press, 2007).

[10]Stephen Hawking, *A Brief History of Time* (Bantam Books, 1988), 179.

[11]David C. Lindberg, "Galileo, the Church, and the Cosmos," in *When Science and Christianity Meet,* ed. David C. Lindberg and Ronald L. Numbers (University of Chicago Press, 2003), 33–60.

[12]Having recently experienced the COVID-19 pandemic, it is interesting that

> Even on entry to Trinity College, Cambridge, [Newton] did not stand out until, ironically, the University was forced to close during 1665 and 1666 due to the high risk of plague. Newton returned to Woolsthorpe and began two years of remarkable contemplation on the laws of nature and mathematics which would transform the history of human knowledge. (Jon Balchin, *Quantum Leaps: 100 Scientists Who Changed the World* [Arcturus, 2006], 66)

[13]Newton's three laws of motion describe the relationship between the motion of an object and the forces acting on it. The law of universal gravitation states that every particle attracts every other particle with a force that is proportional to the product of their masses and inversely proportional to the square of the distance between them.

[14]If the moon didn't have a velocity in the direction of its elliptical orbit, it would fall directly to the earth. Likewise, if the force of gravity didn't exist, the moon would move in a straight line past the earth (Newton's first law of motion). However, because the moon does have a velocity (its average orbital speed is about 1 km/s) *and* there is a force of gravitational attraction between the moon and the earth, the moon is continually "falling" toward the earth as it progresses along its elliptical orbit.

[15]In addition to his contributions in classical mechanics, Newton made significant contributions in optics and shares credit with Gottfried Wilhelm Leibniz for the development of infinitesimal calculus. Newton proposed a corpuscular (particle) theory of light which opposed a wave theory of light that Christiaan Huygens had introduced several decades earlier. This dual understanding of the nature of light would prove to play an important role in quantum mechanics.

[16]Freeman J. Dyson, *Infinite in All Directions* (Harper, 1985), 45.

[17]Joseph-Louis Lagrange, *Mécanique Analytique* (Ve Courcier, 1811).

[18]Emmy Noether, "Invariante Variationsprobleme," *Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen*, *Mathematisch-Physikalische Klasse* (1918): 235–57.

[19]Michael Faraday, "Experimental Researches in Electricity. —Twenty-Ninth Series. On the Physical Character of the Lines of Magnetic Force," *Philosophical Magazine* (June 1852): 407–37.

[20]Faraday's exploration of a potential link between gravitation and electromagnetism foreshadowed 20th-century efforts.

[21]Michael Faraday, "Experimental Researches in Electricity. Twenty-Fourth Series. On the Possible Relation of Gravity to Electricity," *Abstracts of the Papers Communicated to the Royal Society of London* 5 (1851): 994–95, http://doi.org/10.1098/rspl.1843.0267.

[22]A differential equation is a mathematical equation that relates one or more unknown functions and their derivatives.

[23]The displacement current arises when an electric field changes with respect to time. This can occur not only in some materials, but also in vacuum.

[24]James Clerk Maxwell, "A Dynamical Theory of the Electromagnetic Field," *Philosophical Transactions of the Royal Society of London* 155 (1865): 459–512.

[25]Albert Einstein, "Considerations Concerning the Fundaments of Theoretical Physics," *Science* 91, no. 2369 (May 24, 1940): 487–92.

[26]One additional step of unification in the 19th century took place in thermodynamics when heat was connected to the kinetic theory of gases.

[27]In German, *Gedankenexperiment*.

[28]In special relativity, Einstein recognized that the results of measurements of variables such as distance or speed always need to refer to the coordinate system or reference frame from which they are being measured, to be meaningful.

[29]It was generally believed that a medium permeating all space (referred to as the luminiferous aether) was required in order for an electromagnetic wave to propagate say from the sun to the earth. It was believed that the ether would provide an "absolute" reference frame from which all speeds could be measured. However, the careful experiments conducted by Albert A. Michelson and Edward W. Morley in 1887 yielded a "null" result (meaning that there was no evidence of an ether).

[30]Albert Einstein, "Zur Elektrodynamik bewegter Körper," *Annalen der Physik* 17 (1905): 891–921; English translation "On the Electrodynamics of Moving Bodies," in H. A. Lorentz, A. Einstein, H. Minkowski, and H. Weyl, *The Principle of Relativity,* trans. W. Perrett and G. B. Jeffery (Dover, 1952), 37–38.

[31]Other consequences of special relativity include the following:

- Two spatially separated events (e.g., two flashes of light) that occur simultaneously for one observer won't occur simultaneously as measured by another observer if the observers are moving relative to one another;
- The interval of time measured between two events won't be the same for two observers if they are moving relative to one another (this is referred to as "time dilation");
- The measured length of an object won't be the same for two observers if they are moving relative to one another in the direction of the object being measured (this is referred to as "length contraction");
- The mass of an object as measured by an observer depends on the velocity of the object relative to the observer; and
- Mass and energy are equivalent according to the well-known equation $E = mc^2$ (where E is the energy of a particle, m is its mass, and c^2 is the square of the speed of light).

[32]The corrections to Newton's equations are significant for velocities that approach the speed of light and are important in modern particle physics experiments.

[33]In the *Feynman Lectures* noted above, Feynman joked that Newton's "force" could be thought of as "invisible angels" that "fly in a different direction" (p. 142) since there is no physical explanation of how the force is mediated between the two objects.

[34]Albert Einstein, "Die Feldgleichungen der Gravitation," *Königlich Preußische Akademie der Wissenschaften* (Berlin). *Sitzungsberichte* 25 (1915): 844–47; English translation, "The Field Equations of Gravitation," in *The Collected Papers of Albert Einstein, Volume 6: The Berlin Years: Writings, 1914–1917,* trans. Alfred Engel (Princeton University Press, 1997), 117–20, https://einsteinpapers.press.princeton.edu/vol6-doc/272.

[35]In 2017, Rainer Weiss, Kip Thorne, and Barry Barish received the Nobel Prize in Physics for their role in the direct detection of gravitational waves that were generated by the merger of two black holes that propagated as ripples in spacetime at the speed of light. Black holes were predicted by general relativity as the remnant of a massive star after it collapses.

[36]Einstein's gravitational field equations are second order nonlinear partial differential equations that can only be solved exactly by making simplifying assumptions.

[37]The curved manifold of general relativity is represented in differential geometry by a pseudo-Riemannian metric. In the limit of zero curvature, one recovers that flat Minkowski spacetime of special relativity.

[38]One of the confirmations of Einstein's theory is that light from the sun bends as it grazes the moon's surface during a solar eclipse as a consequence of following the curvature of spacetime.

[39]Subrahmanyan Chandrasekhar, "The General Theory of Relativity: Why 'It Is Probably the Most Beautiful of All Existing Theories,'" *Journal of Astrophysics and Astronomy* 5 (1984): 3–11, https://doi.org/10.1007/BF02714967.

[40]Chandrasekhar, "The General Theory of Relativity," 5.

[41]Chandrasekhar, "The General Theory of Relativity," 5.

[42]Semir Zeki, John Paul Romaya, Dionigi M. T. Benincasa, and Michael F. Atiyah, "The Experience of Mathematical Beauty and Its Neural Correlates," *Frontiers in Human Neuroscience* 8 (2014): 68, https://doi.org/10.3389/fnhum.2014.00068.

[43]Albert Einstein, "Kosmolgische Betrachtungen zur allgemeinen Relativitätstheorie," *Königlich Preußische Akademie der Wissenschaften* (Berlin). *Sitzungsberichte* (1917): 142–52; English translation "Cosmological Considerations in the General Theory of Relativity," in *The Collected Papers of Albert Einstein, Volume 6: The Berlin Years: Writings (1914–1917)*, 540–52, https://einsteinpapers.press.princeton.edu/vol6-doc/568.

[44]The prevailing view at the time was that the universe was static and unchanging. Einstein's calculation showed that the field equations did not yield a result consistent with this view, so he inserted an additional term in 1917 (subsequently called the cosmological constant) as a repulsive force to balance the gravitational attraction of the matter of the universe. It was later reported that Einstein considered the insertion of the cosmological constant to be the "biggest blunder" of his life (for a recent account, see Cormac O'Raifeartaigh, "Investigating the Legend of Einstein's 'Biggest Blunder,'" *Physics Today* 30 [October 30, 2018], https://doi.org/10.1063/PT.6.3.20181030a).

[45]Assuming that the universe in general is homogeneous and isotropic.

[46]For example, if the density of matter and energy in the universe were only slightly higher than it is (about one part in 10^{62}), then matter would have collapsed on itself before the conditions were right for us to exist, and if it were only slightly lower, no galaxies or stars would have formed.

[47]The fact that observation shows that the expansion of the universe is accelerating (one would expect the expansion of normal matter to decelerate under the influence of gravitation) has suggested that about 68% of the energy, dubbed "dark energy" in the universe has a negative pressure. Some have proposed that the cosmological constant could be used to represent dark energy.

[48]Astronomical observations have shown that there doesn't appear to be sufficient (normal) matter to explain the motion of galaxies. In fact, it is currently believed that about 85% of matter is "dark," i.e., that it interacts neither with the electromagnetic field (so it doesn't emit radiation) nor with normal "baryonic" matter.

[49]A grand unified theory (GUT) is any model in particle physics that merges the electromagnetic, weak, and strong forces (the three gauge interactions of the Standard Model) into a single force at high energies. Although this unified force has not been directly observed, many GUT models theorize its existence. See Robert P. Crease and Charles C. Mann, *The Second Creation: Makers of the Revolution in Twentieth-Century Physics* (MacMillan, 1986) for a helpful historical account of the Standard Model.

[50]Einstein was awarded the 1921 Nobel Prize for the discovery of the law of the photoelectric effect. He did not receive a Nobel Prize for his work in relativity.

[51]In the words of Richard Feynman:

> Newton thought that light was made up of particles, but then it was discovered, as we have seen here, that it behaves like a wave. Later, however (in the beginning of the twentieth century) it was found that light did indeed sometimes behave like a particle. Historically, the electron, for example, was thought to behave like a particle, and then it was found that in many respects it behaved like a wave. So it really behaves like neither. Now we have given up. We say: "It is like neither." …
>
> Because atomic behavior is so unlike ordinary experience, it is very difficult to get used to and it appears peculiar and mysterious to everyone, both to the novice and to the experienced physicist. Even the experts do not understand it the way they would like to, and it is perfectly reasonable that they should not, because all of direct, human experience and of human intuition applies to large objects. We know how large objects will act, but things on a small scale just do not act that way. So we have to learn about them in a sort of abstract or imaginative fashion and not by connection with our direct experience. (Richard P. Feynman, Robert B. Leighton, and Matthew Sands, *The Feynman Lectures on Physics,* New Millennium Edition, Volume III [Basic Books, 2010], 655)

[52]In the most popular interpretation, advanced by Niels Bohr and Werner Heisenberg and called the Copenhagen interpretation, it is argued that one can achieve only a probabilistic description of nature at the very small scale (e.g., one can calculate the probability that an electron will be detected at a certain location, but it is not possible to know the path it followed to get to that location). As well, if a quantum system can exist in more than one state, then it will remain in a "superposition" of those states until an observation of the system is made and the superposition "collapses" into one or another of the possible states. In order to emphasize how strange this aspect of the Copenhagen interpretation is, Erwin Schrödinger illustrated this property in terms of macroscopic objects—his famous Schrödinger cat thought experiment. Imagine a cat is put into a sealed box with a flask of poison and a radioactive source in such a configuration that if a Geiger counter detects radioactivity (say, with a 50% chance), a mechanism causes the flask to shatter, releasing the poison and killing the cat. The Copenhagen interpretation requires that the cat be simultaneously alive *and* dead (the two states that it can take on) until someone looks into the box (makes an observation), at which point the cat is *either* alive *or* dead. Einstein disliked the idea of a probabilistic interpretation and, in 1935, Albert Einstein, Boris Podolsky, and Nathan Rosen (EPR) published a paper, "Can Quantum-Mechanical Description of Physical Reality Be Considered Complete?" (*Physical Review* 47 [May 15, 1935]: 777–80, https://cds.cern.ch/record/405662/files/Physrev.47.777.pdf), in which they argued that, while quantum mechanics is correct as a theory, it is *incomplete*. A "complete" theory would require "hidden variables." Einstein refused to accept that nature might demonstrate what he called "spooky actions at a distance" or violations of local realism. In 1964, John Bell questioned whether there were any real objection against a completely realistic account of all quantum phenomena or not. His quest led him to the famous Bell inequality that recast the EPR argument into quantitative terms, opening the way for an empirical comparison between the predictions of quantum mechanics and local realism. The most definitive experimental results that followed were achieved in 1982 by Alain Aspect et al., violating Bell's inequality and clearly supporting the *nonlocal* predictions of quantum mechanics.

[53]Paul A. M. Dirac, "The Quantum Theory of the Emission and Absorption of Radiation," *Proceedings of the Royal Society of London* A 114, no. 767 (March 1927): 243–65, https://doi.org/10.1098/rspa.1927.0039.

[54]In quantum mechanics, perturbation theory is an approach whereby one develops an approximate solution for a complex system by using a known solution for a simpler system and then progressively solves for corrective terms in a series.

[55]Paul A. M. Dirac, "The Quantum Theory of the Electron," *Proceedings of the Royal Society of London* A 117, no. 778 (February 1928): 610–24, https://mathweb.ucsd.edu/~nwallach/Dirac1928.pdf.

[56]In 1919, Hermann Weyl proposed that electromagnetism might be invariant under a local change of length scale or "gauge" (a term borrowed from railroads in reference to the different distances between the tracks). At the time, Weyl's proposal didn't appear to have merit, and the term "gauge" was subsequently associated with a change of the phase of the quantum mechanical wave function. Since then, several authors have proposed models based on Weyl's scale invariance, including the current author who proposed a geometric model using microscopic wormholes to explain the nonlocal behavior at the microscopic scale (W. R. Wood and G. Papini, "A Geometric Formulation of the Causal Interpretation of Quantum Mechanics," *Foundations of Physics Letters* 6, no. 3 [1993]: 207–23).

[57]The strong nuclear force is an attractive force between particles like protons and neutrons that keeps the nucleus together. The weak nuclear force is responsible for the radioactive decay of certain nuclei. Both nuclear forces act over a short range. The strong nuclear force is about 100 times stronger than the electromagnetic force and 10,000 times stronger than the weak nuclear force.

[58]C. N. Yang and R. L. Mills, "Conservation of Isotopic Spin and Isotopic Gauge Invariance," *Physical Review* 96 (1954): 191–95, http://dx.doi.org/10.1103/PhysRev.96.191.

[59]Robert P. Crease and Charles C. Mann, "How the Universe Works," *The Atlantic Monthly* (August 1984): 74, https://

www.theatlantic.com/magazine/archive/1984/08/how-the-universe-works/666820/.

[60]The 1979 Nobel Prize in Physics was awarded to Sheldon Glashow, Abdus Salam, and Steven Weinberg for their contributions in establishing the electroweak theory.

[61]See Crease and Mann, "How the Universe Works," for an engaging narrative of this chronology in honor of Sheldon L. Glashow.

[62]Julian Schwinger, "A Theory of the Fundamental Interactions," *Annals of Physics* 2, no. 5 (1957): 407–34.

[63]Sheldon Glashow subsequently suggested that there should be *four* virtual particles (the photon, W^+, W^-, and Z) rather than three, and he made the connection between the special unitary group SU(2) x U(1) and the electromagnetic and weak nuclear interaction. Sheldon Glashow, "Partial-Symmetries of Weak Interactions," *Nuclear Physics* 22, no. 4 (1961): 579–88.

[64]Murray Gell-Mann and Sheldon Glashow, "Gauge Theories of Vector Particles," *Annals of Physics* 15 (1961): 437–60.

[65]Murray Gell-Mann, "A Schematic Model of Baryons and Mesons," *Physics Letters* 8, no. 3 (1964): 214–15. George Zweig proposed a similar model (with constituents called "aces") also in 1964 in George Zweig, "An SU(3) Model for Strong Interaction Symmetry and Its Breaking," CERN Report No. 8182/TH.401, http://cds.cern.ch/record/352337/files/CERN-TH-401.pdf. Initially, quarks were considered to be nothing more than a useful classification device. However, in 1968, the physical existence of quarks was demonstrated in deep inelastic scattering experiments at the Stanford Linear Accelerator Center.

[66]Baryons are made up of three quarks (or anti-quarks) in such a manner that the resultant electric charge is always an integer and the spin is a half-integer, whereas mesons are made up of a quark and an anti-quark with integer electric charge and integer spin and are extremely short-lived. Quarks are bound by the strong nuclear force within baryons and mesons, whereas leptons (the lightest matter constituents such as the electron and neutrino) experience only the weak nuclear force. Glashow proposed that there might be a fourth quark that he called "charm," in addition to the "up," "down," and "strange" quarks. See B. J. Bjørken and S. L. Glashow, "Elementary Particles and SU(4)," *Physics Letters* 11, no. 3 (1964): 255–57. Even though Glashow and Bjørken had no justification for a fourth quark, they went ahead and published the idea anyway. Once again, their intuition based largely on aesthetics, paid off. The current model includes two additional (much heavier) quarks: top and bottom (some physicists used the terms "truth" and "beauty" for a period of time).

[67]Steven Weinberg, "A Model of Leptons," *Physical Review Letters* 19 (1967): 1264–66.

[68]Abdus Salam, "Weak and Electromagnetic Interactions," in *Proceedings of the 8th Nobel Symposium*, ed. N. Svartholm (Almqvist and Wiksell, 1968): 367–77.

[69]The idea of spontaneous symmetry breaking and the role that the resulting "Goldstone" bosons might play in both condensed matter physics and particle physics had been studied by researchers such as Yoichiro Nambu and Philip Anderson in the early 1960s.

[70]Named after Peter Higgs, one of the scholars working in this area.

[71]During a phase transition (e.g., the freezing of water), the state of matter changes as well as the symmetry associated with the phase of the matter. A higher degree of symmetry occurs at higher temperatures, whereas at lower temperatures, the symmetry is "broken." Prior to the phase transition of the Higgs field in the very early universe, there would have been a single electroweak interaction with all the mediating particles being massless. After the phase transition, the W and Z particles acquired mass (which causes the weak nuclear interaction to be short ranged) and the electromagnetic and weak nuclear interactions became decoupled.

[72]See The ATLAS Collaboration, "A Detailed Map of Higgs Boson Interactions by the ATLAS Experiment Ten Years After the Discovery," *Nature* 607 (2022): 52–59, https://doi.org/10.1038/s41586-022-04893-w.

[73]J. D. Bekenstein, "Black Holes and the Second Law," *Lettere al Nuovo Cimento* 4, no. 15 (1972): 737–40.

[74]S. W. Hawking, "Black Hole Explosions?," *Nature* 248 (1974): 30–31.

[75]It should be noted that the principle of supersymmetry was introduced in the mid-1970s to try to address some of the gaps left by the standard model and has continued to play an influential role in unification approaches since then. Supersymmetry proposes that forces and matter should be treated on an equal footing. To accomplish this, a "superpartner" is hypothesized for all known particles, fermions, and bosons. If supersymmetry exists in nature, these new particles should be detectable at facilities such as the Large Hadron Collider (LHC), but no positive results have been obtained to date. Indeed, LHC data suggest that supersymmetry requires some fine-tuning, which was one of the factors that it was designed to get rid of. See Lee Smolin, *The Trouble with Physics: The Rise of String Theory, the Fall of Science, and What Comes Next* (Houghton Mifflin, 2006) and Joseph Lykken and Maria Spiropulu, "Supersymmetry and the Crisis in Physics," *Scientific American* 310, no. 5 (May 2014): 34–39, for overviews of supersymmetry and related theories. Another challenge is that current experimental capabilities are insufficient to provide confirmation of some of the proposed models such as loop gravity, asymptotic safety, and non-commutative geometry.

[76]A promising candidate is Weyl conformal invariance that some authors have proposed existed in the very early universe with the fixed standards of length that Einstein argued exist, emerging as a result of conformal symmetry breaking. See C. Condeescu, D. M. Ghilencea, and A. Micu, "Weyl Quadratic Gravity as a Gauge Theory and Non-metricity vs. Torsion Duality," *The European Physical Journal C* 84 (2024): article 292, https://doi.org/10.1140/epjc/s10052-024-12644-6 and references therein for a recent argument for the advantages that Weyl gravity provides with regard to addressing challenges on the SM.

[77]See, for example, Sabine Hossenfelder, *Lost in Math: How Beauty Leads Physics Astray* (Basic Books, 2018).

[78]See, for example, S. Chandrasekhar, *Truth and Beauty: Aesthetics and Motivations in Science* (The University of Chicago Press, 1987); Frank Wilczek, *A Beautiful Question: Finding Nature's Deep Design* (Penguin Press, 2015); Hunkoog Jho, "Beautiful Physics: Re-Vision of Aesthetic Features of Science Through the Literature Review," *Journal of the Korean Physical Society* 73, no. 4 (August 2018): 401–13; Ivan Melo, "Aesthetic Criteria in Fundamental Physics—The Viewpoint of Plato," *Philosophies* 7 (2022): 96–111, https://doi.org/10.3390/philosophies7050096; and Ivan Melo, "The Role of Beauty in Physics," *Communications – Scientific Letters of the University of Zilina* 20, no. 1A (2018): 144–48,

https://doi.org/10.26552/com.C.2018.1A.144-148. See Russell Howell, "Beauty," in *Mathematics Through the Eyes of Faith,* ed. James Bradley and Russell Howell (HarperOne, 2011), chap. 7, for a comprehensive analysis of mathematical beauty from a Christian perspective.

[79]P. A. M. Dirac, "Pretty Mathematics," *International Journal of Theoretical Physics* 21, no. 8/9 (1982): 603–5.

[80]In Riemannian geometry, parallel lines can converge or diverge.

[81]For example, see Peter Rowlett, "The Unplanned Impact of Mathematics," *Nature* 475 (2011): 166–69, https://doi.org/10.1038/475166a.

[82]Eugene Wigner, "The Unreasonable Effectiveness of Mathematics in the Natural Sciences," *Communications on Pure and Applied Mathematics* 13, no. 1 (February 1960), 157, https://onlinelibrary.wiley.com/doi/10.1002/cpa.3160130102.

[83]Alister E. McGrath, *Science and Religion: A New Introduction,* 3rd edition (Wiley-Blackwell, 2020), 197–99.

[84]John Polkinghorne, "Mathematics and Natural Theology," in *The Oxford Handbook of Natural Theology,* ed. Russell Re Manning, John Hedley Brooke, and Fraser Watts (Oxford University Press, 2013), 449.

[85]John Polkinghorne, *Belief in God in an Age of Science* (Yale University Press, 2003), 2.

[86]Ard Louis, "Beauty and the Sublime in Physics," *Theos* (February 2, 2023), https://www.theosthinktank.co.uk/comment/2023/02/02/beauty-and-the-sublime-in-physics.

[87]Anthony Zee, *Fearful Symmetry* (Macmillan, 1986), 73–74.

[88]Zee, *Fearful Symmetry*, 99.

[89]Among physicists, Wigner advocated for the point of view that mathematics is real and discovered by people. Einstein considered it to be a product of human thought. There are compelling arguments on both sides. Others argue that there is room within mathematics for both universal truths as well as human constructs. See, e.g., Harold Heie, "Developing a Christian Perspective on the Nature of Mathematics," in *Teaching as an Act of Faith,* ed. Arlin C. Migliazzo (Fordham University Press, 2002), 95–116. The author is indebted to Professor Heie for the faith-integration mentoring that he provided as part of a CCCU new faculty workshop 30 years ago.

[90]See the online interview of Steven Weinberg by Ali Kaya entitled "Is Mathematics Invented or Discovered?," https://abakcus.com/video/steven-weinberg-is-mathematics-invented-or-discovered/ (January 10, 2020), 6:55–7:52. Note that the Lawrence Livermore National Laboratory announced that it had successfully sparked a fusion reaction that released more energy than went into it just two months after Weinberg's interview.

[91]Chandrasekhar, "The General Theory of Relativity," 4.

[92]Marco Bersanelli and Mario Gargantini, *From Galileo to Gell-Mann: The Wonder That Inspired the Greatest Scientists of All Time,* trans. by John Bowden (Templeton Press, 2009), 7.

[93]Thomas S. Kuhn, *The Structure of Scientific Revolutions,* 2nd edition (University of Chicago Press, 1970).

[94]Kuhn, *The Structure of Scientific Revolutions,* 112.

[95]One practical way that this can play out is in the determination of what research grants will be approved.

[96]In this regard, the unification "paradigm" might more aptly be called the unification "meta-paradigm" since it has persisted from one scientific paradigm to another.

[97]Einstein, in Bersanelli and Gargantini, *From Galileo to Gell-Mann,* 7.

[98]Lemaître, in Bersanelli and Gargantini, *From Galileo to Gell-Mann,* 244.

[99]Indeed, Barth famously said "Nein!" (No!) to Natural Theology.

[100]Laura Smit, "Review Essay: The Theology of Beauty," *Calvin Theological Journal* 57, no. 1 (April 2022): 143–49.

[101]Hans Urs von Balthasar wrote a sixteen-volume theological "trilogy" on the good, the true, and the beautiful.

[102]For other recent contributions, see, for example, Jeremy Begbie, ed., *Sounding the Depths: Theology Through the Arts* (SCM Press, 2002); Jo Ann Davidson, *Toward a Theology of Beauty: A Biblical Perspective* (University Press of America, 2008); David de Bruyn, "Jonathan Edwards's Synthesis of Definitions of Beauty," *Artistic Theologian* 8 (2020): 75–98; and Junius Johnson, *The Father of Lights: A Theology of Beauty* (Baker Academic, 2020). A recent contribution in science that contains a discussion of theological beauty is Grace Lew, "Teaching the Beauty of God in Computer Programming and Design," *Perspectives on Science and Christian Faith* 73, no. 4 (2021): 220–27, https://www.asa3.org/ASA/PSCF/2021/PSCF12-21Lew.pdf.

[103]Jonathan King, *The Beauty of the Lord: Theology as Aesthetics* (Lexham Press, 2018).

[104]King, *The Beauty of the Lord*, 23.

[105]Hans Urs von Balthasar, *The Glory of the Lord: A Theological Aesthetics,* Volume 1, trans. Erasmo Leiva-Merikakis (T&T Clark, 1998), 80.

[106]Alister E. McGrath, *The Open Secret: A New Vision for Natural Theology* (Blackwell, 2008), 262.

[107]Alister E. McGrath, "Natural Theology," in *St Andrews Encyclopaedia of Theology*, ed. Brendan N. Wolfe et al. (2022), https://www.saet.ac.uk/Christianity/NaturalTheology.

[108]Paul Ewart, "The Physical Sciences and Natural Theology," in *The Oxford Handbook of Natural Theology,* ed. Russell Re Manning, John Hedley Brooke, and Fraser Watts (Oxford University Press, 2013), 421.

[109]McGrath, *The Open Secret,* 268.

[110]Alister E. McGrath, *Re-Imagining Nature: The Promise of a Christian Natural Theology* (Wiley-Blackwell, 2016), 183.

[111]Jason Wilson has drawn upon Alister McGrath's work on truth, beauty, and goodness in his article, "Integration of Faith and Mathematics from the Perspective of Truth, Beauty, and Goodness," *Perspectives on Science and Christian Faith* 67, no. 2 (2015): 100–110, https://www.asa3.org/ASA/PSCF/2015/PSCF6-15Wilson.pdf.

[112]Arthur F. Holmes, "The Closing of the American Mind and the Opening of the Christian Mind: Liberal Learning, Great Texts, and the Christian College," in *Faithful Learning and the Christian Scholarly Vocation,* ed. Douglas V. Henry and Bob R. Agee (Eerdmans, 2003), 112.

[113]Bersanelli and Gargantini, *From Galileo to Gell-Mann,* 250.

[114]Mark A. Noll, *Jesus Christ and the Life of the Mind* (Eerdmans, 2011), 22.

[115]Perhaps there are other guideposts such as God's truth and goodness that would be useful to scholars in seeking theories with more permanence. An indication that one has encountered such a guidepost could be the sense that "they reveal a genuine feature of nature" (Heisenberg), or that "there is something that our mind cannot grasp and whose beauty and sublimity reaches us only indirectly and as a feeble reflection" (Einstein), or that feeling of "eureka!" (Archimedes).

[116]Holmes, "The Closing of the American Mind and the Opening of the Christian Mind," in *Faithful Learning and the Christian Scholarly Vocation*, ed. Henry and Agee, 112.

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The Formation of Scientists and Christian Formation

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This article extends science and faith integration to the process of becoming a scientist and Christian formation or discipleship. A scientist who is a Christian belongs to two communities—faith and science—both grounded in tradition, training, communal understanding, and discovery. To explore the parallels between these two processes, we draw on Étienne Wenger's theory of learning as expressed in his Communities of Practice. *Embedded in an Aristotelian perspective, Wenger's theory aligns with the work of Alasdair MacIntyre and emphasizes practice, community, and tradition, over against propositions. Intentionally mentored undergraduate research, for example, in a Christian context, is a practice that intentionally brings students into both the tradition of science and the Christian tradition. Such programs can become more effective through drawing on the recent work on Christian formation which, in turn, builds on Wenger's theory of learning.*

Keywords: Christian formation, Étienne Wenger, communities of practice, Alasdair MacIntyre, undergraduate research, Lesslie Newbigin

Lesslie Newbigin argued that parallels exist between theological understanding and scientific methods. This article extends the exploration of science and faith to deepen understanding of how the process of science and becoming a scientist might resemble the process of Christian discipleship—that lifelong process of aligning one's life, values, and behavior toward Christ and ministry to the world.

Becoming a scientist is part of a vocational journey for individuals. Likewise, the Christian community often draws on vocational language in reference to the journey of faith. Both processes of transformation include growth in discernment and in the application of information in that growth toward mature understanding.[1] The process of science, in particular, involves the general process of identifying a significant research question that arises out of previous scientific research in a field, the use of the particular methods of a scientific field, the application of standards for evidence in a discipline, and the process of peer review and sharing of results. The specifics may range from one scientific discipline to another, yet each area of science exists within a community that has established standards for itself within this overarching framework.[2]

Scholars such as Tyler Scott found connections between such an understanding of science and faith. He found that students with orthodox views of God who had a deeper understanding of the nature of science were more likely to score higher on complementarism or concordism paradigms in science-theology understanding.[3] However, scholars have done little research on the parallels between

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the methods of science and Christian formation itself. Sir John Templeton, for example, attempted to connect the process of science with theological reflection. He saw scientists as role models for theological reflection through their process of testing hypotheses and developing scientific theories. This process challenges assumptions and requires open-mindedness, resulting in an intrinsically humbling process.[4] Templeton also thought science could contribute to theology by eliminating characteristics such as reliance on models that only partially capture reality. Because theology ultimately is carried out by people, it is unable to clearly and completely capture the elements it attempts to explain. Those elements remain elusive and intangible.[5] Ultimately, Templeton focused on using science to add to our spiritual information as a route to see progress in religion.[6]

Christians fail to perceive the parallels between the process of science and the process of Christian formation whenever discussions of Christian formation remain at the level of ideas and propositions. Paul Scherz suggests that the problem is located in seeing either science or religion only as a set of propositional claims, rather than as practices or ways of life.[7]

Traditions and Communities of Learning

Lesslie Newbigin, drawing on the work of Michael Polanyi, argues that all learning and knowing is an act of faith that asks us to trust the evidence of our eyes and ears, or of individuals who undertake teaching.[8] He states:

> When I say, "I believe," I am not merely describing an inward feeling or experience: I am affirming what I believe to be true, and therefore what is true for everyone. The test of my commitment to this belief will be that I am ready to publish it, to share it with others, and to invite their judgment and—if necessary—correction. If I refrain from this exercise, if I try to keep my belief as a private matter, it is not belief in the truth.[9]

Newbigin goes on to argue that we are responsible for ensuring that what we believe is true for all persons and that this truth will lead to further understanding.[10] Humanity's search for truth is not solitary but rather takes place within a tradition and community that develops skills, practices, and terminology allowing for deeper communal discussion and understanding. Individuals who become part of a scientific community involve themselves in rehearsal, training, and practice as the route to knowing.[11]

Newbigin draws a parallel between the maintenance of the scientific tradition and the Christian tradition. The scientific community depends on the mutual trust scientists have for one another, knowing that the search for truth requires the work of many individual scientists, each who grasps only a small part of the whole. Human knowledge grows through a common understanding of practice within the context of a community. Someone becomes a member of the scientific community through learning to dwell in its tradition—you become a scientist.

Newbigin claims that Christian believers likewise must dwell in the Christian tradition.[12] As in the case of science, he says continued learning requires honoring the authority of the tradition which leads us to decide what claims are implausible and do not deserve serious attention. Individual modification of the tradition must be submitted to the judgment of the Christian community which may debate for many years before reaching a conclusion.[13] To be a Christian and a scientist involves belonging to two communities, and Newbigin would argue that both are grounded in tradition, training, and communal understanding and discovery.

The work of Alasdair MacIntyre, grounded in the Aristotelian tradition, aligns with Newbigin's emphasis on practice, community, and tradition over against propositions.[14] He states that a tradition is historically extended and involves a socially embodied argument. The individual's search is conducted within this context and "the history of a practice in our time is generally and characteristically embedded in and made intelligible in terms of the larger and longer history of the tradition through which the practice in its present form was conveyed to us."[15] Practices within traditions are coherent and socially established activities with long-agreed-upon standards of excellence.[16] MacIntyre further identifies the development of virtue with disciplined practice within a tradition, again focusing on the process and practices rather than assent to a set of propositions. The outcome of the process for individuals is a capacity for judgment and an ability to sort among "the relevant stack of maxims and how to apply them in particular situations."[17]

Humans extend their understanding through this process of being embodied in a tradition. Brad Strawn and Warren Brown see this extended cognition happening where human capacities are enhanced by the tools, persons, and institutions that we encounter and with whom we engage.[18] Thus they make the argument that counter to Western assumptions, the individual is a derivative of the social rather than the social of the individual.[19]

They argue that Christian faith and life exist within a network of relationships that enhance and extend our Christian life beyond individuals.[20] Persons are formed as Christians within the life of the body.[21]

> For us, then, spirituality (if and when we use this word) is the gradual and relational process of being transformed into the image and likeness of Jesus as persons and as groups resulting from experiences of extended (and thus supersized) corporate life.[22]

Drawing on MacIntyre, Strawn and Brown argue that similarities exist between the tradition of science and the Christian theological tradition, as both a process and a protection against intellectual and moral errors.[23] Human advancement of understanding is thus a process that includes individual character formation rather than content.[24] The inherited tradition of communal practice, over against privatized religious beliefs, provides an embedded corrective in both science and the Christian tradition.

Modern empiricism, born out of the Enlightenment, has stripped purpose and direction from our accepted interpretations of science. This empiricism, in turn, removed scientific understanding from the world of virtues and character formation. For Aristotle, what is, and what should be done, were inseparable. For him, the development of practical reasoning was tied to virtue formation and moral decision-making.[25] MacIntyre and others call for a return to a broader and more communal understanding of the creation of knowledge. This communal process of practical reasoning connects to character and faith formation, which express themselves in actions or practices that arise out of moral commitments. MacIntyre does nothing less than ask that we bring the pursuit of scientific truth back into the fold with moral truth and its practice.

The Process of Science and Christian Discipleship

Étienne Wenger's foundational theory of learning, based on his concept of communities of practice, and the high impact practices (HIPs) of undergraduate research in higher education provide an avenue for exploring the connection between the process of science and Christian discipleship. Undergraduate research experiences have long been identified as one of several HIPs in higher education. This type of research involves focused teamwork under the guidance of a faculty member, often leading to joint publications. Researchers have found that HIPs result in enhanced learning for students, including those from historically underserved groups.[26] The reported effectiveness of the HIPs has resulted in support for such programs from many funding sources including the National Science Foundation (NSF), which launched funding for undergraduate research in 1958–1959.[27] The example of major funders such as NSF inspired many other sources to fund undergraduate research projects in and outside the natural and behavioral sciences. In addition to institutional support of research, foundations and individual donors are among the numerous funding sources that contribute to undergraduate research programs. The role of the Council on Undergraduate Research (CUR) in recent years proved pivotal in cultivating and sustaining undergraduate research movements as a form of engaged learning.[28] Other movements, such as the Molecular Education and Research Consortium in Undergraduate Research (MERCURY), which recently celebrated its two-decade history, have contributed significantly to the training of science students in particular fields. These efforts have also shown success in recruiting females and students of color.[29]

While the educational result of such experiences has been studied, scholars have done little research on connections between undergraduate research, theories of the person, learning theory, and Christian faith formation. Harold White alludes to these broader connections when he says, "When does someone become a scientist? When curiosity about something leads to an inquiry for new knowledge."[30] He recognized that the necessary elements for this identity formation existed within the experience of undergraduate research. These elements include problem-based learning: working on complex and real problems within the context of a research team. That team identifies what is not known and develops and implements a research strategy for addressing the unknown and expanding knowledge.

Finally, this learning is tied to dialogue with the larger scientific community.[31] White sees someone becoming a scientist when that individual takes on a particular posture toward life—curiosity and inquiry for new knowledge. Yet, his description of the context within which this happens is much richer than simply listing individual attributes. He points to the need to live out this posture within a community that works together on real-world problems, using strategies and approaches that build upon a tradition and history of knowledge.

Strawn and Brown argue for a parallel between an understanding of this extension of knowledge in science, and the enhancement of the Christian life in *Enhancing Christian Life: How Extended Cognition*

Augments Religious Community. They claim that our Christian understanding, like the tradition of science, is enhanced by countless other persons. The residuals left by their work become embedded in our language, social practices, and culture.[32] We carry out the search for knowledge in community and within the context of various traditions.

Many of the critiques of science fail to address this fundamental communal nature of science. For example, Julia Belluz, Brad Plumer, and Brian Resnick, in their article "The 7 Biggest Problems Facing Science, According to 270 Scientists," portray the scientific process in its ideal form as involving an individual exercise of asking a question; setting up an objective, empirical test; and finding an answer that can be replicated.[33] While they recognize the communal nature of the peer-review process, morality still is seen as embedded in individuals over against a tradition and community.

Likewise, Andrea Saltelli and Silvio Funtowicz lament the decline of the community of scientists whose personal relationships maintained moral standards through peer pressure.[34] They recommend restoring standards in science that expand the community to include more perspectives to help scientists to personally appreciate uncertainty.[35] Paul Tyson, in his work addressing Conor Cunningham's perspective on evolutionary biology, portrays theology as a set of doctrines, but science as provisional.[36] These critiques of science fail to engage with the perspective that both science and the Christian faith are embedded in communities of practice that have traditions, standards for evidence, and processes for apprenticeship.

How do institutions best support the formation of individuals who wish to belong to both scientific and faith communities? Undergraduate research experiences in a Christian context often prove to be particularly effective because of the alignment of the processes of scientific exploration and Christian discipleship, both of which involve communal endeavors that shape identity. Undergraduate research programs at Christian institutions offer unique lenses into the process of students learning to dwell in both the scientific tradition and the Christian faith tradition. Such programs provide a context for engagement in the dialogue between the two traditions. The parallels, clearly articulated by Newbigin, are best viewed through the lens of Étienne Wenger's "communities of practice," a learning theory which posits that, because we are social beings, we learn through social participation in communities.[37] Communities of practice are groups of people who share a concern, a set of problems, or a passion and who deepen their knowledge and expertise by interacting on an ongoing basis.[38] Wenger describes this process of learning as shared histories of learning and interpretation, and a close interaction of order and chaos as we move toward emergent structures and understanding. This process involves doing, experiencing, belonging, and becoming.[39]

Wheaton College, a Christian institution, has established one such program called Wheaton College Summer Research Program. This program, one of many found at faith-based institutions across North America, has the specific goals of fostering both faith formation and scientific exploration.[40] Wheaton's program is an example of one that is intentional about student vocational growth in both science and faith and has assessed student outcomes.[41] One key element in programs that include both science and faith development is regular seminars together as a community of learners. These gatherings often take place weekly. Faculty and students gather to hear presentations from each other, listen to speakers, talk about ethical issues related to their research, pray, and experience fellowship. In addition, participating faculty must be committed to informally engaging with students on issues of faith, vocation, and science as they work together. These features differ from similar programs at secular institutions and other faith-based colleges that are structured to support faculty-student research, but where the focus is more narrowly on the scholarly outcomes of each team rather than on communal experiences across both science and faith.

The Wheaton College program is one that included all the essential elements of an effective undergraduate research program, and was also intentional about faith formation in addition to vocational exploration. Dorothy Chappell, the Wheaton dean when the program was established and a coauthor of this article, carried out a twenty-year (1999–2019) assessment of the program. During these years, the program was overseen by Chappell. Students—primarily in mathematics, natural sciences, or social sciences—collaborated with faculty mentors who engaged them in the faculty member's research and helped students capture a vision for scholarship, while providing mentoring in the faith in the context of a community of Christian scientists.[42] Like other intentional summer research experiences, this program addressed theories and theory formation, the development of hypotheses, the application of theory to the generation and interpretation of data, and professional development through the dissemination

of scholarly outcomes. The faculty involved also had the goal of intentionally modeling the integration of faith and science. They encouraged student mentees to explore ideas in the context of philosophical and theological meaning, language, and historical and cultural contexts.[43]

Chappell, in her report on the program, stated that the goals of the program included the following:

1. To further student knowledge and research skills through engagement with first-rate scholarship in literature and with specialists who are exploring and practicing the theory and applications at the frontiers of their disciplines.
2. To engage students in readings and discussion of the Christian aspects of their disciplines and beyond.
3. To participate with students in spiritual fellowship.
4. To accomplish the outcomes of information dissemination through writing a paper(s) that will be appropriate for a verbal or poster presentation at a professional societal meeting and/or publication in refereed or popular journals.[44]

Essential program components in any effective program are intentionality and commitment to the formation of students. Experiences, as in the Wheaton program, occur during the summer and require full-time investment on the part of the faculty and students. That intensity distinguishes such programs from others in which students have conducted research with faculty during a semester that requires only a portion of each student's time. In contrast, programs like the one at Wheaton award student stipends to allow students to participate in eight to ten weeks of summer research full time so as to foster the characteristics of the creation of a community of practice. Like other such programs, Wheaton's program included weekly brown bag lunch meetings during which all students discussed their projects. In addition, fifty-four percent of the respondents presented their results at professional meetings or through academic publications as coauthors.[45]

In 2020, Chappell compiled the results of surveys of the Wheaton College program participants throughout the preceding twenty-year period. The responses addressed four sets of questions: a set on experiential learning, a set on mentorship, a set on the spiritual development of the students, and a set on the career-research experience. The data set is unique in terms of length and its combination of surveys on both experiential learning measures tied to traditional summer undergraduate research experiences, and spiritual development.[46]

Chappell's summary of survey findings included professional outcomes of the research experience as well as questionnaire results. The surveys paralleled the lenses of Wenger's communities of practice learning theory, with categories including the effectiveness of the experience on participants' increased understanding of the scientific tradition in terms of the research process, their introduction to and training in techniques of science, the collaborative and communal nature of the work, and the process of the communication of discovery within science.[47]

The surveys, using Likert scales, showed strong results in terms of students growing in their understanding of science as a tradition and as a process of exploration that led to the extension of knowledge. Students showed particularly strong agreement (over eighty-five percent) with a statement related to an increased understanding of the culture of an academic discipline. In addition, participants increased their knowledge of both the role of refereed literature as background to research and the relationship of research to the identification of a cutting-edge topic with over ninety-five percent agreement.

The surveys showed evidence of increased confidence in the use of techniques and skills for the development of scholarship with over eighty-five percent of the participants agreeing. To a lesser extent, but still in a strong positive direction, over eighty percent of students agreed that they developed the experience of writing as a scholar. Student growth in self-confidence in the pursuit of a career—a measure of growth in vocational discernment—also showed strong results with over ninety percent agreeing that this was the result of the experience.

Students gained an understanding of science as communal and collaborative. This knowledge was reflected in the strength of agreement (over ninety-eight percent) with the statement: "My mentor served in a strong collaborative role in conducting authentic research."

Communities of practice develop a specialized language that allows for clear and precise communication of ideas. Seventy-five percent of respondents showed agreement that they had grown in the ability to formulate professional and/or formal papers for publication while ninety percent said that they had improved comfort levels and competence in communicating research.

Of the 468 students who participated in the program, 254 (fifty-four percent) presented or published in professional settings.[48]

Chappell's report on the outcomes of the Wheaton program mirrors the results of one of few other studies on the outcomes of research on the communities of practice framework and science engagement done by Rachel Chaffee, Karen Hammerness, Preeti Gupta, Kea Anderson, and Tim Podkul titled, "Re-examining Wenger's Community of Practice Theoretical Framework: Exploring Youth Learning in Science Research."[49] Chaffee et al. included measures of both bonding and bridging as part of their study. Bonding is authentic engagement and mentoring within a community—internal ties within a community. Bridging involves the engagement and identification with a larger group, in this case, the larger scientific community.[50] Bonding and bridging measures parallel the Wheaton measures of internally learning the structure and communal nature of scientific research and externally bridging to the literature and the scientific community through presentations. The Wheaton study and the Chaffee et al. study show increased growth in both bridging and bonding.

Three practices in the Chaffee et al. study were especially effective: designing and planning investigations, analyzing data, and using scientific terms appropriately.[51] Participants who engaged in these practices experienced a stronger sense of belonging, and they developed and deepened their sense of identity as members of the scientific community. They began to imagine themselves as scientists (1) by taking part in a collaborative practice to expand knowledge and produce artifacts, (2) through the growth and application of skills and knowledge, and (3) through increased understanding of the norms that guide the process.[52]

The Wheaton study included survey results related to the overlapping faith community of practice within which the students worked. While the data are less specific to Wenger's categories of understanding tradition, practice, communal understandings of knowledge, and the communal character of communicating discovery, the experience incorporated both fellowship and weekly lunch meetings with the cohort. Survey results showed that over ninety percent agreed or strongly agreed with statements on the presence of fellowship, experiences that led to spiritual development, and discussion of ethical issues related to science and faith. The strongest favorable result was around the question of faculty mentors addressing scholarly work as a valid and valued Christian endeavor (over 95% agreed or strongly agreed).

In the Wheaton program, spiritual formation, the application of faith to work, and the Christian valuing of scientific work were explored in the context of a community that exhibited characteristics of Christian formation. These characteristics merit explanation as they are notoriously difficult to assess. Jennifer Herdt summarized the difficulty. Past assessment efforts limited their emphasis to measuring doctrinal knowledge instead of practice.[53] Her review of the literature also evidenced little consensus surrounding the process of Christian formation and definitions.[54] Wilson Teo, in an earlier literature review laying out the great range of definitions, theological understandings, and desired outcomes related to Christian spiritual formation, found that many are grounded in an individualistic view of formation.[55] Chappell's assessment of spiritual formation, in contrast, was grounded in a communal experience and, though limited, paralleled Herdt's encouragement to develop approaches to Christian formation that are dialogical and foster reflection.[56]

Chappell argued that the Wheaton program showed the importance of relationships, collegiality, and friendship as essential elements in increasing understanding of ethical issues. This is consistent with other assessments that found that, when engaging topics related to faith and science, modeling a communal process of discernment is crucial to learning. Strawn and Brown suggest that such settings contribute to establishing virtues and correcting intellectual and moral errors.[57] Communities of commitment, by having established frames of reference, skills, and traditions, allow for the further exploration of complexity related to issues such as ethics. All these elements—exploration of ethical issues, spiritual formation, application of faith to work, and Christian valuing of scientific work—explored in the context of a community exhibit the characteristics of Christian formation.

Stanley Rosenberg argues that such rich pedagogical contexts as the Wheaton experience, in which two communities of practice—faith and science—overlap, are akin to Charles Malik's *Two Tasks* that call for the forming of the mind among the faithful and forming of faith among scholars.[58] Rosenberg argues that education oriented around information or propositions fosters a simplistic view of integration across communities of practice. He calls for an apprenticeship model of a student working alongside a teacher who is skilled in knowledge-making and discovery. He claims that this

model results in a thickening of knowledge, teaches humility, develops self-awareness, and leads to a greater understanding of the limits of knowledge which allows for problems to be put within their larger historical tradition.[59]

MacIntyre argues that communities of practice are necessary for the development of virtues. Consistent with this, Elaine Howard Ecklund, in her research on scientists and faith, found similar values amongst scientists and communities of faith.[60] She believes that similar virtues arise out of both the science and the faith communities of practice.[61] These results are also consistent with Robert Pennock's findings, that participation in communities was important for the long-term changes in individuals, such as the development of virtues.[62] MacIntyre might argue that the convergence of similar virtues is the natural outcome of the processes of discernment of such communities of practice.

In summary, intense summer undergraduate research programs form students as scientists. They grow in their understanding of science as a tradition, in their ability to use the techniques of science, and in their view of science as a collaborative process that involves the sharing of discovery through particularly defined channels. Students also experience Christian formation in the context of a believing community who are doing science. This context leads to a deeper understanding of ethical issues and the Christian value of work, and thus to forming students as Christians who are in the sciences.

Discussion

James K. A. Smith argues that humans are embodied actors rather than just thinking beings. Human engagement in practice is essential to their full development, and cultural practices—rituals and material practices—shape individual's identities and desires.[63] The process of mentoring students to become scientists and the process of Christian formation are examples of such practices. Erin Smith goes on to argue that an individual's formation involves transformation of self and behavior which in turn reflects changes in brain connectivity and processing. What does it mean to be human? Being human encompasses both internal reflection and externally oriented tasks.[64] The increased intentionality of reflection and task enhances our understanding of ourselves.

But tasks are not done alone. Communities carry out tasks together and, in doing so, enact communal rituals that arise out of a tradition. For example, John Skillen, in his book, *Putting Art (Back) in Its Place*, argues that art is meant to be a reminder of a communal understanding. He goes on to describe that placing art in public spaces, such as churches, frames the communal nature of values. Skillen points out that the meaning of the word liturgy is simply "the work of the people." As individuals and communities carry out various liturgies associated with daily, weekly, or seasonal rituals, they are reminded of their sense of obligation to contribute to the public good or involve themselves in acts of service.[65]

Intentionally mentored undergraduate scientific research in a Christian context and within a Christian community is a cultural practice that brings students into the communal tradition of science as well as the communal Christian tradition of the faith. Adam Laats and Harvey Siegel distinguish between belief and knowledge or understanding.[66] This same distinction can be drawn in both the tradition of science and the Christian tradition. Laats and Siegel say belief typically follows understanding.[67] Rather than focus on propositions and beliefs, a community of practice focuses on the process of understanding within specific traditions.

The process of formation of a scientist and a Christian should move understanding and belief toward closer alignment in each community, built on the nature and role of evidence and reasons in each. This process of formation should also result in virtue development in individuals, where some of these virtues align closely between science and faith communities of practice. For example, Ecklund describes a scientist who was a Christian holding both scientific and theological constructs loosely if they did not account for all the evidence, not due to doubt, but out of an understanding that they possessed a limited viewpoint.[68]

Science and faith communities of practice need each other. David Livingstone, in his book *Putting Science in Its Place*, demonstrates how science is not above culture and does not transcend our particularities. Science is not a disembodied entity but arises out of particular communities.[69] Likewise, he shows how views of science in Christian theological communities have historically been tied to fears related to undermining community identity, particularly related to race.[70] He distinguishes between flashpoints and trading zones. Flashpoints are places in which beliefs—cultural, intellectual, or doctrinal—are so central to a community's identity that when questioned, members of the community have difficulty in building pathways for dialogue with other communities. Paul Scherz suggests that such communities move

fully toward agreement with propositional claims as the only measure for belonging instead of emphasizing practices or ways of life.[71] In contrast, trading zones are spaces of engagement in which communities of practice facilitate fruitful exchange despite the different languages of science and faith.[72] These are places, not necessarily geographic as Livingstone describes, but contexts in which members of different communities of practice dialogue, listen, and learn in the context of deep knowledge of science and deep knowledge of God. In these places, participants may have aspects of their identity challenged, but in the context of communities of practice, they continue to seek God's truth in all things.

Undergraduate research programs within Christian institutions can be powerful trading zones in which young people grow in their identities as scientists and as people of faith. In these overlapping communities, students develop skills, strengthen discernment, and are mentored in the formation of virtues that serve all the communities in which they are members.[73] Another example of a trading zone is the American Scientific Affiliation (ASA). The ASA was founded in 1941 as a professional society of Christians who are in the social and natural sciences.[74] The ASA is a fellowship of Christians in the sciences who have supported its members' spiritual, intellectual, and professional formation to serve society, science, and the church. The ASA supports efforts to interpret, integrate, and communicate discoveries of natural and social science with insights of scripture and Christian theology. The ASA promotes excellence in scholarship and the professional and spiritual formation of its members.

To be a Christian who is a scientist involves belonging to two communities of practice—science and faith—both of which are grounded in tradition, training, communal understanding, and discovery. Undergraduate summer research programs that embed Christian formation into their programs attempt to meld the two together. Such programs can become even more intentional about this integration through drawing on the recent work on teaching Christian formation which, in turn, builds on Wenger's theory of learning. Allen Jackson describes the contribution of teaching to discipleship as a process that transforms a person's values and behavior toward service to others. He says teaching discipleship involves relationships, intentional conversations, and personal discipline.[75] He draws on the model of Jesus for teaching. Jesus's teaching was authoritative and authenticated by life and words. His teaching was not authoritarian in that he did not impose but rather presented the costs of discipleship, and he listened and responded. He required dialogue and for people to engage and think.[76]

Steven Garber, in *Visions of Vocation*, argues that the Hebrew notion of "knowing" involves having responsibility to, or for, something. This responsibility exists in the living out of everyday life. Garber says that this sense of "knowing" is embedded in a covenantal epistemology which is reflected in a relationship/revelation/responsibility dynamic.[77] Undergraduate research programs, like those described in this article, emphasize concepts, require questions, embrace posing problems versus giving reasons, and involve a community working together.[78]

In many models of spiritual formation, Christian discipleship is just one stage in the process for an individual. The process starts with a sense of the spirit, moves toward learning, and then to living out one's faith. Janet Hagberg and Robert Guelich would place undergraduate research in a Christian context as part of their second stage of spiritual formation, a life of discipleship, which they describe as characterized as a time of learning and belonging.[79] They describe the preceding stage as one of awe and a deep sense of love[80] and the stage that follows discipleship as one that involves "doing."[81] The model here argues that formation and learning involve all of these elements working together within the context of a community of practice. That practice goes beyond the engaged spiritual formation of the type described by M. Robert Mulholland, who calls us to a spirituality rooted in a growing relationship with God to address the pain around us.[82] Christian formation requires knowledge, understanding, skill-building, and application together with others.

Faith communities that strongly emphasize individual conversion, and/or propositional truth over virtue development and sanctification, might reflect on what they can learn from the science community of practice to enhance their formation of the next generation. Theologian Sharon Galgay Ketcham says that faith formation involves both learning and doing together. Rituals and communal practices provide coherence and meaning for a community. Christians grow together and faith formation happens while we are doing the Christian faith with others.[83] Learning is *experiencing*. Faith formation occurs when we are learning with others who are making meaning.[84] Learning is *belonging*. Learning together facilitates belonging and comes about through someone contributing to the practice of a group when that person shows increased

understanding and competence, contributing to the community.[85] Learning is *becoming*. Identify formation involves seeing oneself in connection to a community and its practice.[86] Herdt points to the need for further thought around the process and definition of Christian formation followed by the development of measures that align with understanding.[87]

Becoming a scientist, like becoming a Christian, involves a journey that begins with a choice to embed oneself within a community with a common narrative and tradition. Garber describes it as a journey toward coherence, where what we believe is reflected in how we live in the context of our responsibilities and relationships.[88] Through the practice of apprenticeship within this community, individuals are formed in their dispositions, develop virtues, solidify identities, and translate these characteristics into actions.[89] This journey is not individual but involves living out this posture within a community that works together, using strategies and approaches that build upon a long history and tradition, to provide guide rails and wisdom as individuals seek truth, coherence, and wholeness.

Acknowledgment

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Notes

[1]Allen Jackson, "The Contribution of Teaching to Discipleship," in *Teaching the Next Generations: A Comprehensive Guide for Teaching Christian Formation,* ed. Terry Linhart (Baker Academic, 2016), 3–4.

[2]This general statement about the nature of science is not meant to discount the challenges for Christians in engaging with and belonging to some fields of science. Some disciplines are underlain by assumptions that might be antithetical to any religious beliefs and require a materialistic assumption of all reality. This article does not attempt to address these types of challenges which are discipline specific. For example, many social science disciplines are foundationally based on an individualistic view of humans. Methods reflect and are limited by this assumption. For a critique of this particular assumption, see Janel M. Curry and Steve McGuire, *Community on Land: Community, Ecology, and the Public Interest* (Rowman and Littlefield, 2002).

[3]Tyler D. Scott, "A Survey of Science/Theology Paradigms Among Students at a College in the Young-Earth or Old-Earth Creationist Tradition," *Perspectives on Science and Christian Faith* 75, no. 1 (2023): 41–42, https://www.asa3.org/ASA/PSCF/2023/PSCF3-23Scott.pdf.

[4]Peter N. Jordan, "From Soul Science to Spiritual Information: John Templeton on Science and Its Religious Potential," *Theology and Science* 21, no. 2 (2023): 13, https://doi.org/10.1080/14746700.2022.2155908.

[5]Jordan, "From Soul Science," 18.

[6]Jordan, "From Soul Science," 20.

[7]Paul Scherz, *Science and Christian Ethics* (Cambridge University Press, 2022), 2.

[8]Lesslie Newbigin, *The Gospel in a Pluralist Society* (William B. Eerdmans, 1989), 19.

[9]Newbigin, *The Gospel in a Pluralist Society,* 22.

[10]Newbigin, *The Gospel in a Pluralist Society*, 23.

[11]Newbigin, *The Gospel in a Pluralist Society,* 44–45.

[12]Newbigin, *The Gospel in a Pluralist Society,* 49.

[13]Newbigin, *The Gospel in a Pluralist Society,* 50.

[14]Alasdair MacIntyre, *After Virtue* (University of Notre Dame, 3rd edition, 2007).

[15]MacIntyre, *After Virtue*, 222.

[16]MacIntyre, *After Virtue,* 187.

[17]MacIntyre, *After Virtue*, 223.

[18]Brad D. Strawn and Warren S. Brown, *Enhancing Christian Life: How Extended Cognition Augments Religious Community* (IVP Academic, 2020), 2.

[19]Strawn and Brown, *Enhancing Christian Life*, 35.

[20]Strawn and Brown, *Enhancing Christian Life*, 3.

[21]Strawn and Brown, *Enhancing Christian Life*, 5.

[22]Strawn and Brown, *Enhancing Christian Life*, 15.

[23]Strawn and Brown, *Enhancing Christian Life*, 80.

[24]Strawn and Brown, *Enhancing Christian Life*, 96.

[25]MacIntyre, *After Virtue*, 80–84.

[26]The American Association of Colleges and Universities, "High-Impact Practices," accessed March 30, 2023, https://www.aacu.org/trending-topics/high-impact.

[27]Susan Rundell Singer, "Six Decades of the National Science Foundation's Commitment to Undergraduate Research," *SPUR (Scholarship and Practice of Undergraduate Research)* 3, no 2 (2019): 15, https://doi.org/10.18833/spur/3/2/7.

[28]Kerry K. Karukstis, "Analysis of the Undergraduate Research Movement: Origins, Developments, and Current Challenges," *SPUR* 3, no. 2 (2019): 46–55, https://doi.org/10.18833/spur/3/2/8.

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[30]Harold B. White III, "Stimulating Attitudes of Inquiry with Problem-Based Learning," in *Developing and Sustaining a Research-Supportive Curriculum: A Compendium of Successful Practices,* ed. Kerry K. Karukstis and Timothy E. Elgren (Council on Undergraduate Research, 2007), 9.

[31]White, "Stimulating Attitudes of Inquiry," 10–11.

[32]Strawn and Brown, *Enhancing Christian Life*, 74.

[33]Julia Belluz, Brad Plumer, and Brian Resnick, "The 7 Biggest Problems Facing Science, According to 270 Scientists," *Vox,* July 14, 2016, updated September 7, 2016, accessed November 5, 2024, https://www.vox.com/2016/7/14/12016710/science-challeges-research-funding-peer-review-process.

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[35]Saltelli and Funtowicz, "What Is Science's Crisis Really About?," 9.

[36]Paul Tyson, "Can Modern Science Be Theologically Salvaged," *Radical Orthodoxy: Theology, Philosophy, Politics* 2, no. 1 (January 2014): 126.

[37]Étienne Wenger, *Communities of Practice: Learning, Meaning, and Identity* (Cambridge University Press, 1998), 4–5.

[38]Étienne Wenger, Richard McDermott, and William M. Snyder, *Cultivating Communities of Practice: A Guide to Managing Knowledge* (Harvard Business Review Press, 2002), 4.
[39]Wenger, *Communities of Practice*.
[40]For example, Janel Curry oversaw such programs at Calvin University and Gordon College. Similar programs are found across North American in faith-based colleges and universities as well as in secular institutions. NSF also supports faculty research funding that includes these summer research experiences for undergraduates through its RUI program.
[41]Undergraduate research programs across faith-based institutions range in their emphasis on Christian formation. Some such programs replicate programs similar to those found on secular campuses while others have a more extensive emphasis on Christian formation and vocational exploration.
[42]Dorothy F. Chappell, "Research Cultivates Scholars in Training: A Case Study of Effective Faculty Student Collaboration," Wheaton College (IL), unpublished manuscript (June 15, 2020). Used with permission. The original files for the analysis can be found in the Wheaton College Archives as Unprocessed Material for Dorothy Chappell {2020-0021}: five boxes with summer research and grant paperwork. These documents are sealed for 20 years. See http://archives.wheaton.edu/repositories/2/accessions/1761.
[43]Chappell, "Research Cultivates Scholars in Training," 3, 8. Chappell used the Novel Experiential Learning measure which has been used extensively in research across higher education.
[44]Chappell, "Research Cultivates Scholars in Training," 4, 6.
[45]Chappell, "Research Cultivates Scholars in Training," 5.
[46]Chappell, "Research Cultivates Scholars in Training," 8.
[47]Wenger, *Communities of Practice*.
[48]Chappell, "Research Cultivates Scholars in Training," 7–9.
[49]Rachel Chaffee, Karen Hammerness, Preeti Gupta, Kea Anderson, and Tim Podkul, "Re-examining Wenger's Community of Practice Theoretical Framework: Exploring Youth Learning in Science Research," in *How People Learn in Informal Science Environments*, ed. Patricia G. Patrick (Springer, 2023), 15–35.
[50]Chaffee et al., "Re-examining Wenger's Community," in *How People Learn,* 17–18.
[51]Chaffee et al., "Re-examining Wenger's Community," in *How People Learn,* 24.
[52]Chaffee et al., "Re-examining Wenger's Community," in *How People Learn,* 25, 30.
[53]Jennifer A. Herdt, "Problems and Prospects for the Measurement of Christian Seminarian Formation: Spiritual Measurement and the 'Uncertainty Principle,'" *Journal of Spiritual Formation & Soul Care* 16, no. 1 (2023): 16, https://doi.org/10.1177/19397909231151592.
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[55]Wilson Teo, "Christian Spiritual Formation," *Emerging Leadership Journeys* 10, no. 1 (2017): 138–50, https://www.academia.edu/67436476/Christian_Spiritual_Formation.
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[57]Strawn and Brown, *Enhancing Christian Life*, 80.
[58]Stanley P. Rosenberg, "Mission Fit?," *CCCU Advance* (Fall 2022), accessed September 8, 2024, https://www.cccu.org/magazine/mission-fit/.
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[61]Ecklund, *Why Science and Faith Need Each Other*, 21.
[62]Ecklund, *Why Science and Faith Need Each Other*, 33.
[63]James K. A. Smith, *Desiring the Kingdom: Worship, Worldview, and Cultural Formation* (Baker Academic, 2009), 35, 40.
[64]Erin I. Smith, "Neuroscience and Self in Interdisciplinary Dialogue," *Perspectives on Science and Christian Faith* 75, no. 1 (2023): 10–11, https://www.asa3.org/ASA/PSCF/2023/PSCF3-23Smith.pdf.
[65]John E. Skillen, *Putting Art (Back) in Its Place* (Hendrickson Publishers, 2016).
[66]Adam Laats and Harvey Siegel, *Teaching Evolution in a Creation Nation* (University of Chicago Press, 2016), 73.
[67]Laats and Siegel, *Teaching Evolution*, 77.
[68]Ecklund, *Why Science and Faith Need Each Other*, 32.
[69]David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (University of Chicago Press, 2003), 180.
[70]Livingstone, *Putting Science in Its Place,* 155.
[71]Scherz, *Science and Christian Ethics*, 2–3.
[72]David N. Livingstone, *Dealing with Darwin: Place, Politics, and Rhetoric in Religious Engagements with Evolution* (Johns Hopkins University Press, 2014), 200.
[73]More resources, such as the recent book by Justin Barrett, are needed to enhance these programs and increase their intentionality in building coherent communities of practice. See Justin L. Barrett, *How Can Your Faith Fuel Scientific Discovery?* (Blueprint 1543 Media, 2025).
[74]American Scientific Affiliation, accessed November 5, 2024, www.asa3.org.
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[76]Jackson, "The Contribution of Teaching to Discipleship," 6.
[77]Steven Garber, *Visions of Vocation: Common Grace for the Common Good* (InterVarsity Press, 2014), 100–101.
[78]Jackson, "The Contribution of Teaching to Discipleship," 8.
[79]Janet O. Hagberg and Robert A. Guelich, *The Critical Journey: Stages in the Life of Faith* (Sheffield Publishing, 2005), 53.
[80]Hagberg and Guelich, *The Critical Journey*, 58.
[81]Hagberg and Guelich, *The Critical Journey*, 73.
[82]M. Robert Mulholland Jr., *Invitation to a Journey: A Road Map for Spiritual Formation* (InterVarsity Press, 2016), 186.
[83]Sharon Galgay Ketcham, "Faith Formation with Others," in *Teaching the Next Generations: A Comprehensive Guide for Teaching Christian Formation,* ed. Terry Linhart (Baker Academic, 2016), 103–4.
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[85]Ketcham, "Faith Formation with Others," 106–7.
[86]Ketcham, "Faith Formation with Others," 108.
[87]Herdt, "Problems and Prospects," 21.
[88]Steven Garber, *The Seamless Life: A Tapestry of Love & Learning Worship & Work* (InterVarsity Press, 2020), 46.
[89]Scherz, *Science and Christian Ethics*, 3, 115.

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Does Second Peter Require a Global Flood?

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Several recent scholarly treatments of the flood of Genesis navigate dissonance between mainstream science and a global understanding of the ancient deluge by positing a local flood behind the biblical account. However, these analyses specifically address literary and genre aspects of Genesis, and do not resolve the fact that a global perspective on the ancient deluge appears to be important to the rhetoric of 2 Peter 3:3–13, since the flood foreshadows and provides evidence for a future eschatological catastrophe of global/cosmic proportions. This article proposes an exegetical solution to this problem based on the recent treatment of this text by Ryan P. Juza. Juza argues that the passage focuses on the reliability of God's word to effect judgment for wicked humans, and that it portrays the flood as smaller in scope than the anticipated cosmic conflagration. Numerous Jewish interpretations of the flood from the second temple period lend additional historical-cultural plausibility to the sort of interpretation proposed by Juza. It follows that 2 Peter need not present a canonical challenge to a local understanding of the flood.

Keywords: 2 Peter, Genesis, Noah, flood, New Testament, cosmology, conflagration

The great flood narrated in Genesis (chaps. 6–9) is among the most widely known stories of the Bible. From a young age, Sunday school students are presented with images or toys depicting Noah, his ark, and the pairs of animals who were preserved during the great deluge. Older churchgoers often wrestle with the theological and ethical questions that follow from this account of God's sweeping judgment against a wicked generation of humans, or ponder the parallel Jesus draws between the primordial flood and the future coming of the Son of Man (Matt. 24:37–39; Luke 17:26–27).

In science-faith circles, it is likewise well known that the prospect of a global flood presents staggering challenges vis-à-vis a modern, scientifically informed worldview. The various questions covered by interlocution between flood geologists (who argue for a global flood) and more-mainstream scientists (who argue against it) are too extensive to enumerate here, but geologist Carol A. Hill's 2002 article "The Noachian Flood: Universal or Local?" can serve as a suitable survey of the most important issues.[1] In short, the acceptance of a worldwide ancient flood requires one to diverge seriously from mainstream scientific consensus at many points—even then, numerous serious unresolved problems remain.

Science-faith scholars who reject the reality of an ancient global flood have attempted to address the Genesis account in two major ways. The first has to do with the genre classification of the early chapters of Genesis (generally chaps. 1–11). Some scholars classify this portion of Genesis as *myth*. The idea is that the primordial stories are not meant to recount historical events, but rather communicate timeless truths about

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human existence, or make theological contrasts between the one true God of Israel and the polytheistic myths of other ancient Near Eastern cultures.[2] If the flood story of Genesis is considered a myth, then the text can faithfully accomplish its purposes without having to serve as a detailed account of what "really happened."

The second way scholars have attempted to address difficulties with the flood is to argue that a local rather than global flood lies behind the narrative of Genesis. For example, Hill interprets the early chapters of Genesis using her "worldview approach," in which ancient stories are interpreted relative to the worldviews of those who wrote them. Hill understands the biblical deluge as a real local flood that wreaked widespread havoc on the whole of the world that was known to the ancient Mesopotamians who recounted the event to later generations.[3] Hill argues that while a global flood is implausible, it is conceivable that a major ancient flood could have occurred that was essentially confined to the alluvial plain of the Fertile Crescent.[4]

Taking a slightly different approach to the "local flood" idea, Tremper Longman and John Walton understand the Genesis flood as a hyperbolic account of a local event that has been exaggerated for theological purposes.[5] These authors and others classify the early chapters of Genesis as *theological history*, in which real events lie behind the biblical accounts, but they are crafted with a priority on communicating theological truths rather than accurate historical information.[6]

Although the strategies just mentioned are potentially helpful for thinking about Genesis in particular, it must be borne in mind that subsequent biblical texts also mention the flood (see Isa. 54:9; Ezek. 14:12–23; Matt. 24:37–39; Luke 17:26–27; Heb. 11:7; 1 Pet. 3:18–22; 2 Pet. 2:5, 3:5–6), and that claims made about the flood narrative in Genesis may or may not be transferrable to all of these passages. So, if a reference to the flood in one of these other writings also presents a problem to a modern scientific worldview, it is not resolved simply because a problem with Genesis is resolved.

In particular, the second epistle of Peter presents a challenge that to my knowledge has not previously been satisfactorily addressed in science-faith discourse. Peter[7] sets the biblical flood in parallel to the coming day of judgment, which involves a fiery catastrophe and the elimination of ungodly people:

> [I]n the last days scoffers will come, scoffing and indulging their own lusts and saying, "Where is the promise of his coming? For ever since our ancestors died, all things continue as they were from the beginning of creation!" They deliberately ignore this fact, that by the word of God heavens existed long ago and an earth was formed out of water and by means of water, through which the world of that time was deluged with water and perished. But by the same word the present heavens and earth have been reserved for fire, being kept until the day of judgment and destruction of the godless. (2 Pet. 3:3–7)[8]

Here Peter describes the flood as the perishing of the "world" (Gk. *kosmos*), which by Peter's time would have been understood as much larger in scope than the world known to ancient Mesopotamians (or for that matter, the world known at the time when Genesis was composed). Further, Peter sets this event in parallel with an eschatological judgment that involves the disruption of the entire cosmos, seemingly to establish the flood as a precedent for such a cosmic catastrophe.[9] The text of 2 Peter thus presents exegetes with good reasons to understand the flood to be worldwide and comprehensive. So, one can make the case that a global flood is essential to the rhetoric of this passage. In other words, Peter's message is arguably invalidated if a global flood never happened. Suffice it to say, this passage presents an interesting situation for those who would resolve difficulties between science and the Genesis flood by interpreting it as a local flood. This explains why 2 Peter plays a salient role in John C. Whitcomb and Henry M. Morris's seminal text on creation geology, *The Genesis Flood*,[10] and it continues to serve as a key biblical proof text necessitating a global flood in recent discussions.[11]

In this article, I will further explicate the potential problem 2 Peter presents for local interpretations of the biblical flood. I will then propose an exegetical solution to this problem based on the recent treatment of this text by Ryan P. Juza. Juza highlights textual elements of 2 Peter that underscore the greater scope of the eschatological catastrophe in comparison to the flood. The focus of the rhetoric of this passage is not per se that the biblical flood establishes a precedent for cosmic disruption, but that God's word is effectual for both creation and judgment. At multiple points, I will supplement Juza's argumentation along these lines with additional supporting evidence, especially in the form of comparative passages from Jewish sources that represent the literary and cultural world from which 2 Peter emerged. Ultimately, I argue that the exegetical insights here presented give us good reason to conclude that the rhetoric of 2 Peter regarding the biblical flood need not stand as a stumbling block for proposals involving a local understanding of the flood.[12]

It is beyond the scope of this article to build a case for a particular interpretation of Genesis, or to offer a comprehensive argument that twenty-first century Christians should adopt a local understanding of the flood. My goal here is much more specific: I address a lacuna in recent scholarly works that posit a local flood. Specifically, key recent scholarly treatments do not address the challenge presented by 2 Peter.

Further, it is important to clarify at the outset that I do not posit that Peter understood the flood to be local. If we were able to ask Peter how much land he thought the flood covered, I imagine he would say, "all of it," much as he would probably affirm that the sun revolves around the earth and the stars are fixed to a solid celestial structure.[13] The question with which I am concerned is not what Peter thought, but what the rhetoric of this biblical text of 2 Peter necessitates. If the text appeals to the flood to show that God has effected cosmic destruction before, and thus can be expected to do so again, then a local understanding of the flood seems to pose a significant problem vis-à-vis biblical authority. If, as I argue, the text appeals to the flood to attest the reliability of God's word to effect judgment for wicked humans, then a local understanding of the flood does no real violence to the rhetoric of the passage.

Genre Differences Between Genesis and Second Peter

Insofar as recent authors categorize the flood of Genesis as *myth* or *theological history*, this categorization is predicated on an assessment of the genre of Genesis, or at least the initial chapters of Genesis, based on various characteristics of the composition. For example, Longman and Walton's interpretation of the deluge of Genesis relies on the identification of similarities between this material and ancient Near Eastern flood stories like those found in the epics of *Gilgamesh* and *Atrahasis*.[14] They also argue that the flood account is part of a repeating pattern of sin, judgment, and grace that occurs throughout the first eleven chapters of Genesis and establishes the context for God's covenant with Abraham, Isaac, and Jacob.[15]

These aspects of their analysis of the Genesis material do not reasonably apply to the diluvial allusions in 2 Peter, for several reasons. First, although a good case can be made for a literary relationship between the Genesis flood and a tradition of polytheistic ancient Near Eastern flood stories, we have no reason to imagine that the same literary tradition would have been known to the author of 2 Peter.[16] Second, while modern scholars identify a recurring pattern of sin, judgment, and grace in the early chapters of Genesis, it is by no means a given that the author of 2 Peter would have identified such a pattern in the text, as modern literary analysis is conducted under massively different assumptions than ancient biblical interpretation.[17] At the least, we find no indication that such a pattern bears on the references to the flood in the epistle (2 Pet. 2:4–10, 3:3–7), so it is highly questionable whether this aspect of the crafting of Genesis is relevant to 2 Peter. In short, Longman and Walton's analysis of Genesis cannot readily be applied to flood references in 2 Peter.

Following her "worldview approach," Hill posits that the Genesis flood should be understood within the worldview of the ancient Mesopotamians who initially passed on the story. The historical flood was a plausible local flood that covered the alluvial plain of the Fertile Crescent, which potentially constituted the whole of the world as it was known to the people living in that region at the time.[18] So, the flood was worldwide from the perspective of those who experienced it, but not "global" in the sense that modern people understand that term. One might accept this hermeneutical approach to the flood narrative of Genesis, but like Longman and Walton's analysis, it does not seem transferrable to 2 Peter. The epistle says that God did not spare "the ancient *world*" but rather "brought a flood on a *world* of the ungodly" (2:5, emphasis mine), with the result that "the *world* of that time was deluged with water and perished" (3:6, emphasis mine). If the author of 2 Peter understands the flood to have been applicable to the whole world, it is significant that the world as it was known when 2 Peter was written (i.e., around the late first century CE) was much larger than the world imagined by ancient Mesopotamians.

By the time 2 Peter was composed, it was common knowledge among people of high education that the earth was spherical, the approximate size of the globe had been accurately calculated, geographers had mapped roughly all of Europe, many of the North Atlantic islands, and the bulk of Asia and Africa. For that matter, it had been speculated for centuries that additional land masses inhabited by humans could be found beyond the oceans, on other parts of the globe. Although we cannot know with certainty exactly what the author of 2 Peter knew about the earth's shape, size, and geography, the text is sophisticated enough that we can assume someone involved in its production was highly educated, and would have had reasonably up-to-date knowledge of the rudiments of the astronomy and geography of the day.[19] At the least, it is fair to

say that the "world" understood by 2 Peter is substantially larger in scope than the world known to ancient Mesopotamians, or for that matter, anyone involved in the production of Genesis. So, Hill's analysis likewise does little to address the fact that 2 Peter seems to describe a worldwide flood.

In summary, genre analyses of the early chapters of Genesis in general, or the flood narrative of Genesis in particular, potentially provide a fruitful approach to considering this text, but references to the flood in 2 Peter must be considered in their own right, as the nature of this New Testament composition is quite different from Genesis.

Parallels Between Primordial Flood and Eschatological Conflagration

Genre considerations are really a secondary matter when examining whether the flood material found in 2 Peter can accommodate the notion of a local flood. More important is the rhetoric of the text. Most biblical scholars understand the epistle to defend the certainty of future (eschatological) cosmic judgment on the grounds that God already destroyed creation once in response to human sin, so there is no reason to doubt that God will do so again. The eschatological judgment described is clearly global and comprehensive. This is apparent in that "the present heavens and earth have been reserved for fire" (3:7). The text goes on to describe the eschatological catastrophe in greater detail:

> [T]he day of the Lord will come like a thief, and then the heavens will pass away with a loud noise, and the elements will be dissolved with fire, and the earth and everything that is done on it will be disclosed.[20] Since all these things are to be dissolved in this way, what sort of persons ought you to be in leading lives of holiness and godliness, waiting for and hastening the coming of the day of God, because of which the heavens will be set ablaze and dissolved, and the elements will melt with fire? But, in accordance with his promise, we wait for new heavens and a new earth, where righteousness is at home. (2 Pet. 3:10–13)

Peter talks about the heavens passing away, the dissolution of the elements, new heavens, and a new earth. This future judgment is anything but local. It involves a comprehensive transition from present creation to new creation. If the flood serves to confirm this future, global disruption of creation, it would seem that the flood must also be understood globally.[21]

To understand the purpose of appealing to the flood as a parallel to eschatological fire, exegetes commonly turn to the "scoffers" discussed in the passage: "Where is the promise of his coming? For ever since our ancestors died, all things continue as they were from the beginning of creation!" (3:3–4). Most scholars who interpret 2 Peter understand the scoffers' observation in one of two ways.

The less popular of the two major positions is that the scoffers reject the notion of the destructibility of the cosmos because—similar to the Platonic and Aristotelian philosophical schools—they understand the cosmos to be eternal.[22] In this case, the flood demonstrates that the cosmos is indeed destructible. This position necessitates a global understanding of the flood, because the issue in question is the very persistence of the cosmos, and a local flood would not refute the scoffers' view. Indeed, certain scholars posit that the author understands the deluge not merely as a flood that covered the whole earth, but as a watery cataclysm that affected the entire cosmos, including both the heavens and the earth.[23]

The more popular position is that the scoffers reject the notion of the Lord's future appearance because—consistent with the Epicurean school of philosophy—they do not believe in divine intervention.[24] In this case, the flood demonstrates that God does, in fact, intervene in the world, and thus Jesus can return and fulfill God's purpose. A local flood carried out by God would still make this point, but in a sense, this position still involves questions of global scope in that the issue is ultimately whether the creation is open to interruption by God. Those who interpret the scoffers to posit a world closed off from divine intervention generally also understand this passage of 2 Peter to portray the flood as a cosmic-wide event that utterly destroyed the heavens and the earth.[25]

Scholars who articulate this cosmic understanding of the deluge in 2 Peter often appeal to *1 Enoch* 83:3–5 as a parallel within second temple Judaism. This passage, which was probably written during the second century BCE, portrays the biblical flood as a destruction of both the entire earth and the sky above. One can potentially take this as evidence that some Jewish thinkers, from around the time 2 Peter was written, understood the flood to have a more expansive scope than what is explicitly discussed in Genesis.

In sum, our passage of interest in 2 Peter appeals to the flood of Genesis as a justification for expecting a future eschatological cataclysm of comprehensive proportions,

and indeed, describes this flood as a decimation of the "world." The bulk of scholars who study this passage understandably conclude that Peter treats the flood as a cosmic disaster of global scope. If the flood does indeed serve as an example of a global/cosmic catastrophe that confirms the plausibility of a future universal conflagration, then the rhetoric of this passage rests on the global scope of the biblical flood. In other words, we have every reason to expect that God will fulfill the promises that the scoffers call into question (2 Pet. 3:4) because God has brought widespread disaster on creation once before. A local understanding of the flood would then invalidate the rhetoric of this passage, which presumably poses a problem for many Christians who consider 2 Peter to be authoritative scripture. At the least, this passage presents a difficulty to science-faith studies that to my knowledge has not previously been satisfactorily addressed.[26]

The Scoffers and the Reliability of God's Promise

In *The New Testament and the Future of the Cosmos*, Ryan P. Juza analyzes the flood material of 2 Peter in a way that does not rely rhetorically on the premise that the flood had universal ramifications. The particularity of Juza's approach is based partly on his analysis of the scoffers who challenge the hope of the day of the Lord.[27] Whereas biblical scholars generally understand the scoffers to be making a philosophical point about the immutability of the cosmos (see above), Juza argues that, based on what is explicit in the text of 2 Peter 3:3–4, it does not appear that the scoffers are concerned with the indestructability of the cosmos per se. Rather, they observe that creation remains unaltered from its original, created state, and has done so "since our ancestors died" (3:4b; lit., "since the fathers fell asleep"), despite "the promise of his coming" (3:4a).

The majority of scholars understand "the fathers" in reference to the earliest generation of Christians,[28] in which case the argument is not that the world has persisted in its created state for a long time, but that Jesus was expected to return before the first generation of Christians died (cf. Mark 9:1, 13:30; Matt. 16:28, 24:34; Luke 9:27, 21:32), and this had not yet taken place (of course, this position assumes 2 Peter was written by a later author after the death of Peter, not by Peter himself). However, this interpretation is dissatisfying for several reasons.

First and foremost, "the fathers" does not appear as a reference to the first generation of Christians in any first-century writings.[29] By contrast, the New Testament frequently calls Old Testament figures "the fathers" (e.g., Acts 3:13; Rom. 9:5; Heb. 1:1).

Second, several New Testament passages refer to the Old Testament fathers receiving promises (Luke 1:55, 72; Acts 13:32, 26:6–7; Rom. 9:4–5, 15:8), as appears in 2 Peter.

Third, if the concern is that the first Christians died without seeing the Lord's coming, the scoffers' complaint should be that nothing happened *before* the fathers died, not *since* they died.

Fourth, the context suggests that the scoffers question "the words spoken in the past by the holy prophets" (2 Pet. 3:2). In other words, "the fathers" refer to the generation of Israelites to whom the prophets of the Old Testament communicated the promise of the Lord's future appearance, also known as the Day of the Lord.

For these reasons, a significant minority of scholars rightly interpret "the fathers" in reference to the Old Testament patriarchs and prophets.[30]

By the first century CE, when 2 Peter was written, the promise of the coming Day of the Lord had not come to pass over the course of several centuries, despite the fact that many prophecies specifically speak of this day's nearness (see Isa. 13:6; Ezek. 30:3; Joel 1:15, 2:1, 3:14; Obad. 15; Zeph. 1:7, 14).[31] The scoffers appear to understand that "if Jesus had fulfilled God's promise, then the created world would have experienced change from its original state,"[32] and furthermore, they appear to reason that if God's promise were going to be fulfilled, it would have been fulfilled by now. So, 2 Peter suggests that these scoffers are not so much denying a philosophical idea about the immutability of the cosmos as they are challenging the reliability of God's prophetic revelation, and thus, treating the scriptures as though they are open to human interpretation (cf. 2 Pet. 1:20–21).

Juza proposes that Peter's rebuttal to the scoffers is organized into two sections. Verses 3:5–7 address the idea that the continuity of creation proves the prophetic promise to continue unfulfilled, whereas verses 3:8–10 respond to the notion that the long delay of the Day of the Lord indicates unfaithfulness on God's part. It is in the former of these sections that the Genesis flood is discussed, and the point seems to be that "*God's word takes precedence over the created world*. In other words, the validity of God's promise is not dependent on what

can be observed from the created order."[33] So, while 2 Peter 3:5–7 does draw a parallel between the primordial catastrophe wrought by water and the future catastrophe to be carried out by fire, the connection between this pair of events is not that they are two examples of the destructibility of the cosmos, but rather that they both attest the superiority of the Creator's word over creation itself. Notably, Peter explicitly mentions God's word multiple times in this passage: "*by the word of God* the heavens existed" (3:5), "*by the same word* the present heavens and earth have been reserved for fire" (3:7). 2 Peter 3:6 says, "through which the world of that time was deluged with water and perished"; here, the words "through which" (Gk. *di' hōn*) likely refer back to both water and word in verse 3:5, thus explicitly attributing the flood to God's word, as well.[34] If the argument in this passage is the reliability of God's word rather than the destructibility of the cosmos, it is not rhetorically so important that the flood must represent a widespread cosmic destruction. Peter's rhetoric only necessitates that the flood be a significant event carried out in creation by God's mighty word.

The Flood and the Wicked "World"

Second Peter says of God's creation of heaven and earth that "the world of that time was deluged with water and perished" (3:6). The interpretation of this verse hinges on the meaning of the word "world." The typical range of meaning for the English word "world," and the etymological connection between the Greek word *kosmos* and the English "cosmos," readily give the impression that the passage is referring to the whole of creation. However, the Greek word *kosmos* has several shades of meaning not usually applicable to the English word "world." For example, in some contexts, *kosmos* can mean "adornment" (e.g., 1 Pet. 3:3). More importantly for our purposes, the New Testament often uses *kosmos* to connote a morally corrupt human system in its opposition to God.[35] To understand the significance of this usage, one might think of the second part of the commonly quoted Christian phrase, "in the world but not *of the world*."[36] "World" in this second instance is not referring to the material world, but rather to the patterns of behavior characteristic of humanity apart from a commitment to Christ. Likewise, *kosmos* in the sense of corrupt humanity evokes a very different domain of meaning from *kosmos* in the sense of the heavens and the earth.[37]

Scholars often understand "world" in 2 Peter 3:6 to refer to the whole of heaven and earth, which God is said to have created in the preceding verse (3:5), and which is potentially paralleled by the reference to "the present heavens and earth" in the next (3:7).[38] Such an interpretation aligns with the common understanding that the scoffers Peter is discussing are concerned with the immutability of the cosmos (see above). However, Juza rightly argues that "world" in this passage is better understood in reference to wicked humanity at the time of the flood, rather than the cosmos, on several grounds.[39]

First, the Greek word *kosmos*, which lies behind the English translation "world" in 3:6, does not serve as a neutral cosmological term in the other places it appears in 2 Peter. Rather, *kosmos* in this text consistently refers to wicked humanity (see 2 Pet. 1:4, 2:5, 20). If "world" refers to the cosmos as such in verse 3:6, it would be the only place where 2 Peter uses the word in this way rather than in reference to sinful humanity.

Second, verses 3:6–7 set up a parallel between the destruction of the world in the past flood and the destruction of the ungodly in the future fire. In both cases, Greek words built on the root *apol** express the destruction in question (*apollumi*, 3:6; *apōleia*, 3:7). This parallelism lends itself to an equating of the two "destroyed" parties in question, namely "the world" in 3:6 and "the godless" (lit. "the ungodly people") in 3:7.

Third, earlier in 2 Peter, the flood is discussed in the following way: "[God] did not spare the ancient world (*kosmos*), even though he saved Noah, a herald of righteousness, with seven others, when he brought a flood on a world (*kosmos*) of the ungodly" (2:5). This verse makes explicit the connection between the "ungodly" generation that was destroyed by the flood and the language of *kosmos*. So, it should not surprise us if Peter goes on in chapter 3 to use the language of the destruction of the *kosmos* in the flood to refer to the ungodly generation of that day. Indeed, it would be slightly unexpected if *kosmos* in 3:6 is found to carry some other connotation.

Fourth, wherever 2 Peter uses the language of "destruction" or "perishing" (i.e., words from the root *apol**), it is sinful humanity, rather than the broader material creation, that is destroyed (2:1, 3, 3:7, 9, 16). This consistency further supports understanding the destruction of the *kosmos* in 3:6 in reference to the ungodly generation of humans at the time of the flood.

Fifth and finally, Juza points out that when other New Testament texts discuss the flood, they highlight the destruction of ungodly humanity, not cosmic catastrophe (see Matt. 24:37–39; Luke 17:26–27; Heb. 11:7; 1 Pet. 3:20). It is worth adding here that one of these instances, Hebrews 11:7, refers to Noah's condemnation of "the world" (*kosmos*) through his faithfulness, and scholars commonly understand *kosmos* here to connote sinful humanity rather than the physical world.[40] So then, a number of patterns in 2 Peter in particular, and the New Testament in general, support the reading of *kosmos* in verse 3:6 as a reference to the condemnation of ungodly humanity.

In addition to the arguments Juza mentions, I will note further that the flood narrative of Genesis itself makes clear that the deluge was occasioned by pervasive human wickedness, and the goal of the event was the removal of wicked humans from the earth (see Gen. 6:1–7). Although animals are also severely affected by the flood (6:7), nothing in the narrative suggests that God has any problem with the physical creation in general, but rather with humans in particular. So, if 2 Peter 3:6 emphasizes consequences for wicked humans, this is consistent with how Genesis portrays the flood.

Juza is not alone in interpreting *kosmos* in 2 Peter 3:6 in reference to the wicked generation of Noah's day. Many commentators and other exegetes, as well as contributors to multiple Greek lexicons, grant that this word in this text carries the connotation of rebellious humanity.[41]

It is also worth considering that if *kosmos* in 2 Peter 3:6 actually connotes the destruction of ungodly humanity by the flood, rather than the destruction of creation per se, then this fact is congenial to how most Jewish texts of roughly the same era describe the biblical flood. Although the texts of the New Testament are particular in their focus on Jesus Christ and the gospel, and Christians often acknowledge them to be inspired in a way that sets them apart from non-canonical Jewish writings, these biblical compositions nonetheless emerge from the Jewish milieu of the second temple literary period (roughly 200 BCE–200 CE). Thus, our understanding of the New Testament can be aided by comparison with other Jewish writings from this era. Discussions of Noah and the flood are also popular in Jewish texts of this literary period, so we have substantial basis for fruitful comparison. I will only reference the most relevant passages here.

Second temple Jewish writings generally discuss the flood primarily with reference to the purging of wicked humans. For example, a writing from the first century CE called *Biblical Antiquities* recapitulates the story of Noah and the flood (chap. 3). The description of the impending event simply says, "I [the Lord] will establish my covenant with you [Noah], to destroy all those inhabiting the earth" (3:4).[42] No mention is made of any damage to the earth itself, beyond the elimination of wicked humanity (cf. 3:1–3) and the plants that have budded upon the earth (3:3). Curiously, even the decimation of nonhuman animals is not mentioned explicitly.

Philo of Alexandria, a first-century CE Jewish interpreter of the Torah, emphasizes the cleansing away of the wicked generation of humanity and the preservation of creation as a whole. In his *Questions and Answers on Genesis* (2:15), Philo strives to explain that the flood's damage to the earth is superficial and merely removes a problematic generation of corrupt humans, while fundamentally preserving the creation as God initially designed it. He finds confirmation of this in the expression, "every living thing that I have made I will blot out from the face of the ground" (Gen. 7:4) given that it is only "the face of the ground" (i.e., the earth's surface) that is decimated. He takes this portrayal of the flood's superficiality to signal that human, plant, and animal life were not eliminated from existence, but only temporarily wiped out to address the problem of a fickle and impious generation.

Many other texts likewise discuss the deluge with an exclusive emphasis, or at least primary emphasis, on the elimination of wicked humanity rather than the destruction of creation in its entirety.[43] In some cases, the flood is even said to have been a benefit to the earth. For example, a portion of the *Epistle of Enoch* that was written during or before the second century BCE describes the flood as cleansing the earth from all corruption (*1 Enoch* 106:17). The *Genesis Apocryphon*, one of the texts discovered among the Dead Sea Scrolls, likewise describes the flood as God's compassion on the earth since it removed from the earth those who practice violence, wickedness, and deceit (*Genesis Apocryphon* [1Q20], col. 11).

The notion that the flood was ultimately beneficial to the earth demonstrates that the event primarily served to remove wicked humanity and was not understood as a catastrophe of cosmic proportions. Jewish authors may have derived this focus from the comment in Genesis that "Out of the ground that the Lord has cursed [Noah] shall bring us relief from our work and from the toil of our hands" (Gen. 5:29), which potentially suggests that the flood reverses or at least reduces the curse on the

ground that God had pronounced after the transgression of Adam and Eve (Gen. 3:17–19).

That the aforementioned Jewish authors emphasize the flood's function to purge human wickedness from the earth does not imply that they understood the flood to have destructive effects for only humans, still less that they understood the flood to cover the earth partially. The point is rather that they *describe* the flood, first and foremost, as a judgment against wicked humanity and as a cleansing of wicked humanity from the earth.

Specific second temple Jewish texts do exist that attribute to the Genesis flood a broader destructive effect for creation than what is described in the actual text of Genesis. The chief example is *1 Enoch* 83:3–5, which describes the ruin of both the earth and the sky (see above). In addition, *2 Enoch* spends a handful of verses discussing the specifics of the earth's disruption (70:4–9). The text mostly elaborates on the phenomena described in Genesis, but it does add an earthquake that deprives the earth of its strength (70:9). Even in *2 Enoch*, the focus remains on damage to the earth, not the whole of the cosmos, though the emphasis does lie more on the physically destructive aspects of the flood than on the purging of wicked humans, in particular.

Ultimately, comparative evidence from second temple Jewish interpretations of the Genesis flood weighs in favor of the plausibility of the position of Juza and others that 2 Peter 3:6 refers explicitly to the inundation of the "world" of wicked humanity rather than the flooding of the earth in its entirety per se. Such a focus on the judgment of rebellious humanity is thoroughly plausible within the milieu of first-century Jewish literature.

One might object that even if Peter describes the flood as destructive to the "world" of wicked humanity, this still implies a global flood because sinful humans live all over the earth. Indeed, Peter may well have understood that humans lived in multiple hemispheres, and he certainly knew that humans inhabited a much larger portion of the globe than the alluvial plain of the Fertile Crescent (see above). However, it is significant that when "world" (Gk. *kosmos*) describes humanity in its opposition to God in the New Testament, it need not express this idea at a global scale.[44] For example, the prologue to the Gospel of John describes the Son of God coming to the world and not being acknowledged or accepted by "the world" (John 1:10–11). The vast majority of humans living on the earth had no awareness of Jesus during his life. Rather, he was rejected by individuals in a specific region. Likewise, in John's Gospel, Jesus tells the high priest, "I have spoken openly to the world" (18:20), although this action took place in a specific locale (cf. John 15:18, 16:20, 17:14; Heb. 11:7). Interestingly, earlier in 2 Peter, God is said to have "brought a flood on a world of the ungodly" (2:5). The New Revised Standard Version idiosyncratically translates this phrase as "a world of the ungodly" to reflect the absence of the definite article in the Greek text where it would typically precede "world." The absence of the definite article in this passage does not necessarily imply that "a world of the ungodly" (Gk. *kosmōi asebōn*) refers to the ungodly people of a given region rather than of the entire globe, but the passage does lend itself to this interpretation to some extent (cf. 2 Pet. 2:6–8).

Admittedly, most ancient Jewish and Christian interpreters of Genesis presumably understood the flood to cover the entirety of the earth and to eliminate all human and animal life apart from that which was preserved on the ark. I do not intend to posit an ancient Jewish understanding of the flood as local, nor Peter's understanding of the flood along these lines. My point is that the text of 2 Peter 3:6 is sufficiently flexible that it could potentially be interpreted in reference to the elimination of ungodly people in a particular area where intense depravity had broken out. Contrary to the view of many scholars who analyze 2 Peter, the passage need not be understood to exaggerate the scale of the Genesis flood to cosmic proportions.

The Incongruity of the Flood and the Eschatological Judgment

Juza posits that Peter portrays the flood as "*smaller in scope*" than the future, eschatological catastrophe.[45] Although the description of the future event likewise emphasizes the judgment of ungodly humans (see 2 Pet. 3:7, 9, 10, 11, 13, 14), it is clear that the whole of "the present heavens and earth" will be affected (3:7; see above). The ancient act of creation narrated in this passage likewise encompasses both the heavens and the earth (3:5), but Juza notes that the flood is not described in the same cosmological terms. The deluge is said to affect "the world," which probably refers to ungodly humans, rather than the whole of creation per se (see above). Peter does not refer to any act of re-creation or re-ordering after the flood, as might be expected if the flood were understood to involve a total annihilation of the cosmos.[46] Likewise, if the goal of this passage is to show that the cosmos is destructible, we might expect the discussion to elaborate on some cosmological effect of the flood, but to the contrary, we

find language that can readily be understood only in reference to the destruction of the ungodly. Juza thus suggests that "Peter uses the flood story as an analogy for the consummation to identify *the target of God's condemnation* (i.e., ungodly humanity), not the scope of his judgment."[47]

Additionally, Juza points out that the account of creation in this passage, though certainly cosmic in scope, places more of an emphasis on the creation of Earth than on the creation of the heavens. The heavens are simply said to have "existed" long ago, whereas the earth's creation is described at greater length and in greater detail: "formed out of water and by means of water" (2 Pet. 3:5). Further, Peter describes the creation of the heavens with the generic "to be" verb (Gk. *eimi*), but expresses the creation of the earth with the much less common "to form" (Gk. *sunistēmi*), which makes the latter more prominent or "marked" within the sentence.[48] The emphasis on water in the process of Earth's creation obviously also connects this part of the creation account to the flood described in the next clause (3:6).[49] Peter probably places this greater focus on Earth's creation because the flood affected the earth and its inhabitants, but not the heavens. This focus on the earth underscores that our passage does not portray the biblical flood as a cosmic catastrophe (as some have argued), but rather as an act of judgment against the ungodly in which the superiority of God's word over God's creation is apparent.

In addition to the points Juza raises, it is worth noting that Peter refers to the destruction of Sodom and Gomorrah as "an example of what is coming to the ungodly" (2:6, cf. 2:7–10), which presumably alludes to the same eschatological catastrophe discussed in chapter three.[50] This passage potentially serves as a parallel to the flood/fire comparison in that a local event from the book of Genesis establishes a pattern of God's future, comprehensive judgment against ungodly people.

Something of an analogy to the disproportion of past and future judgment in 2 Peter can also be found in Hebrews, where the author contrasts the shaking of the earth by the voice of God at Sinai with the greater eschatological shaking of both Earth and heaven: "At that time his voice shook the earth; but now he has promised, 'Yet once more I will shake not only the earth but also the heaven'" (Heb. 12:26; cf. 12:27–28; Hag. 2:6). The world has seen God's power, but the decisive work of God on Earth in the past is nothing compared to the disruption that the Lord's Day of Judgment will bring to all of creation.

Looking again to second temple Jewish writings, we find a handful of texts that parallel 2 Peter in placing emphasis on the earth's judgment in the flood in a way that rules out a comprehensive, creation-wide scope. Such references lend plausibility to Juza's interpretation by showing that it is at home in the literary world from which 2 Peter emerged.

Philo states that the waters of the flood filled the bulk of the area normally taken up by the air, apart from a small portion near the moon.[51] Consistent with the first-century intellectuals of the Greco-Roman world, Philo understood the earth to be a stationary sphere surrounded by a much larger rotating celestial sphere on which the stars were fixed. In the space between the earth and the celestial sphere were various concentric spheres that respectively contained the moon, Mercury, Venus, the sun, Mars, Jupiter, and Saturn. The air occupied the area between the surface of the earth and the orbit of the moon.[52] Philo's point, then, is that the flood waters fully and thoroughly covered the earth, to the point that even most of the air was affected, but everything beyond the realm inhabited by humans—namely the moon, sun, planets, and stars—was totally unaffected.

The first book of the *Sibylline Oracles* elaborates on the biblical flood story, stating that God caused thick clouds to block out the sun, moon, and stars from view by terrified mortals (1:217–18); the author subtly indicates that the heavenly bodies themselves were unaffected by the deluge. In other words, the disaster focuses on the human habitation, not the whole of creation.[53] In addition, several other Jewish texts explicitly identify the dry ground as the target of the flood's destruction,[54] emphasizing the terrestrial scope of the event.

One other text is worthy of mention here. In a passage recounting the promise that Abraham would inherit the land of Israel, *Biblical Antiquities* states that God preserved the land of Israel during the flood, and did not allow the waters to destroy it:

> [I] will bring [Abraham] into the land upon which my eye has looked from of old, when all those inhabiting the earth sinned in my sight and I brought the water of the flood and I did not destroy it but preserved that land. For neither did the springs of my wrath burst forth in it, nor did my water of destruction descend on it. (7:4)[55]

It is by no means a given that Peter was aware of the idea that the flood did not affect the Promised Land, and of course, the notion that God preserved one special land from the flood is quite different from the position proposed by certain modern scholars that the flood could have been limited in scope to the alluvial plain of Mesopotamia, but at the least, *Biblical Antiquities* serves as a vivid example of how second temple Jewish writings often understand the biblical flood as far from cosmic in scope.

Again, an examination of Jewish sources from the second temple literary period confirms that Juza's interpretation of 2 Peter is at home in the Judaism of the time. Jewish authors often understood the flood to be an event that temporarily affected the surface of the dry ground of the earth, rather than a cosmic cataclysm that completely reset creation.

Juza's argument that Peter portrays the pending eschatological conflagration as greater in scope than the ancient flood is relevant for my purposes because it implies that a local understanding of the flood does not do violence to the logic of 2 Peter. The comparatively limited nature of the flood confirms that Peter's point is not to argue that this primordial event sets a precedent for cosmic catastrophe. Rather, the deluge demonstrates that God's powerful word has effected judgment against rebellious humanity and thus can be expected to do so again. If we imagine that wicked humans were destroyed by a regional flood that was initiated by God's word, such an occurrence would still serve Peter's purposes in bringing up the event in 3:5–7. The sorts of proposals scholars like Hill as well as Longman and Walton have offered do not render the rhetoric of this New Testament text invalid.

Conclusion

This article has focused on one specific passage of the New Testament, but my analysis fits into a larger academic conversation about whether and how Christians might reconcile biblical material concerning the ancient flood with the insights of modern geology, hydrology, and other scientific fields. Typical approaches to Genesis give the impression that the Christian must either dismiss the flood as a mere myth spawned from ancient naïveté about the natural world, or discard mainstream scientific insights while clinging tightly to a traditional understanding of the biblical account. The sort of approach represented recently in scholarly contributions from Hill and from Longman and Walton constitutes a third way that gives due consideration to both science and scripture.

In similar fashion, standard treatments of 2 Peter leave one with the impression that they must either dismiss Peter's account of the flood as an untenable, culturally contingent ancient perspective or adopt a fringe understanding of the natural world to remain faithful to a classical view of the biblical text. The approach I have proposed (largely inspired by Juza's exegetical analysis) likewise offers a way forward that sacrifices neither science nor scripture in favor of the other. This could be considered an instantiation of the "two books" understanding of divine revelation, in which nature and scripture both reveal God to humans in different ways. Although these "two books" generally share little overlap, on the rare occasion that they appear to contradict one another, the faithful Christian thinker should look for some path to reconciliation, rather than discarding one in favor of the other. Such an approach is consistent with the best of the Christian tradition concerning the resolution of dissonance between the typical understandings of scripture and the natural world during a given era.[56]

Notes

[1]Carol A. Hill, "The Noachian Flood: Universal or Local?," *Perspectives on Science and Christian Faith* 54, no. 3 (2002): 170–83, https://www.asa3.org/ASA/PSCF/2002/PSCF9-02Hill.pdf. See also Carol A. Hill, *A Worldview Approach to Science and Scripture* (Kregel Academic, 2019), chap. 7; Stephen O. Moshier, "Proposition 15. Geology Does Not Support a Worldwide Flood," in *The Lost World of the Flood: Mythology, Theology, and the Deluge Debate*, ed. Tremper Longman III and John H. Walton (IVP Academic, 2018), 150–61; and Paul H. Seely, "Noah's Flood: Its Date, Extent, and Divine Accommodation," *Westminster Theological Journal* 66 (2004): 291–311. Earlier iterations of this same basic disagreement are well summarized by Bernard Ramm, *The Christian View of Science and Scripture* (Eerdmans, 1955), 171–249.

[2]E.g., Denis O. Lamoureux, *Evolutionary Creation: A Christian Approach to Evolution* (Wipf & Stock, 2008), 177–282; Daniel C. Harlow, "After Adam: Reading Genesis in an Age of Evolutionary Science," *Perspectives on Science and Christian Faith* 62, no. 3 (2010): 181–87, https://www.asa3.org/ASA/PSCF/2010/PSCF9-10Harlow.pdf; and Peter Enns, *The Evolution of Adam: What the Bible Does and Doesn't Say About Human Origins*, 2nd ed. (Brazos, 2021), 60–90. Each of these treatments has particular nuances, and I have sought to address only the basic strategy employed.

The categorization of the flood account as "myth" was significantly catalyzed by the discovery of the *Epic of Gilgamesh*, which was initially published by Assyriologist George Smith ("The Chaldean Account of the Deluge," *Transactions of the Society of Biblical Archaeology* 2 [1873]: 213–34), though prior to this discovery, scholars suspected that ancient Near Eastern parallels to the Genesis flood

might be found, based on evidence for such traditions preserved in fragments of the third-century BCE Babylonian author Berossus. See George Smith, *The Chaldean Account of Genesis: Containing the Description of the Creation, the Fall of Man, the Deluge, the Tower of Babel, the Times of the Patriarchs, and Nimrod; Babylonian Fables, and Legends of the Gods; From the Cuneiform Inscriptions* (Scribner, Armstrong, 1876), 1–2. Of course, identifying Genesis as an adaptation of earlier flood traditions like that found in the *Epic of Gilgamesh* does not rule out the possibility that such accounts stem from some historical event.

[3]Hill, *Worldview Approach*, 71–87, 167–68; cf. Hill, "Noachian Flood." Although Hill represents a recent articulation of this idea, academic debate over whether the flood can be understood as local extends back to the nineteenth century, when geological discoveries came to call seriously into question the assumption of a worldwide flood. For a nineteenth-century discussion of pertinent scholarship, see John William Dawson, *The Meeting Place of Geology and History* (Revell, 1894), 121–54. Even before this, Edward Stillingfleet argued for a flood confined to the lands inhabited by primordial humans (which to his understanding excluded North and South America, Australia, and perhaps portions of the other continents) as early as the mid-seventeenth century (Stillingfleet, *Origines Sacrae, or, A Rational Account of the Grounds of Christian Faith: As to the Truth and Divine Authority of the Scriptures, and the Matters Therein Contained*, 2nd ed. [Henry Mortlock, 1663], 538–51).

Ramm (*View*, 239–40) differentiates between three versions of a local flood position in the history of this discourse, each of which confine the flood to Mesopotamia. First, some imagine that humanity had not moved beyond Mesopotamia at the time of the flood (e.g., Marcus Dods, *The Book of Genesis,* volume one of the Expositor's Bible Commentary [Armstrong and Son, 1903], 55–57; and Arthur C. Custance, *The Flood: Local or Global?* [Zondervan, 1979], 13–63). Second, George Frederick Wright posits that the ice age killed off humanity outside of Mesopotamia, and the melting ice led to a flood that overwhelmed the last remaining human habitation (Wright, "The Deluge of Noah," in *International Standard Bible Encyclopedia*, ed. James Orr, 5 vols. [Howard-Severance, 1915], 2:821–26). Third, some understand Genesis to describe a local Mesopotamian flood in universal terms. This view, which represents Ramm's own position (*View*, 238–49), acknowledges that humans inhabited other parts of the world not affected by the flood (cf., e.g., Dawson, *Place*, 151–54; and Walter S. Olson, "Has Science Dated the Biblical Flood?," *Zygon* 2 [1967]: 272). This third position aligns most readily with twenty-first-century scientific consensus, and represents the most recent local flood treatments, including those I engage in this article.

[4]See Carol A. Hill, "Qualitative Hydrology of Noah's Flood," *Perspectives on Science and Christian Faith* 58, no. 2 (2006): 120–29, https://www.asa3.org/ASA/PSCF/2006/PSCF6-06Hill.pdf.

[5]Tremper Longman III and John H. Walton, *The Lost World of the Flood: Mythology, Theology, and the Deluge Debate* (IVP Academic, 2018), 36–41.

[6]E.g., Denis Alexander, *Creation or Evolution: Do We Have to Choose?* (Monarch, 2008), chap. 10; C. John Collins, *Did Adam and Eve Really Exist? Who They Were and Why You Should Care* (Crossway, 2011); John H. Walton, *The Lost World of Adam and Eve: Genesis 2–3 and the Human Origins Debate* (InterVarsity, 2015); Longman and Walton, *Flood*; and William Lane Craig, *In Quest of the Historical Adam: A Biblical and Scientific Exploration* (Eerdmans, 2021), 35–203. William VanDoodewaard discusses at length the history of academic discourse on the historicity of the early chapters of Genesis and their genre classification in *The Quest for the Historical Adam: Genesis, Hermeneutics, and Human Origins* (Reformation Heritage, 2015).

[7]For the sake of convenience, I will refer to the author of 2 Peter as "Peter," as is conventional in New Testament scholarship. This is not meant to suggest anything about the historical authorship of 2 Peter, which is irrelevant to my purposes.

[8]All quotations of scripture are taken from the New Revised Standard Version.

[9]The extent to which 2 Peter imagines the annihilation versus the renewal of the cosmos is a matter of significant academic debate, although most of the influential scholarly voices favor renewal over annihilation. For discussion, see, e.g., J. Richard Middleton, *A New Heaven and a New Earth: Reclaiming Biblical Eschatology* (Baker Academic, 2014), 189–98; and Ryan P. Juza, *The New Testament and the Future of the Cosmos* (Pickwick, 2020), 205–47. The distinction between these positions is not crucial for my purposes, but I say "disruption" here to capture that, despite the extreme catastrophic language Peter uses, I imagine both continuity and discontinuity between the present creation and the new creation.

[10]John C. Whitcomb and Henry M. Morris, *The Genesis Flood: The Biblical Record and Its Scientific Implications* (Baker, 1961), 14, 15, 88, 271, 451–53.

[11]E.g., Marcus R. Ross, "The Recent Adam and Eve View: A Modern Young-Earth Approach," in *Perspectives on the Historical Adam and Eve: Four Views*, ed. Kenneth D. Keathley (B&H Academic, 2024), 164–65.

[12]Seely ("Noah's Flood") distinguishes between "concordist" interpretations that attempt to show that Genesis *describes* a local flood and his own position, which imagines *divine accommodation* at work in the Genesis account of a global flood that is rooted in a real local event. The proposals of Hill as well as Longman and Walton are roughly consistent with this latter category, though my goal here is not to adjudicate between the various treatments of Genesis.

Juza's analysis of 2 Peter does not address the question of a local flood, but rather makes the case that "*Peter does not elaborate on the cosmological effect of the flood*" and thus does not intend to prove the destructibility of the cosmos (*New Testament*, 225, emphasis original). In this article, I bring Juza's exegetical analysis to bear on the question of whether the rhetoric of 2 Peter falls apart if one understands the flood to be local.

[13]On the New Testament authors' understanding of the structure of the cosmos, see William Horst, "Did the New Testament Authors Believe the Earth Is Flat?," *Perspectives on Science and Christian Faith* 75, no. 3 (2023): 162–79, https://www.asa3.org/ASA/PSCF/2023/PSCF12-23Horst.pdf.

[14]Longman and Walton, *Flood*, 53–87.

[15]Longman and Walton, *Flood*, 100–111.

[16]Peter may well have been familiar with the Greek tradition of Deucalion's flood, though this account does not present parallels nearly as close to Genesis as the epics of *Gilgamesh* or *Atrahasis*. See Hesiod, *Catalogue of Women* fragments 2–7; Pindar, *Olympian Odes* 9:41–61; Plato,

Timaeus 22b–c and *Critias* 112a; Apollonius of Rhodes, *Argonautica* 3:1086; Virgil, *Georgics* 1:62; Gaius Julius Hyginus, *Fables* 153; Dionysius of Halicarnassus, *Roman Antiquities* 1:17:3; Ovid, *Metamorphoses* 1:318–437, 7:356; and Plutarch, *Life of Pyrrhus*, 1.

[17]For an introduction to key characteristics of biblical interpretation during the second temple period, see Lidija Novakovic, "The Scriptures and Scriptural Interpretation," in *The World of the New Testament: Cultural, Social, and Historical Contexts*, ed. Joel B. Green and Lee Martin McDonald (Baker Academic, 2013), 85–101.

[18]Hill, *Worldview Approach*, 72–73, 167–68; cf. 71–87.

[19]On this and the preceding points, see Horst, "Authors," 162–79.

[20]Ancient manuscript evidence is divided over whether 2 Peter 3:10 should end with "will be disclosed [lit., found]," "will not be found," or "will be burned up." For discussion, see Juza, *New Testament*, 207–10. For my purposes, the distinction is not crucial.

[21]Scholars generally agree that the future judgment described in 2 Peter is global/cosmic. One exception is Peter J. Leithart, *The Promise of His Appearing: An Exposition of Second Peter* (Canon, 2004), who argues for a "preterist" interpretation in which the cataclysmic language describes a first-century event, rather than an eschatological one. I do not find Leithart's analysis persuasive for several reasons. First, he interprets expressions of the imminence of events woodenly, whereas the New Testament pervasively describes eschatological events as coming soon. Second, he presumes that the "fathers" of 2 Peter 3:4 must be the first generation of Christians, whereas a better case can be made that they represent figures of the Old Testament (see below). Third, his argument rests on a textual variant of 2 Peter 3:10 that is plausible but not definitive (see note 20).

The linking in 2 Peter between primordial flood and eschatological fire has some notable parallels within second temple Judaism. Both *Life of Adam and Eve* 49–50 and Josephus, *Jewish Antiquities* 1:70–71 narrate the creation of pillars that recount the story of Adam and Eve, and which are made to withstand God's judgment in the form of both flood and fire. The burning imagined seems not to be eschatological per se, as the purpose is to preserve knowledge of primordial humanity for later generations. The *Epistle of Enoch* (1 Enoch 102:1), Pseudo-Sophocles (Fragment 2), and the *Thanksgiving Hymns* (1QH 11:29–36) arguably all subtly cast eschatological fire as a repetition of the primordial flood; see Edward Adams, *The Stars Will Fall from Heaven: Cosmic Catastrophe in the New Testament and Its World* (T&T Clark, 2007), 64–71. M. R. James, trans., *The Biblical Antiquities of Philo: Now First Translated from the Old Latin Version* (Ktav, 1971), 3:9–10, also connects the flood with eschatological resurrection and judgment (though fire is never mentioned), in that God's promise not to interrupt the cycle of seasons (Gen. 8:21–22) becomes a promise not to destroy the cycle of seasons *until* the day of judgment and new creation. Adams (*Stars*, 118–19) notes a few references within Roman Stoicism to parallel cataclysms by water and fire (Seneca, *Natural Questions* 3:27, 29 and *On Consolation* 26:6; cf. Origen, *Against Celsus* 4:64).

[22]Charles Bigg, *A Critical and Exegetical Commentary on the Epistles of St. Peter and St. Jude*, 2nd ed. (T&T Clark, 1902), 292; Daniel von Allmen, "L'apocalyptique juive et le retard de la parousie en II Pierre 3,1–13," *Revue de Théologie et de Philosophie* 16 (1966): 257; Adams, *Stars*, 206–9; Edward Adams, "'Where Is the Promise of His Coming?' The Complaint of the Scoffers in 2 Peter 3.4," *New Testament Studies* 51 (2005): 106–22; and Jörg Frey, *The Letter of Jude and the Second Letter of Peter: A Theological Commentary* (Baylor University Press, 2018), 381–84. On the identity of the "scoffers" in 2 Peter, see also recently David K. Burge, "A Sub-Christian Epistle? Appreciating 2 Peter as an Anti-Sophistic Polemic," *Journal for the Study of the New Testament* 44 (2021): 310–32, though Burge does not specifically address the scoffers' doubt in the promise of the Lord's coming, and a "sophist" could potentially be influenced by any number of schools of thought.

[23]E.g., Tord Fornberg, *An Early Church in a Pluralistic Society: A Study of 2 Peter* (Lund: CWK Gleerup, 1977), 66; and Adams, *Stars*, 214.

[24]See, e.g., Jerome H. Neyrey, "The Form and Background of the Polemic in 2 Peter," *Journal of Biblical Literature* 99 (1980): 407–31; Richard J. Bauckham, *Jude, 2 Peter,* in Word Biblical Commentary 50 (Word, 1983), 293–95; Steven J. Kraftchick, *Jude, 2 Peter,* in the Abingdon New Testament Commentaries series (Abingdon, 2002), 153; Ben Witherington III, *Letters and Homilies for Hellenized Christians: A Socio-Rhetorical Commentary on 1-2 Peter,* book 2 in the Letters and Homilies Series (IVP Academic, 2007), 372; Gene L. Green, *Jude and 2 Peter,* in Baker Exegetical Commentary on the New Testament series (Baker Academic, 2008), 318; cf. Thomas Scott Caulley, "The False Teachers in Second Peter," *Studia Biblica et Theologica* 12 (1982): 27–41. Neyrey shows that several second temple Jewish writings articulate roughly the Epicurean position on this matter, or evidence engagement with such a Jewish view. Some Epicureans did expect cosmic destruction, but the event would be rooted in a theory of physics, not a notion of divine intervention (see Adams, *Stars*, 109–14).

[25]E.g., Bauckham, *Jude*, 298–99; Kraftchick, *Jude*, 157; Earl J. Richard, *Reading 1 Peter, Jude, and 2 Peter: A Literary and Theological Commentary* (Smyth and Helwys, 2000), 378; and John Dennis, "Cosmology in the Petrine Literature and Jude," in *Cosmology and New Testament Theology*, ed. Jonathan T. Pennington and Sean M. McDonough (T&T Clark, 2008), 173–75.

[26]That this issue is not sufficiently addressed in science-faith discourse is pointed out in William Horst, "The Bible as a Two-Testament Collection of Writings in Science-Faith Dialogue," *Theology and Science* 22 (2024): 696, https://www.tandfonline.com/doi/full/10.1080/14746700.2024.2399896.

[27]Juza, *New Testament*, 214–18.

[28]E.g., Fornberg, *Early Church*, 62–63; Bauckham, *Jude,* 290–93; David G. Horrell, *The Epistles of Peter and Jude* in Epworth Commentaries (Epworth, 1998), 176; Witherington, *Commentary*, 372; and Frey, *Letter*, 382–83.

[29]The earliest possible examples come from two post-biblical Christian texts, *1 Clement* 23:3 and *2 Clement* 11:2, written by Clement, a bishop of the church in Rome, to the church in Corinth, but the context does not make clear which "fathers" are in mind.

[30]See Bigg, *Commentary*, 292–93; Thomas R. Schreiner, *1, 2 Peter, Jude,* in the Christian Standard Commentary series (Broadman & Holman, 2003), 372–74; Green, *Jude*, 317–18; Adams, "Promise," 111–14; Peter H. Davids, *The Letters of 2 Peter and Jude,* part of The Pillar New Testament Commentary (Eerdmans, 2006), 265–67; and Juza, *New Testament*, 215–16.

[31]Adams, *Stars*, 205.

[32]Juza, *New Testament*, 217.

[33]Juza, *New Testament*, 227. Emphasis original.

[34]English translations of this passage commonly rearrange the word order for the sake of eloquence, with the result that "out of water and by means of water" in 2 Pet. 3:5 immediately precedes "through which" in 3:6. This rendering lends itself to understanding "through which" to refer back to the two references to water in 3:5, but in the Greek text, the last words of 3:5 are "by the word of God." One would naturally understand "through which" simply to refer to God's word, except that "through which" is plural in the Greek, and "the word of God" is singular. Thus, exegetes typically favor understanding "through which" in reference to both water and word, e.g., David M. Russell, *The "New Heavens and New Earth": Hope for the Creation in Jewish Apocalyptic and the New Testament* (Visionary, 1996), 189; and Adams, *Stars*, 213. Bauckham, *Jude,* 298, rightly notes that this interpretation leads to a "neat parallelism" in verses 5, 6, and 7, each of which then recounts actions carried out (1) by God's word and (2) by means of water/fire.

[35]Cf. Walter Bauer, Frederick W. Danker, William F. Arndt, and F. Wilbur Gingrich, *A Greek-English Lexicon of the New Testament and other Early Christian Literature*, 3rd ed. (University of Chicago Press, 2000), 562. See, e.g., Matt. 18:7; Luke 12:30; John 1:10; Rom. 11:15; 1 Cor. 11:32; 2 Cor. 5:19; Eph. 2:2; Col. 2:20; Heb. 11:38; James 4:4; and 1 John 2:16.

[36]The phrase "in the world but not of the world" comes from the *Address to Diognetus* 6:3, a second-century Christian text, though Christians often repeat these words without awareness of the source.

[37]More technically, these two meanings of *kosmos* are associated with two different "semantic domains." Johannes P. Louw and Eugene A. Nida place *kosmos* in the sense of "universe" in the semantic domain of "Geographical Objects and Features" (*Greek-English Lexicon of the New Testament: Based on Semantic Domains*, 2nd ed., 2 vols. [United Bible Societies, 1989], 1:1), and *kosmos* in the sense of "world system" in the semantic domain of "Behavior and Related States" (entry 41.38, 1:507). One might be tempted to say that the latter of these senses is a kind of metaphorical extension of the former, and thus it might be reasonable to imagine that Peter intends both senses at once, but to the contrary, Louw and Nida note that "it is this radical distinctiveness in semantic domains which is in a sense the essence of metaphorical meanings" (1:xviii). Likewise, the phrase "in the world but not of the world" is so impactful because it juxtaposes two very different semantic meanings of "the world."

[38]E.g., Adams, *Stars*, 214; Fornberg, *Early Church*, 66; Bauckham, *Jude*, 298–99; Davids, *Letters*, 271; and Horrell, *Epistles*, 177.

[39]Juza, *New Testament*, 223–24.

[40]E.g., James Moffatt, *A Critical and Exegetical Commentary on the Epistle to the Hebrews* (T&T Clark, 1924), 168; William L. Lane, *Hebrews 9–13* (Word, 1991), 340; and Peter T. O'Brien, *The Letter to the Hebrews* (Eerdmans, 2010), 408–10. Some commentators appeal to Jewish texts that depict Noah as a preacher of righteousness who called the ungodly world to repentance (Josephus, *Jewish Antiquities* 1:74; *Sibylline Oracles* 1:125–36; *Jubilees* 7:20; cf. *1 Clement* 7:6).

[41]E.g., Hermann Sasse, "κόσμος," *Theological Dictionary of the New Testament*, ed. Gerhard Kittel and Gerhard Friedrich, 10 vols. (Eerdmans, 1964–1976), 3:890; Horst Balz "κόσμος," *Exegetical Dictionary of the New Testament*, ed. Horst Balz and Gerhard Schneider, 3 vols. (Eerdmans, 1990–1993), 2:311; Bigg, *Commentary*, 294; Schreiner, *Peter*, 377; Green, *Jude*, 321; and Witherington, *Commentary*, 374.

[42]M. R. James, trans., *The Biblical Antiquities of Philo: Now First Translated from the Old Latin Version* (Ktav, 1971), ad loc.

[43]*1 Enoch* 54:7–10; *3 Maccabees* 2:4; *Wisdom of Solomon* 10:4; Philo, *On the Life of Abraham* 41–44; *Sibylline Oracles* 1:131; 2:230; *Testament of Naphtali* 3; and Josephus, *Jewish Antiquities* 1:75.

[44]Cf. Bauer et al., *Lexicon*, 562.

[45]Juza, *New Testament*, 224, emphasis original. Cf. pp. 222–25. Also Schreiner, *Peter*, 377; and Green, *Jude*, 321.

[46]Juza, *New Testament*, 224.

[47]Juza, *New Testament*, 225, emphasis original.

[48]That *sunistēmi* appears in the perfect tense in 2 Peter 3:5 also lends it an emphasis within the sentence.

[49]At the most basic level, *sunistēmi* expresses the notion of gathering together or collecting (Bauer et al., *Lexicon*, 972–73), so the phrase "formed out of water and by means of water" probably intends to evoke the description of Earth's creation in Genesis: "Let the waters under the sky be gathered together into one place, and let the dry land appear" (1:9). On the significance of this language, see further Juza, *New Testament*, 222–24; and Schreiner, *Peter*, 375–76.

[50]See Fornberg, *Early Church*, 43.

[51]Philo, *On the Life of Abraham,* 44.

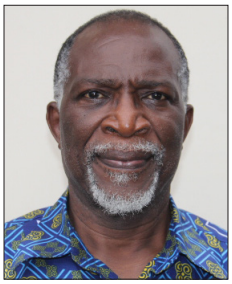
[52]See Philo, *On Dreams* 1:134; *On the Creation* 54, 70, 113, 126; *Allegorical Interpretation* 1:8; *On the Cherubim* 22; *Who Is the Heir?* 221–24, 233; *On the Preliminary Studies* 104; *On the Life of Moses* 2:103; *On the Decalogue* 102–104; *Questions and Answers in Genesis* 1:10; 2:3; and *On the Special Laws* 1:13; 2:15. On first-century cosmological models, see also Horst, "Authors."

[53]The first book of the *Sibylline Oracles* was originally composed by one or more Jewish authors, probably between the second century BCE and the first century CE. The version that survives was apparently revised by at least one later Christian editor, and we cannot know with certainty which parts were original to the earlier Jewish version. However, nothing about the passage I discuss here suggests it is a Christian interpolation, so it is probably safe to assume it is part of the earlier Jewish composition.

[54]*Damascus Document,* 1:17–21; *Admonition Based on the Flood* (4Q370), 6; and Josephus, *Jewish Antiquities,* 1:75.

[55]D. J. Harrington, "Pseudo-Philo," in *The Old Testament Pseudepigrapha*, ed. James H. Charlesworth, 2 vols. (Doubleday, 1985), 2:313.

[56]On the "two books" approach, see William Horst, "From One Person? Exegetical Alternatives to a Monogenetic Reading of Acts 17:26," *Perspectives on Science and Christian Faith* 74, no. 2 (2022): 85–87, https://www.asa3.org/ASA/PSCF/2022/PSCF6-22Horst.pdf.



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Article

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African Theocology: A Theocentric Paradigm for Creation Care in the African Church

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The theologies underscoring Western missionary work in Africa during the colonial period encouraged the domination of creation and overrode theologies of care and concern for the natural order. Further, the proffered dominion theology that discouraged African Indigenous religious ecological conceptions was undergirded by a mechanistic worldview foreign to African understandings of creation. Thus, one challenge to effective cooperation in addressing ecological problems in Africa is that Western Christian creation care approaches perpetuate this mismatch. Consequently, this article argues that African theocology, which integrates Christian theology of nature with insights from both African Indigenous practices and the ecological sciences, may be a preferable alternative paradigm for developing creation care culture in Africa. It explains creation care culture as the life-long transformation of our moral consciousness and instinctual actions to improve our relationships with God, ourselves, other-than-human creatures, and the environment. This article analyzes the role that eco-cultural practices, particularly birthing and funerary rites in Ghana, play in this approach. Specifically, it shows their implicit potency to prime and orient people in ways that promote the development of personal character and church cultures that embody Christian creation care.

Key words: African theocology, creation care, eco-culture, eco-church, theocentric paradigm

Despite climate skepticism and denial still lingering in some Christian circles,[1] there is broad scientific consensus that a global eco-crisis threatens the flourishing of earthly life, that the crisis is anthropogenic, and that its alleviation requires effective human remediation on a global scale.[2] There are a number of manifestations of this crisis in Africa:

- deforestation, in which the land is cleared mainly for artisanal mining and cacao trees, one of the continent's largest cash crops;
- air pollution, accounting for over 300,000 deaths annually;
- water pollution, caused by factors that include illegal artisanal mining in some countries, with the related deaths of 115 people per hour;
- biodiversity loss, resulting from economic and population growth pressures; the continent accounts for 8 of the 36 biodiversity hotspots globally; and
- oil spillage, such as the estimated 240,000 barrels of crude oil spilled annually in the Niger Delta in Nigeria, poisoning agriculture, waterways, and the atmosphere with hazardous chemicals.[3]

Because effective solutions to these problems require broad support and concerned action, there is "a growing consensus that religions may also play a significant role" alongside the ecological and conservation

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sciences in global remediation efforts, in that religious ecology "in the past sustained individuals and cultures in the face of internal and external ecological threats,"[4] especially in Africa south of the Sahara.[5] Theocology is a proposed African religious framework for practicing conservation. It is a holistic method for studying and practicing creation care. It considers both scientific and religious ecologies, the ethical practices they enjoin, and their limitations. It proffers a distinctly African perspective on the theology of nature.[6]

This article proposes that African theocology could provide insights that Christians in Africa and elsewhere may use to engage ecological science, and thus develop holistic approaches to creation care. The proposal seeks to address a need within African churches and, in so doing, address an established problem in missiology—namely, how to adapt the gospel in cultures with very different worldviews than Western Christianity. Ever since missionary times, African Christians have suffered a dilemma: how can they draw from, and at the same time integrate their culturally embedded primal religious consciousness with Christian faith and conservation sciences in ways that promote ecological action? This dilemma has taken on new importance in recent years. With "the demographic shift in the global Christian population" to the global South, new cross-cultural questions are raised that "require a reformulation of Christian faith and practice"—as has always been the case throughout mission and church history.[7]

Primal Spiritual Consciousness as Preparation for African Christian Theologies

The translation and generation of African and global knowledge is crucial to support effective responses to ecological change, both in Africa and worldwide. It also makes Christianity, not a Western, but a world religion.[8] However, efforts to better understand and mitigate ecological change in the global South have had limited success, as Christians have been disproportionately rooted in theoretical frameworks which originated in the global North. African Christians have been and continue to be influenced by ideas transmitted by nineteenth- and twentieth-century Western Christian missionaries whose religious ecologies were rooted in dominion theology. This was a theology based on the Enlightenment: its mechanistic and Western scientific worldviews dichotomized the spiritual and the physical. Furthermore, as Western Christianity was skeptical of Indigenous ideas, it despised any continuity of primal eco-spirituality with Christianity. As Research Professor of Mission at Boston University Jonathan J. Bonk observed in 2008,

> Only now are Catholic, Protestant, and Orthodox missiologists starting to realize that strategies for saving the world have been framed within a theological cocoon that prevented them from adequately understanding the result of their civilization's notions of progress, development, and the social material destiny of humankind.[9]

In other words, Western missionaries considered their own theologies of creation and progress, although lacking continuity with practical primal religious consciousness, to be either exclusively correct or at least superior to non-Western Indigenous ideas. Thus, in their efforts to save non-Westerners and provide them with human development, these Christian missionaries downplayed and de-emphasized local religious ecological conceptions and practices. The result has been a "flattening" of Christianity in Africa into a Western form instead of the universal world religion it is supposed to be,[10] specifically in the form of eco-deculturation. Many Africans converted to Christianity are taught to abandon cultural practices that care for the natural world. The impact of this flattening persists to various degrees in the African church.

Yet, Indigenous eco-cultural knowledge can prime African Christians to care for creation as Christians. It can serve as foundational knowledge that motivates and prepares the mind for engaging more effectively with both biblical creation care theology and conservation science. In African Christian theologies, primal spirituality is a *praeparatio evangelica* that enhances cognitive and practical conversion and moral commitment to biblical and scientific conservation principles. It provides an affinity, a positive *déjà vu* (sense of familiarity), and an instinct to combine Christian moral eco-actions with similar religious impulses as learned from the primal sources.

"Primal" in African theologies is neither "tribal" and "primitive," nor "visceral" and "Indigenous," to a specific cultural or geopolitical people as understood in the West. Rather, "primal" describes spirituality, which is divinely originated, fundamental, and anterior to (or the substratum of) all historically developed religious experiences. It is foundational to Judaism, Christianity, Islam, Hinduism, and others; therefore, "primal" is universal in character although it manifests in different forms within cultures.[11] Though resilient,

primal—like any other religious consciousness—can comfortably succumb to other prevalent worldviews and sociocultural philosophies. Thus, primal spirituality has been largely but inadvertently lost in Western cultures due to Enlightenment and mechanistic worldviews.[12] Hence, Western missionaries debunked it as unworthy of theological reflection, "under the prevailing European value-setting for the Christian faith."[13] Primal spirituality is being threatened by the prevailing socio-economic factors and needs in some parts of Africa today. Historically, primal spirituality has been a field prepared for planting the gospel in most primal cultures. Kwame Bediako explains it as describing "the major religious substratum for the idiom and existential experience of [all religions] in African life,"[14] including both mission-established and African Indigenous or African Initiated Christianity (AIC).

African Primal Spiritual Consciousness and Christian Creation Care

This article asserts that primal spirituality provides convertible cultural continuity—not discontinuity—to the Christian faith, especially in the form of theocentric eco-ethics, which global Christianity may leverage to motivate care for creation. Pope Francis recognized this in his encyclical letter, *Laudato Si': On the Care of Our Common Home*, in which he expressed confidence that we (Christians today) can "build our common home" if we are motivated and educated, and approach global eco-crisis locally with our traditional (primal) ecological understandings first.[15] Similarly, in a 2017 study at Sokpoe in Ghana, Harry L.K. Agbanu, an environmental ethicist at the University of Ghana, Legon, opined that educating the African student in scientific ecology can be enhanced by building on the foundations of their primal African eco-spirituality.[16] Re-awakening the primal eco-spiritual consciousness as a universal experience or sense of "as if I already have some idea" in Christians everywhere, may be foundational for a better cognitive and practical appreciation of conservation sciences.

In the pre-Christian primal culture and spirituality of Africans, ecosystems historically have been sustained by environmental taboos and rituals that serve as major impulsive eco-ethical tools. African theocology, as an emerging theology of nature, integrates these insights with the ecological and conservation sciences in creation care. It proposes leveraging on the strengths of African primal religious eco-practices by refracting them through the prism of the gospel, and converting them to Christ by keeping the Christian creation care values and ethics implicit in them. In this way, the conversion process retains the *meanings and purposes* of primal eco-thoughts and principles as African contextual equivalents of Western Christian and scientific perspectives, while at the same time, the primal *objects of faith* and *symbols* are converted to the Christian way. For instance, whereas the primal motivation for creation care is the *fear of eco-deities and taboos*, which is very strong in Africa but not in the West, conversion to Christ encourages retaining that strong innate religious eco-ethics. Only now the motivation is founded on the biblical injunction to *love the Christian Trinitarian God* of creation and *love creation* itself as our *neighbor* (Matt. 22:37–39).

The cultural foundation of primal eco-spiritual instincts serves as *praeparatio evangelica* to enhance Christian discipleship for a theocentric creation care. Similarly, just as the birthday of a Greek god Mithra was converted and is celebrated freely by Christians as the birthday of Jesus Christ, so eco-taboos that prohibit working the land, harvesting forest wood, or fishing in water bodies on a local deity's "sacred day" can be converted to biblical Sabbath regulations of Yahweh. Why? Both are essentially the equivalent creation care principle: *rest,* a religious injunction (Lev. 25:1–7) that, in conservation science, provides an opportunity for self-rejuvenation and regrowth in nature.

African theocology, therefore, considers the conversion of primal eco-spirituality to be a significant resource for Christian creation care. In fact, primal eco-spirituality can potentially serve as a corrective to Western Christian eco-theologies that do not present biblical Sabbath rest laws as reflective of God's intentions for us to cultivate a propensity toward ecological care. For example, African primal sacred-day taboos for rest encode an attitude of awe and respect for God in ways that provide an ethical instinct to prevent human efforts to overharvest the resources within creation. Both African and world Christianity can take advantage of this natural tendency since primal spirituality is supposed to be universal; even the West can re-awaken their responsibility to care for the environment despite centuries of ignoring it. With African theocology, Christians may develop a God-in-Christ-centered fear as an instinctual impulse toward the development of ecologically minded cultures. According to Andrew Walls, the eco-culture so developed will be a

> [m]oral renewal [that] follows inner transformation: people will adhere to God from their hearts (Jer. 31:31–34). [And this change] will herald

> universal renewal, in which the flora and fauna and the whole environment are enriched and violence [to all creation] will be unknown (Isa. 11:6–9).[17]

Ecological culture is largely the missing link between action and inaction, even when we know what to do scientifically. Here too, however, African theocology can underpin the development of ecological cultures.

African Theocology as a Theology of Nature in African Perspective

To reiterate, African theocology, like Western eco-theology, is an emerging theological discipline, following the mid-twentieth-century trend toward global religious approaches to studying ecology.[18] Christian Danz observes,

> With the onset of the ecological crisis or climate change, the doctrine of creation has again become the focus of theological attention [in the late 20th century]. Theology has taken up these discussions under headings such as "deep ecology," "deep incarnation," and "ecotheology." These discussions have been accompanied by a complete reconstruction of the traditional dogmatic doctrine.[19]

In the late twentieth century, global eco-crisis called for reconstructing appropriate and responsive theologies. In 2015, Pope Francis suggested that such theology should necessarily stem out of and have continuity with our primal eco-spirituality.[20]

> For theological consciousness presupposes religious tradition, and tradition requires memory, and memory is integral to identity: without memory we have no past, and if we have no past, then we lose our identity.[21]

African theocology seeks to uniquely reawaken the identity and memory of past primal but convertible religious eco-ethical systems in ways that empower Christians to see the God who created through Christ in the power of his Holy Spirit, being ever immanent in his creation as Emmanuel (Matt. 1:23). A sense of God the Emmanuel's immanence in creation can commit the Christian to a theocentric creation care just as the primal enchantment of nature was highly successful in the acceptance of a deity-centered moral ecology. African theocology integrates the study of the Triune God as creator, the relationships between God and creation, and the role of humanity in the relationships, from the holistic worldviews and eco-cultural self-understandings of Africans, which may inspire theocentric impulses to care for creation. Western Enlightenment-influenced eco-theology that does not emphasize immanence of spiritual forces in creation lacks, or, at least, does not overtly inspire a Christian understanding of enchantment (God's immanence in creation). So for Africans, Western Enlightenment does not naturally induce theocentric creation care, even though God as creator, along with similar biblical eco-themes, may be implied in it.

Reconstruction of African theocology was inspired from my study of Zimbabwean Earthkeepers' environmentalism in the late twentieth century.[22] To remedy the heavy deforestation during their political war for independence, both African Initiated Christians (AICs) and primal religionists in Zimbabwe—influenced by Marthinus L. Daneel, an African-nurtured Western missionary—embarked on integrated religious and scientific afforestation (forest establishment) projects.[23] These projects included both local know-how and the teaching of basic principles of forest conservation science, such as identifying and selecting purposeful forest-type flora species, sowing and nursing seedlings, and transplanting with appropriate spacing and nurturing young forest trees. Primal religious ecologies which viewed nature as enchanted provided participants with self-motivation and commitment to the afforestation project. Important elements included their fear of the Triune God (Supreme Being), respect for ancestors, sense of kinship with nature, and *ubuntu*[24] (sense of community) to ensure the good life of all. They also gained knowledge of basic forestry science.[25]

The religious rituals of Christians included holding "tree planting Eucharist" on the days of community tree planting that involved thanking God for the values of trees and confession of ecological sins of deforestation. The sermons at these services valued the earth as God's property and convinced Christians to care for it, with incarnational theologies: Jesus's humanity implies earthiness; his divinity is shown as an African Ancestor par excellence whose call for creation care must be obeyed. The liturgy emphasized adhering to converted ecological taboos as God's eco-regulations.

This Zimbabwean-integrated eco-practice is an example of the unique potential of African theocology to motivate interfaith religious ecological research and global eco-crisis remediation efforts that integrate conservation science and community cohesion in caring for creation. Specifically, the interfaith collaboration was in *ubuntu* spirit of "we are one" with similar primal eco-spirituality and in a common eco-crisis despite differences in practicing faith; it was, therefore, not what Westerners call "syncretism."

In addition to the Zimbabwean case, there were others from Burkina Faso, Cameroon, and Ghana. In these West African cultures, environmentally sustainable artisanal gold mining, for example, had greatly depended on adhering to religious insights, rituals, and eco-taboos for many centuries. Without ground-scanning gold-detecting technology and tools, but by respecting eco-taboos, they sometimes are able to determine sites for prospecting and to prevent possible site degradations. Is it difficult to infer that implicit in their religious mineralogy is a rudimental science (knowledge) of gold detection?

In 2017, African theocology was conceived after students of ecological science in a Ghanaian Christian university saw the subject merely as scientific and resisted any religious calls to act ecologically. At the same time, some Western-mission-influenced "deculturated Christian"[26] youth in Sokpoe asked for permission to build development projects in the hitherto indigenously preserved sacred forests. They employed Western missional eco-theologies by arguing that faith and discipleship in Christ overcome African forest-deities whose forest-taboos are mere superstitions that hinder socio-economic development.

These experiences spurred research into what motivates or demotivates creation care in the three main religious traditions of Africa—the primal, Islamic, and Christian—and compared these traditions with the Sokpoe-Eʋe in Ghana as a practical case study. Although not "a strictly comparative study of the ecologies of these religious traditions," their research sought to "[retrieve] and [re-evaluate] religious worldviews, religious practices of creation care, and religious priming for harmonious ecological relationships" in Africa.[27] The findings indicated that the primal religious Sokpoe-Eʋe (like the Zimbabwean, Burkinabe, Cameroonian, and many others in Africa) understand that *xexeme* (the cosmos or creation) was the act of *Mawu Sogbolisa* (the Supreme Being) with the help of *trɔ̃wo* (subaltern deities). *Mawu* himself is uncreated and lives in *dzifo* (residence high above) *xexeme*. But in daily life experience, *Mawu* acts through the eco-deities (together with ancestors in some cases) in the eco-community to sustain ecological harmony.

Kwame Bediako asserts that for primal cosmologies "the supreme Being appears alienated from earthly phenomena but is the sustainer of the universe,"[28] perhaps through Jesus Christ, the Holy Spirit, and the "minor divinities."[29] This implies that, generally, both the primal and Christian sub-Sahelian African, such as the Sokpoe-Eʋe, hold a theistic belief in a divine origin of creation.[30] However, for the primal religious traditions, this divine origin and continuing presence of spiritual entities "confer[s] a sacred shroud over the created beings and the social order."[31] This view of sacredness underpins the primal eco-community's enchantment (not deifying) of nature, fear of the creator spirits, and obedience to their conservational taboos as eco-ethical tools that effectively regulate attitudes and behaviors in the environment. So, the effective ecological ethics of African Christians can be based on their reawakened primal worldviews, which have affinity, and hence possible continuity with, biblical holistic and precarious worldviews (Eph. 6:12). Christian eco-ethics can then be derived from and in continuity with primal enchantment of creation, when converted to a biblical sense of the immanence of the Triune Creator God among, within, and sustaining his creation (Exod. 29:46; John 14:17). In this way, African Christians can obey the Christianized eco-taboos prayerfully, in the power of the Holy Spirit, to God's glory (1 Cor. 10:31), as demonstrating their love for God and his creation (John 14:15).

African theocology explores the "divine-human-earth relations"[32] implied in theologies of nature, and not the "earth-human-divine relations" as implicit in the nomenclature of Western "eco-theology." The inversion of eco-theology to theo-ecology emphasizes to the African religious, including primalists, Christians and Muslims, that a theocentric worldview, derived from primal religious consciousness, necessarily underpins the study and practice of ecological and conservation sciences. It allows the Christian to practice conservation science, first by acknowledging the earth as a big ecosystem created by, belonging to, and sustained by God; and second, by ensuring that conservation science and technology are applied within the ambits of biblical and converted local eco-ethics to glorify God.

How Theocology Is a Unique Paradigm for Christian Creation Care

An example of practicing African theocology can be found in agriculture. Genetically modified (GM) crops can help resolve food insecurity in environmentally devastated communities. But GM crops introduced into Africa use one-time-only (terminator technology) seeds, also called "suicide seeds"; they prevent the farmers from producing their own seed for planting the next crop. The result is injustice and food insecurity as African farmers are made perpetually dependent on Western GM crops. Further, with time, local species may become—in fact, are becoming—extinct due to

GM science. African theocology will expect a Christian agricultural scientist to apply GM science with a moral conscience inspired by the Holy Spirit, considering the long-term negative effects on communities rather than just the immediate scientific and economic gains. African Christian agriculturists should be aware of *ubuntu* (sustaining community) welfare and cohesion; and also aware that God (and Jesus, our African Ancestor par excellence) will not be happy with whoever does whatever to disturb the welfare of the ecological community, especially food security.

At Sokpoe in southern Ghana, seasonal bans on clam-harvesting in the Volta River from November to February coincide with the natural breeding season of clams, allowing time for the self-replenishment of clam populations. These primal African religious ecological taboos are not grounded in Christian theology. But for converted primal Africans, their meaning and purpose stand out, suggesting that African eco-taboos that regulate time for accessing ecological goods are consistent with both biblical Sabbath laws and conservation science: that is, the theology and scientific principle of *rest* for natural regrowth. Christians and scientists can then obey these converted taboos primarily because God, as the creator and provider of natural resources, instituted them to maximize eco-services output for the mutual benefit of all creation. In Semitic eco-culture, this theological principle is enshrined in Sabbath eco-laws; for the African, it is enshrined in eco-taboos attributed to eco-deities. Therefore, rather than being condemned, primal religious eco-taboos can be seen as a preparation for what Kwame Bediako calls "conversion of culture": in this case, ecological culture, the turning of the primal religious ecological impulsions for care and practices, to Christ[33] (*impulsion* here and following in the sense of an "instinctual essential moral habit/principle").

The distinctive difference that African theocology advocates is converting the impulsion, formerly ascribed to an eco-deity, to the Triune God. So, for Christians, the faith object to be feared or reverenced must be Jesus Christ, the Son of the Creator God and our ancestor, through and for whom all things were created, in the power of the Holy Spirit (Col. 1:16). As I have argued earlier, the lack of moral impulsion in Western Christian eco-theology, transmitted to Africa, has contributed to the inability of both African and Western Christians to be proactive in caring for creation. It is not uncommon to note that Christians and scientists, whether Western or African, may know the ecological need and understand what they can do to remedy it while still being unable to take necessary ecological actions. Why? Because moral impulsion is either absent or not strong enough.

So, the African ecological concepts and practices are not superstitions to be rejected as un-Christian and unscientific, but signposts which call for caution and scientific study, and which otherwise can be looked on as opportunities for Christians to care for creation God's way. Through such a judicious engagement with African local knowledge and practices, the African church can contribute more effectively to global efforts toward building a Christian creation care culture. In this, African theocology can be a paradigm for the African Christian context and beyond.

A paradigm is "a conceptual or methodological model underlying the theories and practices of a science or discipline at a particular time; [hence] a generally accepted world view."[34] In this sense, African theocology is paradigmatic, because it conceives and postulates a holistic method for studying and practicing creation care, from the knowledge of both scientific and Christian religious ecological ethics and practices, and their limitations. As a paradigm, African theocology's unique characteristics are that, first, unlike Western eco-theology, it insists on Christian research and practice of conservation science that *begins* by acknowledging God as the creator, owner, and sustainer of the earth, in accordance with biblical and African primal worldviews. Second, it encourages applying conservation science and technology within the ambits of biblical and converted primal eco-ethics to ensure not only appropriateness of the technoscience, but also Christian impulsion and commitment to theocentric creation care, to the glory of God. Third, it promotes socio-ecological transformation by relying on African *ubuntu*—socio-cultural self-understanding as eco-communal beings—to forge concerted interfaith efforts in responding to common ecological concerns in plural-religious eco-communities.

In short, African theocology is a model that teaches the sharing of common practical experiences, concepts, and cultural tolerance on common problems of ecocrisis from the perspective of religious and scientific ecologies and ecological ethics.[35] It has the potential of building creation care culture in the African and global church.

African Christian Creation Care Culture and Its Development

African Christian creation care culture envisioned by this article involves a life-long change or transformation for a better creation care habit. In this context,

creation care is a call to action for human beings, particularly in the religious traditions (primal religionists, Jews, Christians, and Muslims, etc.), to rethink and reinvigorate our inner predisposition to take actions, individually and corporately, to sustain harmony with our environment. Patrick Curry describes this call as a "reawakening of something very old" that we have forgotten from our intuitive experience.[36] In other words, creation care is and ought to be what Emmanuel Katongole, citing Pope Francis, refers to as "ecology of daily life."[37] He explains it as our attempt

> to shape our environment to express our identity: in our rooms, our homes, our workplaces, and our neighborhood [by taking] those simple daily gestures which break the logic of violence, exploitation, and selfishness.[38]

According to Bediako, daily ways of life that define and identify a "substantial social grouping of people" in an environment, with history and traditions, constitute their culture.[39] Daily actions to shape our environment are therefore expressions of our cultural identity not just as individuals but, more importantly, as an eco-community. This suggests that creation care is a cultural ecology: "treasures of humanity" (the positive habits of a social group) transmitted "dynamically into the present."[40] It is "something very old" in a people, a culture, but it needs "reawakening." Since creation care is cultural, it should not be difficult to build a robust Christian creation care culture—the Christian moral character or instinct for daily sustaining the integrity of the earth.

Bediako avers that culture, as a subset of worldview, begins internally from the mind.[41] Hence, creation care culture will imply epistemologically that we first rethink our relationships with God and his created earthly environment. In other words, the way of life of a people in their environment is essentially an outward exhibition of their inner perception or knowledge of environmental phenomena, and a consequential response to them as part of the natural way of things. Humans are relational beings in an interconnected environment. "We are part of nature, so the social and the environmental belong together."[42] An epistemic or inner disposition of being, which determines an outer way of relational life in and with the environment, can be described as moral ecological character or simply, eco-character.[43] In this sense, creation care culture is the moral eco-character that can prompt instinctual actions for the sustenance of balanced and sustainable ecological relationships in our common *'oikos*, earthly home. It is the changed heart—reflecting the character of God—that can motivate us to be the new *imago Dei* in Christ, and so naturally be proactive in addressing anthropogenic environmental injustices and perturbations.

African Christian eco-character may align with, but is distinct from, Western ecological virtue ethics, which is more an intellectual or theoretical category. This article has argued that the distinctiveness of African Christian eco-character is that it drinks from the wells of African primal traditions—a reawakening and conversion of the historically transmitted and experienced holistic worldviews, especially the strong primal sense of interconnectedness with nature—to produce a theistic impulsion and empowerment for a creation care culture.

Some Ways of Building African Christian Creation Care Culture

A pressing question for the African Christian, in which African Christians in science might take the lead in asking, is, how do African worldviews and cultural self-understandings of the Christian practice of creation care relate? In other words, how may we build a Christian creation care culture from an African perspective? From the preceding arguments, it is not difficult to conclude that the process for building creation care culture in the African church cannot be based on Western epistemologies rather than on African Indigenous cultural frameworks. The latter can helpfully model a God-fearing instinct, when converted in the light of Christ. Bediako suggests how the conversion can be done: it is to use the scriptures as the hermeneutic of the African primal religious ecological ideas, beliefs, impulsions, and practices. In his view, this involves refracting primal episteme through the prism of the gospel.[44]

That means a critical assessment, both biblically and theologically, of the African Indigenous knowledge and practices. The aim is to point out possible ways to reflect how Christ (the second Adam) could approach creation care and, as a result, inform the new way of life of the African followers of the second Adam—the regenerated African humanity, an identified people called the African church. In fact, the process often discovers that the primal African religious eco-ethos, in many ways, has affinity with the scriptural views on moral creation care. Two primal eco-cultural practices that may be converted to build Christian eco-culture are birthing and funerary rites.

As observed earlier, Pope Francis believes that building a creation care culture or eco-character in the church

should necessarily include a continuous Christian eco-culture education, beginning with primal knowledge.[45] Proverbs 22:6 teaches that such Christian eco-cultural education needs to start in childhood; only then will Christians keep it throughout life as they grow. Research among the Sokpoe-Eʋe in the Volta Region of Ghana indicates how fulfilling this scriptural injunction is provided for in their primal religious birthing rites.

The birthing rite entails rituals (symbols and prayers) to orient, first, the child's community of care (family, neighbors, the religious) to view the baby in a particular ecological way and raise it to think of itself in that same way, growing up in the eco-community. But they are believed to also influence the baby itself by inducing a cultural sense for good health, belongingness to, and dependence on the ecosystem for livelihood. Consequently, the baby begins to be oriented toward harmonious ecological relationships with both human and other-than-human creation in the eco-community. Converted to Christ, these rites may provide significant impulse for Christians to care for the environment.

The rituals initiating a neonate include, among others, postpartum *amenɔɖiɖi* (placenta burial) on the first day, neonatal *ɖiɖɛxɔmenɔnɔ* (maternal detention) for eight days, and perinatal *viɖeɖeɖego* (child outdooring), eight days postpartum. The neonatal *ɖiɖɛxɔmenɔnɔ* rite detains mother and baby in a clean and warm *ɖiɖɛxɔme* (maternity ward) at home for the first eight days postpartum. The mother could go out, but only when necessary, and ideally not very frequently in the first three days and should always keep the baby close to herself for body touch. Family members provide any needed support during the maternity detention.

Primal religious explanations suggest that *ɖiɖɛxɔmenɔnɔ* buys time to get the baby acclimatized and fortified against evil forces that may inflict ill-health before its exposure to *xexeme,* the open physical world. Science, however, may see it as ensuring filial bonding and acquiring natural immunization. The filial bonding is an emotional connection between mother and child and believed to work in a feedback mechanism. Baby's skin-to-skin body touch with mother and pleasant touches in breast suckling stimulate secretion of oxytocin and prolactin from maternal posterior pituitary for milk let down and evacuation of uterine congestion. Thus, reproductive and psychological sciences affirm the meaning and purpose of a religious ritual that establishes a sense of care between mother and baby. In addition, the insistence on closeness of mother to baby in *ɖiɖɛxɔme* within the first three days postpartum has immunological implications. Breastfeeding during the first 24 to 72 hours postpartum is critical for accessing colostrum immunoglobulins. The resultant natural immunities acquired, then, may be what Indigenes describe as religious fortification against evil forces of ill-health feared in the *xexeme*, the environment outside the uterus.

For the Sokpoe-Eʋe, the orientation provided by these rites prepares the child to develop caring relations with both human and other-than-human creation. The fortification provided by the rites primes the growing child to develop ecological relations that prevent environmental ill health caused by physical and spiritual pollutions. The spiritual pollutions are the wrath of God and eco-deities offended with improper human ecological conducts such as disobeying eco-taboos. Therefore, when converted, African theocology expects the birthing rite to prayerfully reassure that Jesus's protection against evil environmental forces and the need to remain healthy in relationship to the environment should motivate development of habits of environmental care.

The postnatal *amenɔɖiɖi* ritual involves burying the placenta and umbilical cord of the baby under a tree, or planting a tree seedling on the burial ground, in or near the family compound. It is accompanied with prayers for the baby to take pride that *kokloxɔ mekpea ŋu na koklo o* (the fowl is never ashamed of its coop). The significance of this rite is seen in its grounding or rooting the baby in its future land of inheritance. It orients the baby to learn to respect the land with a pleasant sense of belongingness, and take care of and provide for itself from trees and other crops on the land.[46] Ideally, the Christian baby must grow to care for this land and its florae and, by logical extent, fauna, because the Bible enjoins us to live by developing the land in ways that caringly sustain it, mindful that it will receive our mortal remains in the end (Gen. 2:15, 3:19). Similarly, placing of baby on bare ground to wet it with urine or with water sprinkled from roof eaves during *viɖeɖeɖego* (child outdooring) symbolizes a formal introduction to and priming of the baby to be aware of the earth and its climatic conditions outside the uterine environment.[47] It affirms to the Christian baby the importance of hydrologic science and the conditions of the earthly world, of which God is the source and explanation (Job 38:25–29). By extension, the baby is to please God by caring for the earth.

The meanings and purposes of these symbolic inducing, priming, and orientation birthing rituals resonate

with David Bookless's argument that we are not able to intuitively feel oriented to care for the earth as our home unless we are "grounded and rooted in our ecosystem or we become uprooted and displaced."[48] He explains that our relational God made us relational beings tied to the earth by our dusty origins. As scripture says, "dust thou art and into dust shall thou return" (Gen. 3:19b). Russ Parker asserts that a strong and most basic need of humanity is "to belong in the place or on the land where we can connect, be rooted and grow."[49] Theocologically, the Sokpoe birthing rites vividly enact creation care culture building. They believably ground the child as an earthly creature and orientate it toward valuing and developing healthy relationships with God, people, and the natural environment it has entered.[50] Ideally, this could be a theocentric reasoning for the Christian child and scientist to be morally proactive in caring for creation until death.

Creation care impetus is found also in enacting the concepts of death, particularly in funerary rites. The Sokpoe-Eʋe funerary rites convey a message for the living to develop eco-ethical relationships with all creation in the ecological community during earthly life before death. This is vividly symbolized with *hlɔtsilele* (clan bath) of a corpse laid in state. This ritual enacts the African primal religious cyclical concept of time,[51] which views death as mere transition from *kodzogbe* or "geosphere" (earthly abode of the living living) into *avlime* or "terresphere" (the abode of ancestors or living dead).[52] The Sokpoe-Eʋe believe that their *ancestors* would readily identify and welcome only deceased clan members who had no contamination from unacceptable social and ecological relationships in the environment prior to their demise. Otherwise, the *luvɔ* (soul) may remain wandering painfully until it may by chance be reincarnated for self-correction. Since clan leaders are not sure of the eco-moral status of their beloved deceased, the practice of *hlɔtsilele* for all deceased members of the clan then serves as a gracious cleansing of possible contamination with socio-ecological pollutions that may hinder ancestral acceptance in *avlime.*[53]

Theocologically, converting the meaning and purpose of *hlɔtsilele* may inspire the African Christian to develop the moral character required for living and relating well, in and with creation before death. The pointer to Christian faith here is the understanding that we shall transit one day from earthly life to a heavenly home (Phil. 3:20). Only those whose sinful character (including ecological sinfulness) on Earth is washed clean by the Lord Jesus, our Ancestor par excellence, shall be welcomed into the heavenly home and welcomed happily (Rev. 11:18b, 22:14–15).

David H. Roper contributed a devotional homily to *Our Daily Bread* on May 14, 2023. The topic was "Taken in." Although not necessarily a theological discourse, his points implied the biblical and Christian truth in Rev. 22:14–15. He cites Robert Frost who described a home as "the place where, when you have to go there, they have to take you in."[54] Basing his discourse on Psalm 49:20 and John 14:3, Roper implies that a Christian's moral conduct on Earth should aim at a choice for heaven as our eternal home. Then "Jesus, [my Ancestor par excellence] who gave to God the price of my life," will "welcome me into His Father's house with open arms," that is, as a familial and social obligation as much as in a loving relationship.

For the African Christian, then, ecological sin, like all other sins not cleansed by the Lord Jesus, may disqualify one being welcomed to the heavenly home by Jesus, our Ancestor par excellence. It points then to seeking genuine conversion, water baptism, and Holy Spirit sanctification through confession of all sins. Above all, it is a significant impulsion for endeavoring to overcome sinful temptations, including temptations to act unharmoniously in relationships with and in the environment while living on Earth.

These rituals in birthing and funerary rites, however, have the potential to instill eco-care culture better and faster, especially in Christian children, if they are constantly practiced in the eco-community. Children need not be taught to care for creation as much as to "catch" caring for creation instinctively from their parents and elders. They must be taught biblical meanings and purposes of the rites: how some of these, such as the rites for filial bonding and natural immunization acquisition, are affirmed by science. But better still, Christian parents and the eco-community at large need to manifest the ecological implications of the birthing and funerary rites in a lifestyle that is an example for children to emulate. Churches that nurture children with integrated biblical and scientific insights of converted primal ecological rites to promote creation care will have to be, or aim at being, eco-churches.

The Eco-Church as an Atmosphere and Means of Building Creation Care Culture

Moral ecological character is a quality of life. It comprises inherent attributes or patterns of thinking that determine a person's consistent outward habits and behavior in and with the environment. It results from inborn genetic traits modified by environmental factors,

including formal and informal education.[55] Of these, while formal education may be helpful, moral character formation primarily occurs informally. Acquiring moral eco-character requires that the innate predispositions or orientations that underpin a person's ecological behaviors are consistently infused with ideas, beliefs, and values that are normative to an eco-community.[56] Hence, the meaning, purpose, and eco-actions implied in the birthing and funerary rites need to be translated into regular ecological practices in the Christian eco-community. These rites will allow for moral ecological character development to be more caught than taught, especially in an eco-church.

An eco-church for building creation care character needs to aim at continuous eco-cultural education for both church leaders and members. Specifically, the theological formation of eco-church leadership needs to include intensely practical courses on African Christian creation care, such as those being promoted at Akrofi-Christaller Institute of Theology, Mission and Culture (ACI) in Akuapem-Akropong, Ghana. Such courses reflect that, as Ben-Willie Kwaku Golo argues, "Africa's environmental problems require environmentally responsible leadership at all levels of society, including our households, and families."[57] So, the goal of such pastoral training is "not simply to impart information or simply develop skills, but to form a unique lifestyle that ensures appreciation and conservation of God's creation, as requirements for sustainable development."[58] Further, eco-church members need to experience what Pope Francis, as cited by Katongole, calls "ecological conversion." He means that in an eco-church the effects of our encounter with Jesus Christ should become evident in our relationship with the world around us,[59] whether Christians or scientists.

An eco-church encourages Christian creation care actions even at individual and family levels as a Christian witness. Since 2020, my wife and I decided to and have now developed the habit of separating plastic waste at home, and keeping empty water sachets (packets) on hand until the next dust bin (trash) collection. It was initially a challenge since we were, like many other Ghanaians, not used to the practice; most Ghanaians, including Christians, know that Zoomlion, a sanitation company, is responsible for that job. But the concepts of African theocology motivated our Christian moral commitment, and we added our little contribution to the national sanitation effort. Now we donate the bags of sorted empty plastic water sachets and bottles to a church member who sells them to recycling companies for a small income. But our local church becoming an eco-church may take some time since human character transformation is slow. Start small.

To start small, the Rev. Lawrence Kumi has initiated steps for his Revival Outreach Church International in Accra, Ghana, to become an eco-church. He is an engineer, pastor, and 2023 graduate of ACI's Certificate in African Christian Creation Care Studies. The knowledge gained and moral passion induced by the program led him to introduce a practical plastic waste recycling, through forming creation care clubs in his church. His approach, like the Zimbabwean Earthkeepers, involves eco-sin confession prayers and homilies to inspire commitment to the project. The liturgy leverages their primal religious ecological consciousness as impulsion to care for the environment to the glory of God and for the good of the eco-community. Rev. Kumi hopes that with time, Revival Outreach Church will be an eco-church where he and the clubs will be able to gradually develop an African Christian creation care culture.

In April 2023, a partnership between ACI, A Rocha, Ghana (a Christian creation care NGO), African Challenge Book Enterprise, and World Vision embarked on a project to develop a national creation care framework based on concepts of African theocology. Its objective was to provide some guidelines for churches interested in becoming eco-churches to offer Christian education that may motivate their members to be proactive in developing a creation care culture in their community. The outlined eco-actions for eco-churches includes planting and maintaining lawns, flowers, and trees on church premises and members' homes to beautify and prevent erosion; keeping proper environmental hygiene and sanitation habits; obeying changing eco-regulations (including the converted primal religious eco-taboos); properly disposing plastic and e-waste; and always using energy-saving lighting systems.

Farmers in eco-churches should be taught to align agriculture science and farming practices with God's perspective on human relationships with the environment. Thus, composting, mulching, intercropping, limiting mono-cropping, and appropriately limiting use of inorganic chemicals need to be taught and promoted. Eco-church members involved in fisheries, mining engineering, and socio-economic development projects engaging land, water bodies, atmosphere, and forests need to respect the eco-taboos of the cultural area as God's eco-regulations. Particularly, respecting "rest" for water bodies, land, and animals not only reflects God's universal eco-ethics, but refusal may also lead to degradation of creation and may incur God's wrath

(Rev. 11:18). In all cases, African theocology encourages each Christian to start creation care small, as love for God and his creation. Such is a theocentric care for creation.

Conclusion

I have argued that the African church must care for creation because we are in ecological and missiological Kairos moments (times of opportunity) which demand that we act. From an African perspective, the church can contribute to a global Christian ecological mission by leveraging converted primal eco-taboos and rituals to build a creation care culture. Such a theocentric creation care culture involves a life-long transformation of Christians' moral consciousness and instinctual actions (character) to improve our relationships with God, ourselves, other-than-human creatures, and the environment. In this, primal religious ecologies should be retrieved, re-evaluated, and re-interpreted in the light of the gospel. In addition, the converted ecologies may be integrated with conservation sciences for a holistic approach to practicing Christian creation care. However, all this requires churches to continually teach and practice creation care in ways that encourage emulation. The Akrofi-Christaller Institute of Theology, Mission and Culture is one agency in Ghana promulgating African theocology through holistic Christian higher education and grassroots community projects. Although very young, the ACI is promoting Christian creation care lifestyles at some homes, creation care clubs, and churches.

Notes

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[2]Patrick Curry, *Ecological Ethics: An Introduction*, 2nd ed. (Polity Press, 2011), 201.

[3]Lei Nguyen, "5 Biggest Environmental Issues in Africa," published February 25, 2024, Earth.org, accessed October 16, 2024, https://earth.org/environmental-issues-in-africa/.

[4]Mary Evelyn Tucker and John Grim, "Series Foreword," in *Islam and Ecology*, ed. Richard C. Foltz, Frederick M. Denny, and Azizan Baharuddin (Harvard University Press, 2003), xx.

[5]Allison M. Howell, "African Spirituality and Christian Ministry: 'Discerning the Signs of the Times' in Our Environment and Community," *Journal of African Christian Thought* 20, no. 1 (June 2017): 12.

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[7]Emmanuel Katongole, "Mission as Integral Ecology: Doing Theology at Bethany," *Mission Studies* 39 (2022): 165, https://www.academia.edu/88409732/Mission_as_Integral_Ecology_Doing_Theology_at_Bethany.

[8]Katongole, "Mission as Integral Ecology," 165.

[9]Jonathan J. Bonk, "Mission and the Groaning of Creation," *International Bulletin of Missionary Research* 32, no. 4 (October 2008): 170, https://www.thefreelibrary.com/Mission+and+the+groaning+of+creation.-a0186861485.

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[11]H.W. Turner, "The Primal Religions of the World and Their Study," in *Australian Essays in World Religions*, ed. V. Hayes (Australian Association for World Religions, 1977), 27–37.

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[14]Kwame Bediako, *Christianity in Africa: The Renewal of a Non-Western Religion* (Edinburgh University Press, 1995), 83–84.

[15]Pope Francis, Encyclical letter, *Laudato Si': On Care for Our Common Home* (Our Sunday Visitor, 2015).

[16]Ebenezer Yaw Blasu, *African Theocology: Studies in African Religious Creation Care* (Wipf and Stock Publishers, 2020), 236.

[17]Andrew Finlay Walls, "Converts or Proselytes? The Crisis over Conversion in the Early Church," *International Bulletin of Missionary Research* 28, no. 1 (January 2004): 3, https://www.scribd.com/document/725716936/Converts-or-Proselytes-WallsA-2004.

[18]Blasu, *African Theocology*, 6.

[19]Christian Danz, "Theology of Nature: Reflections on the Dogmatic Doctrine of Creation," *HTS Teologiese Studies/Theological Studies* 77, no. 3 (July 2021): 1–7, https://doi.org/10.4102/hts.v77i3.6720.

[20]Pope Francis, *Laudato Si'*.

[21]Bediako, "Understanding African Theology in the Twentieth Century," 15.

[22]Blasu, *African Theocology*, 7; and Marthinus L. Daneel, *African Earthkeepers: Holistic Interfaith Mission* (Orbis Books, 2001), 106.

[23]Daneel, *African Earthkeepers,* 106.

[24]This is a Bantu term, yet its philosophy of communalism—oneness of humanity—so that even distant relations are still relatives to be cared for, cuts across many African cultures in varied forms, levels of intensity, and expressions.

[25]Daneel, *African Earthkeepers,* 106.

[26]Blasu, *African Theocology,* 232.

[27]Blasu, *African Theocology,* 6.

[28]Kwame Bediako, *Jesus in Africa: The Christian Gospel in African History and Experience* (Editions Clé and Regnum Africa, 2004), 22.

[29]Ogbu U. Kalu, "'The Sacred Egg': Worldview, Ecology and Development in West Africa," in *Indigenous Traditions and Ecology*, ed. John A. Grim (Harvard University Press, 2001), 234.

[30]It is significant to establish the fact that, linguistically, to the African religious, there is only one Supreme Being, the same transcendent and Creator God that Jews and Christians refer to as Jehovah, although not necessarily conceived theologically as triune. Because of this view, missionaries had no choice but to use the various Indigenous names for translating the biblical God in the various cultures. That transcendency seems more emphatic in the

informal or grassroots theology and, hence, the conception of God in Africa is depicted in the Indigenous names. For example, in Ghana, the Eʋe call him *Mawu*—He who nothing is beyond or greater than; the Akan say *Onyame*—He beyond whom nothing satisfies. This conception does not change when converted to Christ, because it is primal, the substratum upon which Christian doctrine of God is built. The African, as a Christian, then enriches their natural and basic conception of God's transcendence with the Trinitarian doctrine but does not replace it. God is a Trinity, but the Trinity is essentially a transcendent Supreme Being, a conception that necessarily helps the African's faith, trust, and reliance on God for salvation in a world viewed as holistic but precarious. Hence, both the Christian and primal religionist call the Transcendent with the same name, e.g., *Mawu*. In the daily life experience of the African Christian, they don't consciously go about distinguishing God as the transcendent Supreme Being of Christians different from God conceived by a primal religionist. Rather, the Christian distinguishes God from deities, which primal religionists uphold, in addition to calling themselves "children" of God.

[31]Kalu, "'The Sacred Egg,'" 234; and Ebenezer Yaw Blasu, "Evolution Worldview and Creation Care in the African Society," *Journal of African Christian Thought* 22, no. 2 (December 2019): 22.

[32]Tucker and Grim, "Series Foreword," in *Islam and Ecology*, ed. Foltz et al., xxiv.

[33]Kwame Bediako, "Scripture as the Hermeneutic of Culture and Tradition," *Journal of African Christian Thought* 4, no. 1 (June 2001): 2.

[34]*Oxford English Dictionary*, "paradigm (n.), sense 4," accessed March 31, 2025, https://doi.org/10.1093/OED/1152286518.

[35]Blasu, "Evolution Worldview and Creation Care," 22.

[36]Curry, *Ecological Ethics: An Introduction*, 12.

[37]Katongole, "Mission as Integral Ecology," 167.

[38]Katongole, "Mission as Integral Ecology," 167.

[39]Kwame Bediako, "Gospel and Culture: Some Insights for Our Time from the Experience of the Earliest Church," *Journal of African Christian Thought* 2, no. 2 (December 1999): 8.

[40]Katongole, "Mission as Integral Ecology," 167.

[41]Bediako, "Gospel and Culture," 8.

[42]Katongole, "Mission as Integral Ecology," 167.

[43]Blasu, *African Theocology*, 74.

[44]Bediako, "Scripture as the Hermeneutic of Culture and Tradition," 6.

[45]Pope Francis, *Laudato Si'*.

[46]Ebenezer Yaw Blasu, "Religious Cosmology and Ecology: Traditional Birthing Rites of the Sokpoe-Eʋe as Priming for Creation Care," *Journal of African Christian Thought* 20, no. 1 (June 2017): 32.

[47]Blasu, "Religious Cosmology and Ecology,"34.

[48]David Bookless, *Planetwise: Dare to Care for God's World* (InterVarsity Press, 2008), 50.

[49]Russ Parker, *Healing Wounded History* (Darton, Longman & Todd, 2001).

[50]Ebenezer Yaw Blasu, "Engaging Culture with Scripture: Toward an African Christian Ecological Liturgy for the Outdooring Rite of the Sokpoe-Eʋe," *Journal of African Christian Thought* 21, no. 1 (June 2018): 33–41.

[51]Blasu, *African Theocology*, 233.

[52]Blasu, *African Theocology*, 211.

[53]Blasu, *African Theocology*, 211.

[54]David H. Roper, "Taken in," in *Our Daily Bread*, annual edition (Our Daily Bread Ministries, 2023), 141.

[55]Ebenezer Yaw Blasu and Jonathan E. T. Kuwornu-Adjaottor, "Challenges with Building Christian Academy in 21st Century Africa: Dilemma of Promoting Discipline Character in Christian Tertiary Institutions in Ghana," *Asian Journal of Education and e-Learning* 1, no. 3 (August 2013): 150, https://docslib.org/doc/2422848/challenges-with-building-christian-academy-in-21st-century-africa-dilemma-of-promoting-discipline-character-in-christian-tertiary-institutions-in-ghana#google_vignette.

[56]Blasu and Kuwornu-Adjaottor, "Challenges with Building Christian Academy in 21st Century Africa," 150.

[57]Ben-Willie K. Golo, "The Deficit of Environmental Leadership in Africa and Its Implication for Theological Education in the 21st Century," *OGUAA Journal of Religion & Human Values* 3 (October 2014): 25.

[58]Katongole, "Mission as Integral Ecology," 170.

[59]Katongole, "Mission as Integral Ecology," 170.

Christian Culture

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THE SCIENCE OF THE GOOD SAMARITAN: Thinking Bigger About Loving Our Neighbors by Dr. Emily Smith. Zondervan Books, 2023. 288 pages. Paperback; $19.99. ISBN: 9780310366690.

"Who was the neighbor?" This is the question that Jesus asks in the tenth chapter of the book of Luke, and the question that prompted Emily Smith's book *The Science of the Good Samaritan*. She sets out to show her readers that neighboring is about shifting our thinking and worldview. To achieve this task, Smith wields her wealth of education and experience. Having earned a Master of Science in public health from the University of South Carolina and a PhD in epidemiology from the Gillings School of Global Public Health at UNC Chapel Hill, she is currently an assistant professor in the Department of Emergency Medicine/Surgery at Duke University and at Duke Global Health Institute. She is a mother, a pastor's wife, and the creator of the popular Facebook page "Friendly Neighbor Epidemiologist." Throughout her book, Smith weaves together her Christian faith and her vocation. To her, "epidemiology is the story of the Good Samaritan!" (p. 28); "the sacred work of telling people's stories through calculus and weighted metrics and integrals" (p. 145).

The book is divided into three parts: centering, cost, and courage—the themes in the story of the Good Samaritan (Luke 10:25–37). The first part is about changing our mindsets and challenging our worldviews through centering. The second part is about the cost of doing so; the third is about the courage needed to live as neighbors and to show our faith through deeds. Each part has chapters that begin with quotes from scripture and/or inspirational scholars. The book concludes with acknowledgments and an appendix that contains practical tips, a reading list, and bibliographic notes.

In Part 1, Smith describes centering as the act of showing attention and focusing. The things we center are the things that compel us. She argues that, as Christians, we must center our neighbors: "The Good Samaritan story shows us that centering on our neighbors requires us to shift our attention and focus toward our neighbors" (p. 11). In doing so, we see many inequities. We see the hard truths of discrimination, structural violence, marginalization, and privilege. If these concepts put you on the defensive, I suggest focusing on chapter 5, in which Smith dismantles common arguments with grace and wisdom. She tells how her grandparents earned everything through hard work and perseverance. They didn't have wealth. But they did have white privilege. Smith acknowledges her own family's efforts and hard work, while also acknowledging the system that worked for them and not against them. Her grandparents could own land and farm at a time when others were unable to do so simply because of the color of their skin.

In nearly every chapter, Smith shares examples from around the world: New Mexico, Texas, Honduras, Somaliland, Burundi, India, and more. Readers learn of events such as the Great Scramble, consider the importance of statues such as the Mothers of Gynecology Monument, hear stories from United Nations meetings, and evaluate the importance of access to healthcare. The reader will have both their worldview and their knowledge of geography challenged.

Part 2, surprisingly only two chapters, focuses on the cost of living as a neighbor. Perhaps naively I thought that this section would discuss the financial cost of helping our neighbors. Certainly, food and medical supplies cost money. But instead, in thirteen concise pages, Smith focuses on the costs to our relationships and our health. I found the stories shared in these pages to be particularly heartbreaking. Not to say that the stories of racism in the United States and poverty in Somaliland were not heartbreaking; they definitely were. But the stories of Christians threatening Smith and her family were particularly distressing. She writes that "more than 90 percent of the threats" that she received were from Christians (p. 119). This is an unexpected cost. Throughout the pandemic, Smith has shared her love and epidemiological expertise to help people around the world understand what was happening through her Friendly Neighbor Epidemiologist page on Facebook. Then members of her own community and church family attacked her for it; she even received hand-written threats in her family's mailbox. She recalls a message written in red and black marker that used both biblical revelation language and also language she couldn't repeat. She and her family had to move for their own safety.

Part 3 focuses on the courage to relearn, dismantle our unconscious biases, and live as neighbors. It includes a challenging chapter entitled "Topics Too Many Evangelicals Don't Want to Talk About" (p. 169). This explored several contentious topics such as socialism, capitalism, equity, climate change, and more. She reminds readers that God cares about our faith, and also about how we spend our money and care for our planet. Smith argues that we shouldn't be scared of taboo words. Instead, we should "hold the words up to the cross and see if they reflect heaven" (p. 180). Another equally challenging chapter was entitled "How Do We Measure the Worth of a Life?" (p. 190). Smith tells the story of two doctors: Sheik Humarr Khan, who was Sierra Leone's top Ebola physician, and an unnamed American doctor. Both contracted Ebola while working in Africa. At the time, there was an experimental drug available, but only enough for one person. Although it was stored in the health facility where Humarr Khan was, he didn't receive it. Instead, it was shipped to

the American doctor in Liberia. This doctor lived and the African doctor died. Smith explains that part of "being courageous is coming to terms with the fact that these inequities happen all the time" (p. 199).

While much of the content was inspiring, I also found some disappointments. For example, Smith's suggestion to "have courage to be fully you" (p. 141) made me hesitate. Statements like this may lead people to be more complacent than courageous. Yes, we shouldn't try to be someone else. We should use our unique giftings to love God and love our neighbors. But shouldn't we always strive to be better? To be like Jesus?

Strengths of the book include the detailed stories and science, with moving anecdotes alongside convincing data. All of these are equally inspiring and thought provoking. Emily Smith is clearly a skilled storyteller and scientist. Thus, this book is a successful display of science communication. It integrates science and faith seamlessly. For example, she frequently repeats a phrase attributed to Saint Dominic: "your desk is your prayer bench" (p. 69). Science and faith are not separate; for Smith, her epidemiological desk work is how she communes with God and expresses her faith. Overall, this book should satisfy a variety of readers.

I recommend this book for anyone curious about the field of epidemiology, or curious about how knowledge of public health and poverty can help Christians be good neighbors. While this book may not be a suitable text for a university-level course, since it is neither a "faith book" nor a "science book" (p. 3), it does serve as a helpful example of science as vocation and of science and faith integration. For those with a theology background, it helps to show that science can be embraced. For those with a science background, it can shows that faith can turn work into a calling.

Throughout the book, Smith introduces the reader to many people: Dr. Edna Adan Ismail (p. 15), Frederick Douglass (p. 44), Dr. Paul Farmer (p. 77), Father Gustavo Gutiérrez (p. 80), Dr. Kathryn Hayhoe (p. 172), and many more. So, who was the neighbor? Clearly, these people were. They courageously centered their lives around their neighbors. May we learn from their examples, and from the expert stories and science shared by Emily Smith.

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Environmental Science

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CREATION CARE DISCIPLESHIP: Why Earthkeeping Is an Essential Christian Practice by Steven Bouma-Prediger. Baker Academic, 2023. 213 pages. Paperback; $25.99. ISBN: 9781540966322.

Steven Bouma-Prediger is a religion scholar at Hope College, Michigan, and a well-known theologian who has written about the need for Christians to care for the environment. In his latest book, Bouma-Prediger summarizes the main arguments for earthkeeping and illustrates them with personal testimonies, which make for a delightful and convincing read. He utilizes a pastoral tone that does not water down the scientific content while backing up his arguments with abundant footnotes and Christian meditations from scripture at the end of each chapter. The author presents earthkeeping as a practice solidly rooted in the Bible, Christian theology, and tradition, that is demonstrated in several Christian communities. In short, he maintains that "care for the earth and its flourishing is part and parcel of what it means to be a Christian" (p. 3).

Earthkeeping is a concept related to creation care that, in Bouma-Prediger's mind, is better than stewardship. Stewardship in English "churchy" jargon often minimizes the inherent value of the environment, seeing nature as a collection of resources to be exploited. By using the word earthkeeping, the author emphasizes the meaning of Genesis 2:15: "to take care of the garden."

After clarifying why we should read his book in the first chapter, Bouma-Prediger walks us through selected scriptural passages about nature in the second chapter. We realize the strong connection between us and the other creatures and God's provision to all the created order. He also emphasizes the need to revise our view of the end times. If Christians see the future as living in an immaterial heaven, the earth is not worth saving. With a proper reading of scripture, we understand that God loves his creation, and he expects us to care for it.

The third chapter delves into theological aspects of earthkeeping, in which the author dismantles an accusation that it implies pantheism. Christian theology removed gods from nature but did not remove nature's sacredness. No creatures are gods, but they still have value to God. The pillage of nature cannot be justified. A biblical meditation from the book of Job centers on the use of Leviathan and Behemoth to understand ecological hospitality. The lengthy descriptions of these creatures (assumed by the author to be the crocodile and the hippopotamus) are a reminder that "we humans are not at the center of things" (p. 82). God cares for these creatures even though they are not designed for our specific use.

Chapter 4 borrows relevant teachings about nature conservation from different theologians influential in the history of the Christian church. He quotes Pope Francis, Patriarch Bartholomew I, H. Paul Santmire, Rosemary Radford Ruether, and Randy Woodley. Their views represent diverse theological positions: Roman Catholic, Eastern Orthodox, Protestant, Ecofeminism, and Native American Christian, respectively. The chapter ends with excerpts from the "Joint Message for the Protection of Creation,"

a document written in 2021 by the heads of the Catholic, Eastern Orthodox, and Anglican churches.

Bouma-Prediger gives a practical guide in chapter 5 to describe what to do in our earthkeeping ministry. We should start with reflections on scripture and rescuing Christian tradition in our relationship with the natural world. Living simply is a virtue to cherish, and avoiding overconsumption minimizes severe damage to the environment. "Remember that you have never seen a hearse with a luggage rack" (p. 137) is a phrase that admonishes us not to be greedy with the environment. The disconnection of humans with nature is regarded as "ecological homelessness," which should be counteracted by developing the virtue of caring for creation.

In the author's discussion of environmental justice and environmental racism, he points out that the consequences of pollution and resource depletion are suffered unequally by specific human communities. To be aware of these injustices, we should educate ourselves on how to manage the earth wisely and not abuse its resources. In this way, we will develop ecological consciousness. This section finishes with several ways we can practice earthkeeping as individuals and as a community, after we have learned how to practice gratitude, generosity, and the sabbath rest.

The last chapter presents a biblical statement of shalom: "It is not just about reconciliation between people or reconciliation between humans and God. It is about flourishing of all the earth" (p. 187), where God's creatures, including plants and animals, praise the Lord.

An important omission from this book that is essential to understanding the value of creation care was Lynn White Jr.'s criticism of Christian theology as an exploiter of nature in his influential article "The Historical Roots of our Ecologic Crisis."[1] Some may argue that much of the "greening" of theology was a response to this article, which corrected a misunderstanding of "dominion" and the stewardship mandate in scripture.

Bouma-Prediger's assertion that the afterlife will be "earthy" may not be acceptable to some evangelical groups. If we do not go to heaven and heaven comes to us, then the "left behind" theology is wrong, requiring us to value this earth and not consider it disposable. "An escapist eschatology implies an ethics of neglect and exploitation" (p. 69).

The author's endorsement of positions considered by many as extreme will also be controversial. For example, he quotes the environmental activist and writer Wendell Berry several times, once saying that the destruction of nature is "the worst horrid blasphemy" (p. 39). Most Christians would probably take issue with that statement. He also quotes the African American theologian James Cone, who accuses conservationists of being racists if they do not fight against white supremacy. Environmental racism is a possible root of injustice and nature destruction in some cases but conflating it with white supremacy does not help the Christian cause.

These controversial topics do not diminish the book's value as an excellent pastoral and academic resource for Christians and anyone interested in conserving nature. Bouma-Prediger is highly qualified to teach us about creation care and the different ways to engage in earthkeeping. His masterful biblical exegesis is persuasive in making the case that the environment should matter to Christians regardless of their political perspectives. I highly recommend this book.

Note

[1]Lynn White Jr., "The Historical Roots of Our Ecologic Crisis," *Science* 155, no. 3767 (1967): 1203–7, https://archive.org/details/HistoricalRootsOfEcologicalCrisisV.

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RECONCILIATION IN A MICHIGAN WATERSHED: Restoring Ken-O-Sha by Gail Gunst Heffner and David P. Warners. Michigan State University Press, 2024. 314 pages. Paperback; $29.95. ISBN: 9781611864939.

I am certain, because it piqued my anxious imagination, that I first heard the phrase "reconciliation ecology" from my friend Dave Warners (coauthor). It's at least partly an allusion to the phrase "restoration ecology," which was by then recognized as a subspecialty of applied ecology, even having its own academic journal. Its goal is scientific support for restoring biodiversity and ecosystem function. The problem with restoration ecology is that, while populated with dedicated researchers and practitioners, it struggles with making its case in the wider North American culture.

This new book by Heffner and Warners addresses that issue and is an absolute joy for the hopeful direction it offers. My review copy is well marked up and, having read it twice, I can report that it gets richer on second pass. It too is about restoring biodiversity and ecosystem function, but it probes deeper into human worldviews and their effects on both degradation and restoration.

Plaster Creek (Grand Rapids, MI) is the "Ken-O-Sha" in the title. That Heffner and Warner choose to use the Ottawa name (translation, "Water of the Walleye") presages their centering of human history and cultural significance in its Indigenous roots. It also recognizes that the human-nature connection and relationship, which is associated with Indigenous worldviews, offers an alternative to the rigorous commodification and conquest attitudes of white settlers and, regrettably, most of their descendants.

The book is ostensibly an expansive report on the authors' efforts (with volunteers, students, and community members) to restore a degraded urban stream to

better ecological health. It carefully examines the historic, cultural, ecological, and human contexts that led to the stream's degradation and how their team, Plaster Creek Stewards (PCS), navigates those contexts to restore the human-nature connections to enable the stream to recover.

Key to the restoration story has been the co-founding of the PCS group by Heffner and Warners. This group is an affiliation of watershed stakeholders, students, and volunteers who provide a collective energy and (literal) muscle for the restoration work.

Reconciliation in a Michigan Watershed is well written and good to read. It has thirteen chapters organized into three thematic sections: (1) recognizing the problem, (2) acknowledging our (settlers and descendants) complicity, and (3) committing to restoration. The treatment is rigorous in an academic sense with liberal (though unobtrusive) use of footnotes that link to a reasonably extensive bibliography spanning literature and poetry, news sources, and scientific journals. There is a table of contents and an index of topics to aid in orientation.

Reconciliation … draws from scholarship in a wide variety of disciplines including geology, human history, ecology, sociology, policy, and even faith traditions. Indeed, this could have been simply a successful academic book, making all the interdisciplinary linkages by first explaining the degradation of Ken-O-Sha and then supporting its movement toward restoration within a philosophical frame of reconciliation.

The book is all that for certain, but what sets it apart is the truly tactile blending of personal stories (not only of the authors but also of volunteers and watershed residents) and a clear sense that the authors invested themselves in the restoration work and the people connected to it. There are stories of their apprehension and missteps in public engagement, of discovery or rediscovery of ecological richness and relic rare species, of a living memory of the good and bad. You read this and you know something intimate about the creek, something that can emerge only because the authors write from firsthand experience—mucking about, both literally and metaphorically, in the socio-ecological realities—and from an unspoken but clear love of the place.

I think this is a singularly important book. The term "reconciliation ecology" traces back to one of those interesting thought pieces found in academia. The sort of thing that one reads and maybe offers up as a discussion topic in a student seminar in which we sort through abstractions in a self-satisfying way. This, though, is an example of the idea put into emerging successful practice with all the granular detail about wins and losses, where the dirt under one's fingernails (again, real and metaphorical) is hard won.

Reconciliation …, the book and the idea, is a next step in the authors' scholarship in re-considering the stewardship paradigm for Christian creation-care discipleship. Both authors were contributors to *Beyond Stewardship* (Calvin University Press, 2019), in which an interdisciplinary group of Christian scholars assembled to consider moving beyond the transactional/detached nature of the common stewardship paradigm (God wants me to care for creation so I must care for it) to a paradigm of interrelationship and communion between Creator and creation. It is easy to see the intellectual and spiritual connections between both books and how the authors' experience with PCS grounded their thinking.

It is telling and a little damning that Plaster Creek became "west Michigan's most contaminated waterway" in the very backyard of Calvin University, an institution that rightfully prides itself on rigorous Christian scholarship located in a city (Grand Rapids) closely identified with robust Reformed and Calvinist traditions. It speaks to a blind spot in expression of Christian faith and, likely, a pathology in worldview. Gail Gunst Heffner and David P. Warners make a wise and accurate diagnosis and offer the most promising treatment that I am aware of: reconnection.

It is a wise book and an important book. Highly recommended.

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HOPE FOR GOD'S CREATION: Stewardship in an Age of Futility by Andrew J. Spencer. B&H Academic, 2023. 240 pages including indices. Paperback; $24.99. ISBN: 9781087751474.

Andrew Spencer, who blogs at ethicsandculture.com, has a PhD in theological studies, serves as a supervisor of operations training at a nuclear power plant, and is a senior research fellow for the Institute of Faith, Work, and Economics. His 2023 book *Hope for God's Creation* takes on a difficult task: defining and expanding a Christian environmental ethic based on orthodox, theologically conservative doctrine. Creation should be stewarded with hope even though we are currently in an age when it is subject to futility (Rom. 8:19–21). Overall, Spencer offers a strong theological basis for creation care to an American evangelical readership.

The book considers four major doctrines: Revelation, Creation, Anthropology, and Eschatology. In "Part I: The Background of Creation Care," Spencer describes reasons for creation care, dangers of "environmental entanglement," and a history of humanity and the environment. Christians need to transpose doctrine to action, applying the theocentric approach of ancient Christianity to modern questions, because ethics should flow from theology rather than the other way around. Spencer repeatedly warns that it is dangerous to entangle Christian belief with environmentalism: the fusion could result in pantheism,

contentious issues, and progressive causes such as the liberal social gospel becoming our focus instead. However, Spencer concedes that other ideas, such as libertarian economics, American representative democracy, and even opposition to climate change theories, can also become ultimate values in people's minds and distract from the gospel.

In a summary of the history of environmentalism, Spencer responds to Lynn White Jr.'s famous 1967 essay, "The Historical Roots of Our Ecologic Crisis,"[1] in which White claimed that ecological problems are rooted in European medieval Christianity because it was an extremely anthropogenic religion. Spencer disagrees, explaining that environmental degradation did not begin in the Middle Ages nor is it found only in Christianized parts of the world. Elsewhere, Spencer attributes environmental degradation to a variety of problems: universal human sin, devaluation of creation, modernity, and over-prioritization of economic concerns.

"Part 2: A Theology of Creation Care" relates some classic theological doctrines to creation care. The doctrine of Revelation says that God speaks truth through the special revelation of scripture and the general revelation of the whole of creation. Scripture is true, trustworthy, and authoritative. It tells us that the path to salvation is through Jesus Christ, but it is not comprehensive. The doctrine of Creation holds that the inherent value of all creation derives from its relationship with the creator. The natural world reflects God's glory, fulfilling the purpose for which he intended it, and science allows us to study it in detail. Biblical passages suggest that the curse on the ground after the Fall is both because of human sin and for the good of humans, to draw us to the truth of Christ (e.g., Rom. 8:18–25).

Unlike other creatures, we humans sin, reflect on our lives, have a God-given role as stewards, and bear the *imago Dei*. The doctrine of Anthropology says that we are God's stewards, part of God's great plan of restoration. The goal of humanity is to glorify God as we cultivate creation and work toward shalom. Eschatology, the doctrine of the end times, completes the arc of creation—from a garden with a tree of life and a river, through sin and the wilderness, to redemption with a heavenly city with wildlife, cultivation, technology, and humans. Some people read the Bible to say that the creation will be completely destroyed and a new one made, while others view the earth's end as a fiery purging of evil and the renewal of the current creation in a glorified form. Spencer argues for creation care regardless of your beliefs about God's plan for the end times. He suggests using Francis Schaeffer's term "substantial healing" to describe the Christian task of counteracting effects of the Fall such as injustice, pollution, disease, and poverty.

Spencer lays out ways to live out the mandate for creation care in "Part 3: The Practice of Creation Care." He describes the tension between American culture's individualism and collective action, saying that, just as the Israelites cared for the city of their exile (Jer. 29:7), so Christians should pursue justice and human flourishing for all. He refers to Schaeffer's concept of the church as a "pilot plant," a scaled-down version of the world in which broken relationships are healed. We become more Christlike by doing Christlike acts; as we bring new Christians into faithful acts, we disciple them in the faith as well. Spencer suggests that readers who still are unconvinced about the science of climate change could think of Pascal's wager; we should lower our carbon footprint regardless, since the costs of being wrong are high and many solutions to climate change result in other benefits.

Christians are called to hope in a world full of despair. Spencer advocates for a local focus in which we form a love of place and connection with our neighbors. Resisting the constant pressure to purchase more will leave us more content and less harried. We can make our churches and communities more efficient and intentional in several ways. Spencer himself planted part of his church property in wildflowers to promote pollinators, and he participates in neighborhood clean-ups, working with nonbelievers on projects where his values align with theirs. Spencer resists efforts by extremists to control people's behavior by proposed legislation such as the Green New Deal, advocating instead for balanced regulation that uses incentives to motivate and to drive innovation.

Throughout the book Spencer highlights several themes. One is how Christians have related to the environment. He claims variously that theological conservatives have had an interest in creation care like that of the culture at large, but most people are too involved in their own lives to lead any movement. He accedes that care for creation is not a feature of Western, modern cultural Christianity.

Another theme is concern over the danger of becoming too focused on ideas such as the social gospel of Protestant liberalism and losing focus on the gospel and our identity as Christians. Spencer argues that the abandonment of environmentalism by Christians occurred when strident environmentalists tied care of the environment to other causes.

The nature of science is another book-wide theme. Spencer cautions against scientism, a dangerous philosophy that holds that the only truth that can be discovered is found by study of the material universe. Instead, science is limited; it cannot tell us what to value or what is right or wrong. New scientific discoveries do not threaten our faith because our faith equips us to deal with any new topic, including environmental changes. However, Spencer sometimes describes science negatively—as robbing us of wonder at nature, allowing despoiling of nature, and contributing to the environmental crisis.

Hope for God's Creation makes a compelling argument for creation care that is consistent with theologically orthodox doctrines in a way that suggests kindness, love, and hope. Nonetheless, to people who do not need to be convinced, some of the book might seem repetitive and defensive. Spencer's repeated defense of Christianity against blame for environmental problems, his description of science, and his fear of the danger of liberal values may deter people concerned about the synergistic effects of environmental degradation, poverty, displacement, and other harms to human flourishing.

Spencer does not say much about the Christian mandate to care for the poor, typically a major part of any discussion about creation care theology. He also does not mention the differential effects of environmental degradation on poor or racial minorities. Neither does he talk about evangelical brothers and sisters around the world. There is no mention of the World Evangelical Alliance, Lausanne Movement, or the many Christian organizations working globally on creation care issues.

Spencer cites Francis Schaeffer to represent Christian environmental ethics, and Katherine Hayhoe, contemporary climate scientist and Christian, to represent current Christian environmental concepts. However, he does not cite many prominent theological writers or engage with some of the doctrines one might expect in this discussion, such as the Kingdom of God or the nature of the Church. Perhaps in a follow-up book, Spencer may address how orthodox doctrines transpose into action in a world in which the majority of Christians are not American. For his target audience, evangelical Christian Americans, though, this book is a valuable contribution.

Note

[1]Lynn White Jr., "The Historical Roots of Our Ecologic Crisis," *Science* 155, no. 3767 (1967): 1203–7, https://archive.org/details/HistoricalRootsOfEcologicalCrisisV.

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Evolutionary Theory

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ORIGIN STORY: The Trials of Charles Darwin by Howard Markel. W.W. Norton, 2024. xii + 352 pages, including endnotes and index. Hardcover; $35.00. ISBN: 9781324036746.

Howard Markel, a physician and prominent historian of medicine, has written several books about pediatrics; quarantines; epidemics; cocaine addiction; the Kellogg brothers of Battle Creek, Michigan; and the discovery of the structure of DNA. Extrapolating from that list, a book about Darwin is somewhat surprising; the only obvious connection is Darwin's generally poor health. *Origin Story* is shorter than its pagination implies, with generous margins, seventy pages of endnotes, wide spacing between lines of text, and many low resolution, black-and-white images that sometimes add nothing of value.

The narrative, however, is well written, often engaging, and heavily based on primary sources that are the raw materials from which historians create history—newspapers, magazines, published correspondence (especially from the massive modern edition of Darwin's letters[1]), and unpublished manuscripts. Markel draws effectively on contemporary descriptions of personality, appearance, and character, such as poet William Allingham's observation that Darwin was "tall, yellow, sickly, [and] very quiet" (p. 169).

What were Darwin's trials? His illnesses, concerns over how his theory would be received, and a deep anxiety to be fully credited for discovering natural selection. Markel provides a wealth of detail on each. Unsurprisingly, much attention is given to medical history, especially Darwin's famous maladies, which have inspired diverse diagnoses by qualified experts. While cautioning readers not to expect certainty, Markel favors the view that Darwin "likely suffered from systemic lactose intolerance" (p. 171), as evidenced by his constant battles with headaches, indigestion, nausea, and flatulence.

His poor health directly impinged on the legendary debate about evolution at Oxford in 1860 between Bishop Samuel Wilberforce and anatomist Thomas Henry Huxley, a close friend of Darwin whose nickname "Darwin's Bulldog" encapsulated his love of rhetorical conquest. Ironically, Darwin himself was absent. Why? "Instead of defending his controversial work to his colleagues at Oxford, the self-proclaimed invalid was at a water cure in Surrey" (p. 175). Historical literature devoted to the debate is voluminous. Markel has read everything important—one footnote by itself runs nearly two pages. His comprehensive narrative fairly presents the complexities facing historians. Which original sources are most reliable? What were the biases of their authors? Can we determine with any confidence what actually happened? Many historians have doubted the oft-repeated story that Wilberforce impugned Huxley by asking whether the ape in his family tree was his grandfather or his grandmother, inviting an equally insulting riposte from Huxley. The report in the influential literary magazine, *The Athenaeum*, did not contain this story, but in 2017, Richard England found a local newspaper account that did, effectively altering the historical landscape.[2] Markel's emphasis on this raucous exchange as an important moment in the reception of Darwin's theory is fully justified.

Equally commendable is his treatment of Darwin's dilemma, when Alfred Russel Wallace sent Darwin an essay outlining essentially the same theory of evolution by natural selection that Darwin had formulated twenty

years earlier—but had not yet published. Markel chastises Darwin, Charles Lyell, and Joseph Dalton Hooker for "the subtle devaluation of Wallace's essay" (p. 54) in their carefully orchestrated handling of it at a meeting of the Linnean Society and the subsequent publication in their journal, all designed to ensure Darwin's priority. However, the statement that "Wallace coined the term *Darwinism*" (pp. 65–66) in 1889 is not correct. According to the *Oxford English Dictionary*, it was used in 1860 by Huxley and twenty years earlier in reference to the views of Charles's grandfather, Erasmus Darwin, not to mention the title of Charles Hodge's 1874 book, *What Is Darwinism?*

Just one aspect of this book merits serious criticism: shallow and sometimes misleading coverage of Christian beliefs and their role in the history of science. Perhaps the author's bias is partly to blame. At one point, he describes "the doctrine of materialism" as a "foundational point of modern science" (p. 225), *ipso facto* ruling out any higher dimension(s) of reality, even for humans, although neither mechanistic neuroscience nor reductionist philosophy has solved the mind-body problem.

I do not begrudge Markel his point of view, but a better understanding of religious ideas could have made an otherwise excellent book even better. For example, he speaks of "the hidebound history of Christianity" (p. 8) as if theology never changes or engages changing science in productive conversation. Darwin's critics did not hold "that God created each species perfectly, in His image" (p. 43), a distinction reserved only for humans. The broad assertion that "natural theologists" (Markel's peculiar term for natural theologians) simply "shoehorned the 'facts' they discovered into awkward explanations of the Holy Scriptures," whereas Darwin and Hooker "were fearless in letting the data they collected carry them to logical, fact-based conclusions" (p. 27), is unwarranted. It has never been the job of theologians to discover scientific facts (even if some have done so), and the natural theologians of Darwin's day cannot be blamed for drawing speculative theological inferences from the science of the time, any more than we can blame Darwin for drawing speculative theological inferences from his own theory.

The most important natural theologian in Darwin's circle, the brilliant Anglican priest, polymath, and Cambridge professor William Whewell, was an accomplished mathematician with a profound respect for scientific facts, a few of which (related to the tides) he helped discover. His ideas about philosophy of science and natural theology strongly influenced Darwin, who quoted with implicit approval a passage from Whewell's *Bridgewater Treatise* (a major work on natural theology) opposite the title page of *On the Origin of Species*. Nevertheless, in the footnote accompanying this very point, Markel speaks dismissively of Whewell's "inner conflict on science and religion" concerning the possibility of life on other worlds, because "he argued [in another work] that human life existed only on earth, thanks to God's special relationship with his greatest creation, and railed against those who tried to usurp Judeo-Christian doctrines with unproved scientific theories" (note 56, p. 284). It is instructive that Michael J. Crowe, the leading expert on nineteenth-century debates about this issue, offers a very different assessment of Whewell's position. He "drew heavily on widely available scientific information," treating "the question of extraterrestrial life as a scientific question, rather than an issue that must be decided on religious grounds."[3]

Finally, Merkel's unqualified claim that Lyell's ancient earth was "blasphemous" (p. 22), when first proposed in the early 1830s, contradicts the fact that orthodox Christian scientists and clergy had for decades been finding ways to embrace it without denying biblical truths. Elsewhere he writes unambiguously about Lyell's "Christian faith" being opposed to human evolution (p. 96). This fails to capture the complexity of Lyell's religious beliefs. According to Martin Rudwick, although Lyell never actually "abandoned his earlier nominal allegiance to the liberal wing of the Church of England," by the 1850s Lyell "had become *de facto* a Unitarian after seeing the role of that denomination in America," which he had visited several times starting in 1841–1842.[4] He and his wife worshipped often at the Little Portland Street Unitarian Chapel in London. At the same time, he could not comprehend how the human mind could supervene the rest of nature, if it had arisen from such primitive forms of life. Even as a Unitarian, Lyell continued to believe in human pre-eminence and a providentialist interpretation of natural history inspired by natural theology, while vociferously attacking the biblical literalism of the scriptural geologists (intellectual ancestors of today's young-earth creationists). This theological perspective ultimately lay behind his lifelong struggle with common ancestry. Yet, Markel fails to mention Darwin's very similar quandary: "With me the horrid doubt always arises whether the convictions of man's mind, which has been developed from the mind of the lower animals, are of any value or at all trustworthy. Would anyone trust in the convictions of a monkey's mind, if there are any convictions in such a mind?"[5] Perhaps the author's materialist convictions are also evident here.

Despite my reservations, I recommend this book to anyone interested in Darwin's trials, which were very important parts of his life and career. The wealth of detail and the liberal use of primary sources cannot be ignored.

Notes

[1]Frederick Burkhardt et al., eds, *The Correspondence of Charles Darwin*, 30 vols. (Cambridge University Press, 1985).

[2]Richard England, "Censoring Huxley and Wilberforce: A New Source for the Meeting that the *Athenaeum* 'Wisely Softened Down,'" *Notes and Records of the Royal Society of London* 71 (2017): 371–84, https://doi.org/10.1098/rsnr.2016.0058.

[3]Michael J. Crowe, "William Whewell, the Plurality of Worlds,

and the Modern Solar System," *Zygon* 51 (2016): 431–49, 441, https://doi.org/10.1111/zygo.12265.
[4]Martin Rudwick, "Lyell, Charles," in *Oxford Dictionary of National Biography*, vol. 34, ed. H.C.G. Matthew and Brian Harrison (Oxford University Press, 2004), 856.
[5]Darwin to William Graham, 3 July 1881, Darwin Correspondence Project, "Letter no. 13230," accessed 15 January 2025, https://www.darwinproject.ac.uk/letter/?docId=letters/DCP-LETT-13230.xml.

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THE SACRED CHAIN: How Understanding Evolution Leads to Deeper Faith by Jim Stump. HarperOne, 2024. 261 pages. Hardcover; $29.99. ISBN: 9780063350946.

Jim Stump has served as the host of the *Language of God* podcast for BioLogos since 2019. Many ASA members, including myself, have been interviewed by Stump over the past half-decade. I have frequently interacted with Stump through our common work with BioLogos, both in his role as vice president of the organization and as host for its podcast.

In this book, Stump steps from behind his microphone and tells his own story. His voice sounds the same written as it does spoken. His methods are also the same: he continues to gather evidence through interviews. But in this book, Stump uses his feet as well as his voice, as he travels to about a dozen locations throughout America, Europe, and Africa, combining the data-driven experiences of research with those of a pilgrim searching for relics. These relics are ancient genes and bones, which tell a story of the transition from animal to human.

Stump's travelogue starts in a board room meeting years ago, which resulted in his departure from the Christian university where he had taught. He writes that his "crime" was believing that "human beings evolved over time" (p. 2). In the rest of the book, Stump speaks to us outside the board room, as he wrestles with the evidence for deep time and human evolution, all in the context of his personal philosophy in which science and faith do not only co-exist but also cooperate and co-inhere.

This is a book about a person of faith accepting science, not about a scientist becoming a person of faith (for those stories, turn to Francis Collins and Sy Garte). Stump's story is divided into five parts, with short chapters that read easily, interspersed with black-and-white illustrations by his daughter, Sloan Stump.

The first part is titled "Bible," although it might be titled "Church," because the first chapter focuses on interpretation rather than the Bible itself. Its centerpiece is not quotations, but social science data: for example, a large graph showing the increased acceptance of evolution over time (p. 20). Stump contrasts this data with a personal visit to the Ark Encounter theme park, which is built around a young-earth interpretation of Genesis.

Stump concludes the first part by suggesting that there are ways to read Genesis other than with wooden literalism. To support this claim, he quotes C.S. Lewis on how the "human qualities of the raw materials show through" (p. 54) in scripture. Stump recalls standing over Lewis's grave as a sort of anticlimax: "Nothing mystical or magical happened. … But a pilgrimage like ours to Oxford put flesh and blood on our idea of C.S. Lewis. He was a real guy" (p. 56). Likewise, Stump argues that scripture shines with God's truth despite its "human qualities."

The patience of the Creator is the subject of the next three sections: "Time," "Species," and "Soul." Stump uses vivid metaphors to illustrate the depths of time. One of these is "God's Weekly Planner for Creation," which shows the deep timespan of creation—if the billions of years of natural history were mapped to a seven-day week in a planner, then "all the events that interest us [humans] would be packed into the last hour of the week" (p. 67). A second metaphor is a stack of baseball cards as tall as the Washington Monument, which shows "there are 120,000 generations between us" and the first ancestors of genus *Homo* (p. 126).

In what becomes almost a running joke, his travel plans are repeatedly thwarted. Stump remains "philosophical," almost Stoic, as he retells these events. A vivid section in the middle of the book occurs when Stump finally reaches one of his destinations in France, seeing for himself cave paintings of mammoths in a cave where bears had scratched up the walls. "The difference between [the paintings] and what the hibernating bears left behind is shockingly obvious" (p. 135). The random bear-claw scratches are natural—but the graceful pigment-strokes left by human artists are something else entirely.

As a reader, I want to spend more time thinking about why the paintings look the way they do, and what it means that humans create beauty, while animals can embody it. As a scientist, I wonder what it means that the oldest such paintings were discovered in Indonesia, not Europe. But to address these questions, we are going to need a bigger book. As Stump says himself, the goals of his book must be more modest, because "the beauty and complexity of art and literature have to be experienced in their entirety. That experience can't be summed up in words without massive reduction in meaning" (p. 91).

Yet Stump has no choice but to sum up his reactions in words. Many of his reactions can be aligned with ancient philosophers: he reacts to his woes like Boethius did (who wrote philosophically about his unjust imprisonment) and Stump builds from a material, even chemical, view of the evolution of the universe like Lucretius and Epicurus did (although Stump builds to a Christian theology that

neither of those Greek philosophers could adopt). Stump is a philosopher to the core of his being, integrating and balancing insights from across history, as he is a Christ-follower to the very same core.

As I was reading, I thought of Gregory of Nyssa, a fourth-century Cappadocian Father who also balanced ancient philosophy with the science of his day. To my delight, Gregory showed up later in the book. Stump devotes chapter 17, "Bones and Relics," to Gregory's bones (which are apparently in San Diego today) and to Gregory's arguments about body and soul, which are "surprisingly modern-sounding" (p. 164). Gregory wrote his work, "On the Making of Man," that Stump cites as a direct response to Plato's *Timaeus* and Galen's physiology, so that Gregory too was integrating insights from philosophy and science into the light of faith. Gregory's inclusion in Stump's narrative is apt, and it shows that Christians have been writing books like this for a very long time.

In the fifth and final part, "Pain," Stump asks weighty questions about evil and suffering, which he ultimately addresses with scripture. This section has the most darkness and the most light, as it moves from the evil of eugenics to the hope of Romans 8. Stump states provocatively that "evolution is not random" (p. 213) and that cooperation points to a "clear directionality in how life has developed" (p. 214). He quotes Simon Conway Morris to the effect that life evolves with "an underlying melody" (p. 214), which happens to coincide with musical metaphors commonly used by Gregory of Nyssa. This is new and fascinating science, which is not merely compatible with, but can be driven by, a millennium-old faith. Stump doesn't have room for much detail, but his book opens a door to a world of investigation. The reader might use these citations as a springboard to find out more about the positive contribution faith can make to the study of evolution.

This book is especially targeted at those who, like Stump, grew up in faith communities and feel dissatisfied with the status quo of skepticism, whether that of young-earth creationists skeptical of evolutionists or that of materialists skeptical of faith. In his account, Stump spends the most time on time itself (arguing that we live in a very old universe) and on human evolution (arguing that a material account of the origins of the body is not incompatible with the experienced reality of the human soul).

Most of Stump's book argues a double negative—"not incompatible"—that allows a Christian to accept science but does not emphasize how science might be changed by faith. Near the end, Stump points to positive synergies between science and faith, and to other authors who have explored the same questions, from Gregory of Nyssa to Simon Conway Morris. These connect to a whole literary universe of other authors, each of whom has a slightly different answer to these big questions.

Stump's questions penetrate to the heart of the matter, inviting the reader to participate. His summaries of philosophical debates are both balanced and crystal clear (such as why symbolic reasoning is "qualitatively different" [p. 121] from what came before). He demonstrates a posture of openness rather than of defensive skepticism.

God can work through this book. A Christian with a negative or conflicted view of evolution may be convinced by Stump's patient and thoughtful narrative, especially if they are wrestling with questions of deep time and if they value direct experience in specific places. If they walk along with Stump, they too might end in a place of "sheer, unadulterated hope" (p. 247, quoting Bill Newsome).

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PURPOSE: What Evolution and Human Nature Imply About the Meaning of Our Existence by Samuel T. Wilkinson. Pegasus Books, 2024. 352 pages. Hardcover; $29.95. ISBN: 9781639365173.

As a scientist and a theologian interested in the science-faith discourse, it was a privilege to think through issues regarding human meaning, purpose, and flourishing raised in Samuel Wilkinson's book. Wilkinson received his MD from the Johns Hopkins School of Medicine and is currently an associate professor of psychiatry at Yale University. Like many of us, Wilkinson has struggled with the question, "Is belief in a benevolent God weakened by the theory of evolution?" Fortunately for the readers of this excellent book, Wilkinson challenges familiar claims about the meaninglessness of human existence with a well-organized presentation of interdisciplinary evidence supporting the author's thesis that the purpose of human existence is to choose between our competing natures: the good and the evil.

Wilkinson begins his work by pointing out two overarching dilemmas caused by the theory of evolution that must be addressed. The first is the "doctrine of randomness," which claims that if evolution is a random and haphazard process, then human existence is merely a product of intricate molecular accidents and is consequentially meaningless. The second dilemma is related to the negative evolutionary characteristics associated with human nature, particularly genetic determinism, aggressiveness, and selfishness. These are frequently cited to show the unlikelihood that human beings were created by a loving, benevolent God.

In response, Wilkinson uses evidence from the fields of genetics, biology, ethology, sociology, psychology, and economics to paint a different view of evolutionary processes and human beings. By weaving insights from these varied sciences together, Wilkinson persuasively suggests that a Higher Power used evolution as the mechanism to

create all life, and that human beings have been uniquely equipped to choose between our two competing natures of selfishness and selflessness.

Wilkinson organizes his argument into five main principles which are expanded throughout the book. First, evolution has only the appearance of randomness, because the evolutionary record repeatedly demonstrates a directionality known as convergent evolution. Citing the work of paleontologist and evolutionary biologist Simon Conway Morris and others, Wilkinson shows that while nature may use separate evolutionary pathways for plants and animals to adapt to their unique environments, these pathways repeatedly converge upon the same basic forms, structures, and functions. For example, wings evolved differently in birds, bats, and butterflies; echolocation evolved in land animals such as bats, birds, and shrews as well as in aquatic creatures such as dolphins and toothed whales; and C4 photosynthesis evolved independently among different species of land plants over 60 different times. Consequently, convergent evolution suggests that there are higher-order natural laws that compel the evolution of more highly sophisticated organisms, rather than haphazard random processes alone; this would be compatible with a Higher Power which uses the laws of evolution to create all life.

Second, nature has created competing dispositions within human beings: selfishness and altruism, aggression and cooperation, lust and love. Because human beings have evolved to be both socially generous and self-protective, Wilkinson's discussion helps the reader understand how both the positive and negative characteristics of humanity would have been beneficial for the survival of our species and describes this as the dual potential of human nature.

This leads to the third principle: free will is a key aspect of human nature and enables human beings to choose between the good and evil dispositions within us. Wilkinson persuasively argues that the case for genetic determinism has been overstated. This view claims that humans cannot exercise free will because their choices are determined by their genetics, their brain-body chemistry, and/or their environment; humans are like machines whose brain outputs are determined by the sum of the inputs. Wilkinson counters this argument using the concept of emergence, where evidence shows that the whole often has properties that are greater than the sum of its parts. He also reminds the reader that the rules at one level of reality are often not true at other levels of reality. For example, while quantum mechanics shows that the behavior of matter at the subatomic level is notoriously indeterministic, Newton's laws of motion show that the behavior of matter at the human level can be described with a high degree of deterministic predictability. Yet, when studying the behavior of animals with the simplest brains (e.g., fruit flies, leeches, and microscopic roundworms), researchers discover that their behavior is remarkably indeterministic. Therefore, it would be an oversimplification to assume that the output of human thought and behavior is nothing more than the product of what was eaten at breakfast. Wilkinson strengthens his point further by discussing the large body of psychological research showing that humans consistently and measurably influence and improve their outcomes to the degree that they choose to focus their mental energy on a goal. In other words, because research shows that conscious thought can affect behavior and outcomes, it strongly suggests that human beings do have the causal mental control necessary to make choices over their own behavior, otherwise known as free will.

The fourth principle Wilkinson shares is that strong family relationships are key to the Good Life. During difficult periods of evolutionary history, human beings were most likely to survive if they had strong relationships and were part of a close-knit group. As a result, humans became hard-wired for forming and maintaining deep relationships, especially with those they are genetically most closely related to—their family members. Psychological studies show that adults with strong familial relationships have greater happiness, life satisfaction, sense of purpose, and mental and physical health than those without such relationships. According to Wilkinson, this is how God has evolutionarily rewarded people who have accepted the responsibilities of parenthood.

Wilkinson's fifth principle is that strong family relationships are key to the Good Society. He explains that family life is nature's strongest way of helping us to choose our better natures, biologically driving humans toward the positive attributes of love, trust, loyalty, and kindness. These in turn benefit the broader community in two ways. First, parenthood redirects men's aggressive tendencies, deflecting them toward prosocial ends. Second, such environments produce better outcomes for children. Wilkinson uses sociological studies to show how marriage and engaged fatherhood lead men to adopt more altruistic and cooperative attitudes and provide safe and supportive environments for children to mature and pass down their genetics, simultaneously benefiting society. Therefore, Wilkinson concludes that rather than being a random meaningless process, evolution was God's mechanism for creating all life and shaping human beings through deep relationships in order to choose their better natures.

I found Wilkinson's arguments very robust because he doesn't rely on just one field of study to build his case. He cites research from genetics, biology, ethology, sociology, psychology, and economics to present a fresh and well-reasoned understanding of evolution and human nature that resonates well with belief in a benevolent Creator God. Furthermore, he includes viewpoints and research from voices who are not usually friendly to theism, such as Sam Harris and E.O. Wilson. For example, Wilkinson

uses Wilson's kin selection theory to help support his argument that blood-related family members would be likely to show more altruistic behaviors to one another, thus leading to more kindness and cooperation amongst the group. Yet, Wilkinson is aware that kin selection is controversial amongst some evolutionary biologists, so he also demonstrates that kinship is not required for altruistic behavior. He does this by citing additional research, including the experiments of psychologists Felix Warneken and Michael Tomasello who observed altruism in 18-month-old infants who happily helped adults they had never met before.

I was also impressed with Wilkinson's tact and objectivity when touching on potentially uncomfortable topics such as how to define "God" or the importance of strong marriages for the mental health of both children and adults in a culture in which many families have experienced divorce. Wilkinson's well-informed understanding of both sides of controversial issues appears to have made him an empathetic writer who is easier to read because he makes his points gently with the empirical evidence he brings to the table.

Wilkinson's *Purpose* has a significant and timely message for Western society in an era that is reeling from the cultural revolutions of the 60s and 70s that told us that lives of self-centeredness would make us happy. As self-absorbed individualism increased, commitment to relationships in families and communities decreased, leaving people emotionally disconnected, depressed, and anxious. Wilkinson's book is innovative in that it shows how evolution is coherent with the existence of a benevolent God. It is counter-cultural in an age that encourages meaningless sexual encounters, the abortion of our children, and selfish moral relativism. Lastly, Wilkinson's message is healing for those who wish to return a sense of meaning and purpose to their lives that comes only from deep and committed relationships with friends and family.

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Philosophy of Science

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THE BLIND SPOT: Why Science Cannot Ignore Human Experience by Adam Frank, Marcelo Gleiser, and Evan Thompson. MIT Press, 2024. xvii + 328 pages. Hardcover; $29.95. ISBN: 9780262048804.

Is it possible for a doctor to correctly diagnose a problem but fail to provide a useful cure? That is how I felt as I read this book.

The authors are respected scholars: two astrophysicists—one a Templeton Prize laureate—and the third a philosopher of science specializing in philosophy of mind. They correctly point out that all science begins with human experience, which spurs measurement and abstraction. For example, we experience hot and cold, we then learn to measure temperature, and eventually we develop abstract mathematical models of temperature in terms of molecular kinetic energy or partial derivatives of energy and entropy. We experience color, we then learn to measure wavelength, and eventually we develop a theory of quantum electrodynamics. The authors do not oppose measurement or abstraction; this is how science progresses.

What the authors decry is that the starting point—human experience—gets pushed out of the center of scientific thought and practice, relegated as something to be explained (or explained away) as epiphenomenal. Just as our retinas have a blind spot which we do not see but is essential for vision, so, they argue, we have been trained to ignore human experience when doing science, even though human experience lies at the heart of science and makes science possible.

In the first two chapters, the authors note the contributions of ancient Greek philosophy and Abrahamic religion in the development of science. They celebrate the successes of classical physics from Galileo through the end of the nineteenth century. They also claim that the triumphs of mathematical abstraction in classical physics led to a scientific worldview (that is what they really call it) that embraces the "Blind Spot" way of thinking. They list its main ideas (pp. 5–7): (1) Bifurcation of nature into what is subjective experience (e.g., color) versus what is objective and external (e.g., wavelength), (2) Reductionism—thinking of complex systems as fundamentally nothing but arrangements and interactions of their components, (3) Objectivism—believing that science provides an objective, "God's-eye view of reality," independent of any observation, (4) Physicalism—believing that everything that exists is completely physical, (5) Reification of mathematics—thinking of our mathematical models as if they are what is truly real, the ultimate truth of the universe, and (6) Human experience as epiphenomenal—treating conscious experience as something (or the illusion of something) to be explained by neuronal activity, but fundamentally no more real than, say, a glowing image on a computer screen.

The authors claim that the "Blind Spot" has produced a "crisis of meaning."

> On the one hand, science appears to make human life seem ultimately insignificant. The grand narratives of cosmology and evolution present us as a tiny contingent accident in a vast indifferent universe. On the other hand, science repeatedly shows us that our human situation is inescapable when we search for objective truth because we cannot step outside our human form … (p. viii)

Thus, the authors, like scientists of many religious beliefs, diagnose problems with an atheistic-reductionistic interpretation of science. What they offer as a cure is not a

theistic worldview that provides significance for humans and a place for the practice of science. Instead, they argue that a cure can be found through alternative atheistic worldviews, ones which focus on human experience at the center of science and other parts of life.

In chapters 3–8, the authors describe several scientific fields in which they believe the "Blind Spot" has led to scientific paradoxes and problems, slowing down scientific progress. Humans experience time as unidirectional. We learn to measure time with clocks. We then develop physics theories of particle interactions in which the mathematical abstraction of time is reversible. This seems to create a problem. Time's direction reappears in physics, not at the most abstract, microscopic reductionistic level, but by looking at the big picture of many particles, the growth of entropy, and the overall narrative of the universe that this produces. The "Blind Spot," by reductionism and reification of mathematics, points science away from some of time's most crucial features.

Humans experience interactions with a world of matter. In reductionistic theories of matter, human experience is taken out of the picture. But quantum theory, especially quantum measurements and the apparent "collapse of the wavefunction," currently has several competing philosophical interpretations. In contrast to the "Blind Spot" way of thinking, some of these interpretations put human experience back to playing a central role in explanations.

Humans experience a cosmos that appears to have a beginning. The "Blind Spot" way of thinking insists that science should encompass all objective truth, and it does not accept that our scientific theories are models with limits and boundaries. Unsatisfied with such limits, the "Blind Spot" catalyzes not only the creation but also the acceptance of a variety of multiverse theories which deny a beginning-in-time, at the cost of piling on many untestable assumptions.

Humans experience life and we experience cognition. Reductionism looks for explanations of life and cognition only in terms of how the tiniest pieces (cells, molecules, particles) are arranged and interact. In doing so, the "Blind Spot" misses the fundamental phenomena of living organisms as having autonomy and agency.

Humans experience consciousness as irreducible and fundamental to how we encounter the world. Physicalist thinking treats consciousness as an epiphenomenon whose apparent existence must be explained scientifically only in terms of brain activity. Yet consciousness has existential and cognitive primacy, prior to any scientific studies we do. Moreover, the knowledge we gain by doing science comes to us only via direct experience.

In chapter 9, the authors lay blame for the growing climate crisis on the "Blind Spot." While acknowledging that the growth of science is interwoven with history, economics, and politics, they argue that the "Blind Spot" manifests in all those areas by encouraging humanity to exploit the natural world. (Although, it could be noted, some neolithic cultures—centuries before modern science or economics—thoroughly harmed their local environments, while other cultures lived sustainably for centuries. The critical difference in those cases does not appear to be the "Blind Spot" identified by the authors.) To counteract these environmental harms, the authors encourage using the non-reductionistic tools of complex systems analysis that consider humans as part of the system.

The "Blind Spot" way of thinking, as the authors have identified it, does seem to be fairly common among scientists, and more generally among science-minded individuals. But have the authors identified a unified theme that is a source of paradox and crisis across multiple fields of science? Or have they instead identified a few fields of science which have ongoing controversies—each of which will be debated and resolved within its own field—and imposed a unifying meta-narrative of crisis that does not really explain each individual case? The authors believe the former, but by the end of chapter 9, I found myself thinking the latter.

This book might appeal to Christians who discuss philosophical and religious ideas with science-minded individuals whose worldviews tend toward physicalism and reductionism. The authors have usefully described the "Blind Spot," and some of the problems to which it contributes, in ways that might catch the attention of some non-religious scientists, because the authors' arguments do not come from theistic presuppositions.

The authors do not claim to have developed a comprehensive philosophical framework to replace the "Blind Spot." They call attention to it. They ask scientists and philosophers to work together to create a new framework for science—one which is still fundamentally non-theistic—but which no longer sidelines human experience and instead incorporates it as being primary in the generation of knowledge.

Have they offered a pathway to cure the "Blind Spot"? When I was a scientist-in-training at a Christian college, I was offered something different—a religious worldview in which science played an important role. To counteract objectivism and reification of mathematics, I was taught a critical-realist view in which scientists not only believe that there is a reality beyond their perceptions, but also humbly accept that their best theories are not objective truth but are human-created models which continually need improving. (The authors would not disagree with a critical-realist view of science, but their prescription focuses more attention on the centrality of human experience than on humility.) To counteract radical reductionism, physicalism, and treating human experience as epiphenomenon, I was taught that science is compatible with multiple religious worldviews, and compatible with Christianity in particular—a world-

view that admits multiple sources of knowledge besides science. To counteract some of the harms caused by treating the environment reductionistically as a mere resource, I was taught to think vocationally, with science as a useful tool for achieving some of the broader goals which my Christian worldview said were important. Based on my experience, I think this provides a more therapeutic prescription.

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CONSCIOUSNESS AND MATTER: Mind, Brain, and Cosmos in the Dialogue Between Science and Theology by Kirill Kopeikin and Alexei V. Nesteruk, eds. Pickwick, 2024. 262 pages. Paperback; $35.00. ISBN: 9781666776997.

This is a notable interdisciplinary volume that tackles the complex relationship between the mind and body, exploring it within the broader context of dialogue between science and theology. The collection draws heavily from Eastern Orthodox theological frameworks, using patristic language and thought to engage with the central theme of the mind-body problem. It aims to offer a theologically informed critique of materialistic naturalism and reductionism in the scientific study of consciousness while providing new avenues of thought by integrating theological perspectives. In this review, I will give a brief overview of all nine essays but, more importantly, I will focus on the unifying arguments across the volume and highlight the essays that offer the most significant contributions.

The book's contributors come from academic traditions centered in Eastern Europe, primarily Russia and Greece. Each author's expertise combines scientific, philosophical, and theological perspectives demonstrating impressive multidisciplinary competency and synthesis. While the perspectives vary, their common theological foundation, Eastern Christian thought, provides a cohesive thread. The editors successfully bring together essays that engage with the "hard problem of consciousness," challenging the adequacy of materialistic and reductionistic explanations of mental activity and offering both scientific and theological alternatives.

The essays are organized around two primary approaches to understanding consciousness: one that moves from the brain outward toward the cosmos, and another that begins with the phenomena of consciousness and works inward to the material. This dual structure, as outlined in the introduction, allows for an engagement with consciousness that respects both the microcosmic (individual brain activity) and macrocosmic (the relationship between consciousness and the cosmos) dimensions of human experience. Both approaches, however, are united in their rejection of materialist reductionism and their embrace of various forms of dualism—whether it be the classical Cartesian division of mind and body or theological distinctions such as creator and creation.

The first four chapters take a critical stance toward the reductionist paradigm of materialism. Tatyana Chernigovskaya's opening essay sets the tone by exposing the limitations of artificial intelligence and neural network models in accounting for the full scope of human subjectivity. Chernigovskaya argues that "meanings are more important than algorithms and structures" (pp. 5,7). In other words, the richness of human experience depends on the phenomenological and cannot be reduced to parallel physical processes alone. The critique of materialist reductionism is carried forward by Kiryanov in chapter 2, highlighting the unnecessary metaphysical assumptions that underlie much of contemporary science's dependence on ontological reductionism. Alexander Kaplan's contribution in chapter 3 continues this trajectory by exploring the way in which individual brain activity contributes to the creation of mental models that shape how a person inhabits the world. Each of these chapters points to the insufficiency of any approach that seeks to explain consciousness solely in terms of material phenomena.

A particularly innovative contribution comes from Kavokin in chapter 4, where he introduces quantum mechanics into the discussion of consciousness. Kavokin draws on the condensation of polaritons and the superfluidity of polariton condensates—where light-matter particles enter a unified quantum state, moving together without resistance like a frictionless liquid—to suggest that quantum states may influence the operations of human thought. He links this theory to biblical metaphors of light, proposing that the exciton-polariton model could offer insights into free will and determinism. However, while this quantum-based synthesis is imaginative, it risks overextending itself by drawing speculative theological conclusions from scientific data.

The second half of the book shifts toward a more cosmological approach, with chapters 5 through 9 examining consciousness in relation to the broader cosmos. Alexei Nesteruk's contribution stands out as particularly significant in this section. Nesteruk brings together cosmology, theology, and phenomenology to frame consciousness as a reflection of the universe's complex structure. Addressing the "hard problem," he bridges the dual nature of first-person subjective experience with third-person objective observation. Nesteruk uses patristic theological concepts like hypostasis (the unique, individual expression of a nature or essence in a distinct, relational form) to account for the interplay between the microcosmic and macrocosmic dimensions of the person, offering a profound theological and patristic reframing of the study of consciousness.

Kirill Kopeikin's essay in chapter 6 builds on Nesteruk's insights by integrating theological concepts, such as *creatio*

ex nihilo and *Theosis* (the divinization or transformative process of sharing the divine nature of the godhead), with quantum mechanics. Kopeikin argues that subjective knowledge, the very act of knowing, can alter reality itself, suggesting a panentheistic understanding of the world in which the divine is deeply intertwined with material existence. His theological engagement with quantum theory is one of the most explicit examples of Orthodox theology in the volume, drawing on the concept of the *Logos* to argue that consciousness and the cosmos are fundamentally interconnected.

Chapter 7 offers a brief but intriguing detour from the main thrust of the volume. Kobozev's exploration of the neglected work of chemist Sergey Krivovichev challenges methodological naturalism by offering a fresh voice from outside the usual academic authorities. This chapter adds diversity to the volume's interdisciplinary dialogue, though it remains somewhat disconnected from the broader theological concerns of the book.

The final chapters, including a lengthy essay by Walker Trimble, bring the conversation back to ethical and theological concerns. Trimble draws on an impressive array of classical, patristic, and modern sources to argue for a premodern understanding of the person as an agent shaped by the incarnational theology of the *Logos*. In doing so, he critiques Cartesian dualism and the metaphysical categories of modern philosophy, suggesting that a hypostatic model of human flourishing better accounts for the ethical and spiritual dimensions of human life. This final chapter offers a fitting conclusion to a volume that is deeply concerned with the ethical implications of its theological and scientific inquiry.

The volume is a wide-ranging and ambitious work that succeeds in placing Orthodox theology in dialogue with contemporary scientific debates about consciousness. The interdisciplinary nature of the volume is one of its greatest strengths, as it brings together insights from neuroscience, quantum mechanics, cosmology, and theology in a manner that is both rigorous and imaginative. The book's critique of materialistic reductionism is particularly valuable, as it highlights the limitations of purely scientific approaches to the study of consciousness and opens up new possibilities for theological engagement.

Nonetheless, the book is not without its limitations. The theological reflections, while often insightful, can at times feel speculative or overly reliant on scientific theories that are themselves still in development. The quantum-based approaches in particular run the risk of overextending theological claims based on emerging scientific data. Furthermore, while the volume brings together a diverse range of disciplines, it is less diverse in its theological perspectives, with most of the contributors adhering to a broadly dualistic framework. This can make the volume feel somewhat monolithic in its approach to the mind-body problem, despite its interdisciplinary aspirations.

Consciousness and Matter offers a rich and provocative contribution to the dialogue between science and theology. For those interested in the intersection of science and theology, particularly from an Eastern Orthodox perspective, this book is a significant and worthwhile contribution.

Reviewed by Allan Theobald (MA in biblical literature, MSc in philosophy of science), rector of Emmaus Anglican Church in Montreal, QC.

Physics

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ON THE ORIGIN OF TIME: Stephen Hawking's Final Theory by Thomas Hertog. Bantam Books, 2023. 313 pages. Hardcover; $28.99. ISBN: 9780593128442.

The two most vexing problems for naturalistic cosmologies are the beginning of time and the exquisite fine tuning of numerous physical parameters that make life possible. The late theoretical physicist and cosmologist Stephen Hawking, a professed atheist, wrote: "It would be very difficult to explain why the universe should have begun in just this way, except as the act of a God who intended to create beings like us."[1] *On the Origin of Time* is the culmination of Hawking's quest for a theory of everything that aims to explain the universe without reference to a transcendent deity. In language accessible to a scientifically educated reader, Hawking's close collaborator, theoretical physicist Thomas Hertog, charts Hawking's abstract journey toward a final theory by use of analogies and thought experiments. The reader unfamiliar with advanced mathematics will be grateful not to find pages filled with exotic calculations but, rather, an engaging science lesson enriched by personal anecdotes of a poignant friendship. Hawking's final theory is brilliant and, if true, would be quite elegant. There are reasons, however, to doubt whether his theory accurately models reality.

The first challenge for any naturalistic ultimate theory is the metaphysical implication of a beginning in time. Astronomical observations of the red shift of distant starlight provide strong evidence that the universe is expanding, and that the cosmic microwave background radiation confirms a beginning. Hawking's theory abolishes the notion of time zero by folding the first moment of time into a perpendicular dimension of space, as the indeterminacy principle renders time and space indistinguishable within the initial Planck interval. Hawking presents his "no boundary hypothesis" geometrically as a rounded (rather than pointed) origin on the time chart of the universe, and mathematically with equations written in imaginary time notation. His conclusion that the quantum fuzziness of time zero, rendering initial Planck time indistinguishable

from initial Planck scale, follows logically from Heisenberg's uncertainty principle.

Less convincing is Hawking's slide from mathematics into metaphysics, as he then reasons that the question of what preceded the universe is therefore meaningless. And yet, meaningful questions remain. Although he succeeds in arguing that the temporal beginning of the universe was quantifiably indistinct, his model overlooks the separate category of a discrete ontological beginning. His theory leaves unanswered what initiated the expansion and why there exists something rather than nothing.

The second challenge is to explain the precise specificity of the many physical constants and parameters that make possible galaxies, stars, planets, and living creatures. Hawking recognizes that if any one of these values had been even slightly different, life could not have appeared anywhere at any time in the history of the universe. Hertog writes that "the fundamental laws of physics appear to be specifically engineered to facilitate the emergence of life" (p. 9). Aware of its theological implications, he calls this anthropic principle "the most contentious issue in theoretical physics" (p. 28). Whereas many theists consider these finely tuned parameters of the cosmos to be compelling evidence for purposeful design by a transcendent intelligence, Hawking looks elsewhere for an explanation. His ambitious final theory rests on the claim that the laws of physics were not imprinted onto the universe from the beginning but emerged through a cosmic natural selection process.

In the journey toward Hawking's final theory, Hertog guides the reader through a breathtaking series of mathematical explorations of the history and concealed geometries of the universe. One suspects that the intricacies of quantum entanglement, gravitational time dilation, string theory, black hole entropy, and infinity paradoxes are just ordinary conversation for a genius such as Hawking. Putting it all together, he speculates that the universe is a hologram, and all that we experience is a projection arising from a hidden thin slice of spacetime (p. 212).

Hawking's answer to the anthropic principle may be summarized conceptually in the following way. If, as quantum mechanics predicts, every particle and packet of energy in the universe behaves as a quantum wave function, then the universe may be described as the complete set of quantum states that, when combined, compose a universal wave function. Furthermore, wave functions are defined mathematically by the Schrödinger equation as probability distributions that collapse into definite values or eigenstates only when an observer performs a measurement. Prior to a measurement, wave functions may be thought of in terms of Feynman's "sum-over-histories" scheme, by which a quantum system is described as a path integral containing all possible paths. Applying this mathematical approach to the physical parameters of the universe, then every specific physical constant, parameter, and event that might have been different can be thought of as a collapsed probabilistic wave function. For Hawking, what brings about this collapse of indeterminacy to specificity, such that the parameters of the universe happen to align in such a way as to be finely tuned for life, is the act of measurement.

Hawking envisions a series of such measurements in a natural selection process intrinsic to the universe. He posits a *retroactive* selection process for biofriendly parameters, a process performed by life that emerged billions of years after the big bang. For Hawking, whose mathematical finesse had erased zero from the cosmic timeline, such a time paradox was not an insurmountable challenge. Once life emerged, he reasoned, its existence and awareness of the universe somehow constituted a measurement or observation that caused all alternative hypothetical past histories to melt away. "This," wrote Hawking in an earlier volume, "leads to a radically different view of cosmology, and the relation between cause and effect … We create history by our observation, rather than history creating us."[2] Note that Hawking is not saying that the history of the universe can be understood only in retrospect; he is claiming that our observation of the universe has retroactive force. According to his theory, the existence of humanity and our measurement of the behavior of the universe, rather than God, are the creative influences that made it as it is and not otherwise.

Hawking supports his principle of retrocausality by appealing to the delayed-choice quantum experiment of John Wheeler. In this experiment, a photon passing through a series of two beam-splitters seems to "choose" its behavior after a change has been made in the detection apparatus. Wheeler himself rejected the inference of retrocausality but maintained, consistent with Hawking's perspective, that "no phenomenon is a phenomenon until—by observation, or some proper combination of theory and observation—it is an observed phenomenon." Further, "The universe does not 'exist, out there,' independent of all acts of observation. Instead, it is in some strange sense a participatory universe."[3] Thus, Hawking would have us believe that the finely tuned parameters of the universe, though they must have been what they are from its beginning for us to exist, are merely an artifact of our observation.

Holographic cosmology, explains Hertog, "envisions that physical reality isn't just made up of real things, like particles of matter and radiation or even the field of spacetime," but rather, mathematics "brings about physical reality" and even the laws of physics (pp. 244–45, 258). Holographic theory catapults cosmology into an abstract realm of elaborate speculation. It succeeds in dispelling theories of multiverses but at the expense of reducing reality to an artifact of mental abstraction.

The suggestion that we, as observers, create reality for ourselves is an exhilarating idea, but spectacular mathematics does not make it true. Hawking's hypothesis that the laws of physics originated from a natural selection process and "not in a structure of absolutes beyond it" (p. 258) overlooks the logical prerequisite that laws and mathematics to govern such a selection process would have had to originate from somewhere. His final theory, it turns out, is less than final, for it leads to a paradox of endless regress that fails to explain fine tuning but only defers the explanation to other levels.

Furthermore, Hawking's romance with subjectivism invalidates reason itself, including mathematics, on which his cosmology is based, for if physical brain events and their corresponding thoughts are nothing more than artifacts of our subjective observation, then there can be no basis for believing any theory to be a true model of the cosmos. The mathematics of quantum cosmology has not rendered the idea of God unnecessary. Rather, it leads to further questions, such as why quantitative mental models can effectively represent spacetime and make scientific predictions. Why is the universe humanly comprehensible?

Hertog writes that Hawking considered his final theory "to mark the end of my battles with God" (p. 208). Although his purpose in wrestling with God differed from that of Jacob, who sought God's blessing (Gen. 32:22–32), this reviewer wishes for God's blessing on Stephen Hawking and his colleagues, whose scholarship challenges us all to continue to pursue the challenging and ultimately meaningful questions about the universe and our place in it.

Notes

[1]Stephen W. Hawking, *A Brief History of Time: From the Big Bang to Black Holes* (Bantam Books, 1988), 127.

[2]Stephen W. Hawking and Leonard Mlodinow, *The Grand Design* (Bantam Books, 2010), 140.

[3]John Archibald Wheeler, "John Archibald Wheeler," in *The Tests of Time: Readings in the Development of Physical Theory*, ed. Lisa M. Dolling, Arthur F. Gianelli, and Glenn N. Statile (Princeton University Press, 2003), 490–91.

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Psychology/Neuroscience

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THE INTEGRATION JOURNEY: A Student's Guide to Faith, Culture, and Psychology by William B. Whitney and Carissa Dwiwardani. InterVarsity Press, 2024. 227 pages. Paperback; $30.00. ISBN: 9781514000564.

There is a plethora of books regarding the integration of Christianity and psychology. It is no wonder, then, that one could get either overwhelmed or frankly bored by the repetition of very similar ideas told in seemingly infinitely different ways. But I was pleasantly surprised by this work by Whitney and Dwiwardani. It contrasts with most earlier works on integration by extending the discussion beyond the theoretical and challenging the reader to consider the process of integration in a more dynamic and expansive way that emphasizes the vital role of cultural context. Though the authors neglect to mention a few others (e.g., David I. Smith[1]) who have likewise written about the integral role of culture for Christians' understanding of the world, this book is nevertheless engaging and challenging. It is also understandable despite discussions of the complex interplay between personal, cultural, spiritual, and emotional variables involved in the integration process. The authors intersperse biblical texts throughout the book in a way that flows smoothly with the discussion, treating the relevance of scripture in substantive ways rather than "forcing" a fit. Reflection exercises and questions in each chapter add interest and interactivity. This eight-chapter book is written for students, but I have no doubt that professionals from across different disciplines would also benefit from reading it.

The authors begin by clearly stating that the views they present are meant as a guide, not as a definitive work on integration. This is a refreshing demonstration of intellectual humility, and encouraged me to approach the book with a non-defensive stance. They also make no assumptions about the readers' knowledge of key terms, and thus briefly explain all relevant concepts before moving forward. Importantly, integration involves not only the obvious factors of Christian theology and psychology, but also culture. The interplay of these topics is the main focus of this work. The authors' challenge to the reader to consider the powerful role of one's own cultural identity in professional and everyday life is the most impactful aspect of this book. They note that this cultural self- and other-awareness is not only important, but is *required* of all believers if we seek to love others in our work and personal lives. This is one of the main reasons why I highly recommend this book.

Whitney and Dwiwardani then proceed to discuss how ideas of integration are embedded in the stories we have heard while growing up and those that we inhabit. They emphasize this point throughout the book by seamlessly interweaving their own stories where relevant. One main point is that these stories bias the ways we interpret the world, and thus considering them can help us challenge ourselves to broaden our understanding of the way our Christian faith interacts with our understanding of others and our approaches to integration. While respecting the multitude of stories represented by humans, the authors nevertheless emphasize that the ultimate narrative that should guide our approach to life is that of the Bible. This delicate balancing of respect for others' traditions alongside the universal mandates of scripture to love and seek justice for all is handled well throughout the book. As the authors note repeatedly, it is that love of Christ and others

that is the guiding principle for all of integration and life. By presenting the familiar Creation, Fall, Redemption, and New Creation/Restoration framework (chap. 3), the authors hold the tension between the brokenness of the human condition and the hope that exists in Christ to be agents of redemption and renewal in our lives. It is that grace, alongside our cooperation, that is key in our efforts to love others in our personal and professional lives.

In subsequent chapters, Whitney and Dwiwardani elaborate on the role of culture in integration by, for example, noting the oft-overlooked point that much of culture is "invisible" (chap. 4) and thus often overlooked or underestimated in its potential effect on our ideas and ways of interacting with the world. Further, our cultural identities and experiences are dynamic and flexible. One example of cultural influence is the assumption of dualism (body and mind) and inherent naturalism so prevalent in Western culture. It would have been helpful for the authors to also discuss the dualism of our cognitive and emotional capacities, and how the separation of these two is an artificial dichotomy characteristic of our culture.

The next chapter discusses the process of transformation when we go beyond mere intellectual knowledge to experiential knowledge. In keeping with their holistic view of humans, the authors emphasize the important role of our emotions in our deeper understanding of social realities. Emotions should not be underestimated or relegated to the role of "obstructing" our knowledge of truth; they are a gift from God that can draw us closer to truth, to one another, and to God.

In chapter 6, Whitney and Dwiwardani discuss "epistemic injustice" and "testimonial injustice." They challenge readers to consider their own biases in terms of whose stories and ways of understanding and integrating scripture with psychology we prioritize. As with the tone of the whole book, this is presented in an inviting manner, with grace and truth.

The following chapter discusses the vital role of lament in our ongoing journey of transformation and learning about integration. We need to be willing to see injustices, allow ourselves to feel the lament, and yet hold space for hope. We need to "learn to live in the liminal space of lament and restorative hope" (p. 184). As a minor critique, it would have been helpful for the authors to note the work of others (e.g., Soong-Chan Rah[2]) who also speak of a uniquely Christian lament in response to a broken world. The final chapter comes full circle, returning to the idea that practicing integration requires active participation; it cannot simply be accomplished by simply reading good works on integration. It is a process that involves our whole selves. In keeping with the authors' intellectual humility, the book does not end with any statement suggesting "now that you know all about integration after having read this book …" Instead, the authors remind readers to honestly explore their own stories and cultural embeddedness as they further develop their faith, love for others, and their own integration approaches. The only distracting part of this last section is a brief history of integration, which might have been better placed in the introductory chapter.

In sum, Whitney and Dwiwardani emphasize that crucial to the integration endeavor is the Christian's desire to live in accordance with the narrative of scripture, which calls us to love God and others. Their views regarding integration of faith, psychology, and life aptly hold the tension between respecting cultural differences and calling us all to aspire to live out the same narrative of scripture. It is a paradox well worth continuing to explore in the integration literature and beyond.

Notes

[1]David I. Smith, *Learning from the Stranger: Christian Faith and Cultural Diversity* (Eerdmans, 2009).

[2]Soong-Chan Rah, *Prophetic Lament: A Call for Justice in Troubled Times* (InterVarsity Press, 2015).

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Science and Faith

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GOD THE GEOMETER: How Science Supports Faith by Thomas J. McAvoy. Resource Publications, 2024. 180 pages. Paperback; $23.00. ISBN: 9798385208272.

Thomas McAvoy, a chemical engineering professor for nearly forty years, chose to pursue how science supports faith in the years following the tragic death of his first wife. This left him seeking answers to questions about how God interacts with us and allows suffering. His Roman Catholic faith influences his writing and gives it a distinct style, different from typical Protestant books on science and faith. I appreciate many of McAvoy's insights. However, his goal of demonstrating that science truly supports Christian beliefs is a bold, wide-scope endeavor that may not be persuasive to every reader, since this concise book briefly summarizes McAvoy's thoughts on a range of topics: the big bang, fine-tuning of the universe, the solar system, and evolution, with digressions on free will and quantum indeterminacy, natural and moral evil, and miracles.

One expression that McAvoy often uses is the "design imperative," something his engineering mind has latched onto in reference to the design of something to "perform a specified task (subject to certain solution constraints) optimally." He repeatedly uses this phrase in his discussions of modern scientific findings and theological views, arguing that God created a physical universe with apparent order and laws that allow for free will. In such a universe, natural evil and thus human suffering will be inevitable. McAvoy

is familiar with Harold Kushner's work, *When Bad Things Happen to Good People*, and he finds common ground with the Rabbi, who experienced deep suffering from his own son's disease. Both view God as not personally responsible for human suffering from natural evils since God created a world in which free will is possible and thus random and chance events will take place.

McAvoy takes the reader through exciting findings of modern cosmology, that is, the confirmation of the big bang. Studies of cosmic microwave background radiation allow us to infer the earliest moments of the universe, beginning in a hot, dense state, rapidly expanding and cooling to yield a cosmos in which star and planet formation could take place only if many factors were finely tuned. Appealing to a multiverse to explain the fine-tuning is not very convincing to McAvoy, who claims that "God's design imperative" is a better explanation. In other words, he sees Christian belief in a Creator God aligning much better with scientific findings than appealing to numerous undetectable universes.

The most interesting part of the book for me is the discussion of biological evolution. It is obvious that McAvoy is well read in this area. He begins by critiquing Harvard paleontologist Stephen Gould's claim that if the history of evolution could be re-run, it would most likely not result in intelligent life. McAvoy is strongly persuaded by biologist Simon Conway Morris's arguments of convergent evolution. Morris holds that evolution is a process that leads inevitably to certain features, including intelligent life. McAvoy rejects Daniel Dennett's claim that evolution is a purposeless algorithm. Amazingly, he finds himself in agreement with Richard Dawkins on the claim that moral altruism arises naturally out of the evolutionary process. Unsurprisingly, he finds much in common with Michael Ruse, author of *Can a Darwinian Be a Christian?*, and who is quite critical of Dawkins's narrow views of Christianity. McAvoy's engineering mind leads him to emphasize that there are tradeoffs in a universe that allow free will, and one of those will be natural evil or human suffering. This is part of the "design imperative" view he emphasizes. For him, biological evolution fits neatly into this view.

McAvoy digresses to discuss intelligent design (ID), focusing on two competing authors: Michael Behe and Kenneth Miller. Behe is one of the best-known proponents of ID and has used the concept of irreducible complexity to argue in favor of design. Miller is a well-known proponent of theistic evolution and a critic of Behe. McAvoy finds Miller far more compelling and in alignment with his own views. He focuses on the example of blood clotting as an extremely complicated biological process that appears to be irreducibly complex. Yet Miller uses the work of molecular biologist Russell Doolittle to show how it could have evolved. Furthermore, the presence of pseudogenes in our DNA supports an evolutionary scenario and makes ID an unsatisfactory approach. McAvoy concludes that ID is not a valid science.

He then discusses how God intervenes in this world, often in ways that involve spiritual matters and rarely by overriding natural laws in the form of miracles. McAvoy claims that the latter must be rare for us to truly be creatures that have free will. He argues that if God often performed miracles, we would depend on those instead of accepting a natural world governed by physical laws and principles. His digression on free will and quantum indeterminacy is meant to establish how determinism is not possible in this universe. The fact that the microscopic realm is governed by probabilistic rules, rather than deterministic ones, allows for nondetermined outcomes, and thus allows for free will and limits how God interacts in the world. This argument is a bit unsatisfying to me, since it does not consider the role of our minds and consciousness, which still defy adequate scientific explanation. Nor does it allow for God interacting in other ways that we cannot understand. McAvoy is not a deist, but he does appear to limit how God works in this world.

I also found that the final two chapters on miracles diminish the thrust of the book, rather than add to it. While McAvoy wants to show that there is scientific evidence to support miracles having taken place, his choices of the Shroud of Turin, Our Lady of Guadalupe, Eucharistic miracles, and others reveal his deeply Catholic perspective and give a parochial twist in the book. I can appreciate that miracles have indeed occurred, because I am already a Christian who believes in miracles. But I doubt that skeptics will be impressed by the chapters on miracles. Most Christians believe that the greatest miracle is the Resurrection and our resulting salvation through faith in Christ. The author may agree, but that gets lost in his focus on other matters. McAvoy concludes by emphasizing once again the "design imperative" and how all the scientific evidence presented affirms it. God is the grand Geometer who designed this universe and science affirms faith in him. Overall, I recommend the book as a worthwhile read for anyone interested in science and faith and particularly in the topic of human suffering.

Note

[1]Joseph Shigley et al., *Mechanical Engineering Design, 7th ed.* (McGraw Hill, 2004), 5.

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THE ROAD TO WISDOM: On Truth, Science, Faith, and Trust by Francis S. Collins. Little, Brown and Company, 2024. 288 pages. Hardcover; $27.00. ISBN: 9780316576307.

Even though Francis Collins has a PhD in physical chemistry from Yale University, an MD from the University

of North Carolina at Chapel Hill, was the director of the Human Genome Project, and served as the director of the National Institutes of Health for 12 years under three presidents, to anyone who knows him, he is just "Francis." Approachable and humble, Collins is an active member of the American Scientific Affiliation.

While serving in these influential roles, Collins made time to speak and write widely. His 2006 book *The Language of God: A Scientist Presents Evidence for Belief* received widespread acclaim and thrust him into the public as a foremost spokesperson for the compatibility of Christian faith and science. It also coincided with his founding of the BioLogos Foundation in 2007. His winsome personality and understated intellect disarm critics and engage listeners and readers. But the COVID-19 pandemic challenged and tested Collins in new ways, beyond the resistance he had met previously as a leading scientist and Christian believer. This elevated Collins's concern about the need for wisdom in these unique times. *The Road to Wisdom* is his response and guidance for how to live as a thoughtful Christian in today's contentious world.

In this book, Collins develops an argument that political discourse in the USA has become divisive and has abandoned wisdom. In his estimation, the road to wisdom requires four goods: truth, science, faith, and trust. One might add other goods to these, but Collins makes a good case for how important these four are.

First, Collins makes the case that scientific and spiritual truth are available to all who are willing to pursue it humbly and earnestly. To illustrate this, he uses the metaphor of a spider web of truth to illustrate varying degrees of confidence. The strongest and most tightly woven threads in a spider web are at the center and lessen in strength as they widen and move outward. Similarly, we hold different levels of truth with different levels of confidence. The spider web moves from necessary truth in the center (2+2=4), then outward to firmly established facts (the earth is round), uncertainty (dark matter), and finally to opinion (dogs make better pets than cats). This typology of levels of certainty in what we consider true is a helpful framework for guiding discussions on complex topics. This section brought to light for me the different views Christians have about the role of extra-biblical information in determining truth. Collins has opened an important topic that invites further exploration.

Second, Collins defends science as a time-tested and powerful method for separating truth from falsehood. He expresses significant dismay at the level of distrust in science that has emerged in the USA in recent years, given the degree to which science benefits every person's life every day. Collins gives examples of mistakes scientists, including himself, have made, but he maintains that the peer-review process of the scientific community is able to guide the work of science appropriately. This chapter becomes quite personal, as Collins defends his response to the COVID-19 pandemic, while acknowledging his own errors. As an epidemiologist who was active in mitigation measures during the pandemic, I shared Collins's angst about how things unfolded. Critics might find him to be somewhat defensive; I found his argument compelling.

Third, Collins makes the case that faith is necessary for wisdom. Faith can illuminate vital transcendent truths. In this chapter, Collins freshens up views he has previously developed in his other books: *The Language of God* (2006); *The Language of Life: DNA and the Revolution in Personalized Medicine* (2010); *Belief: Readings on the Reason for Faith* (2010); and, with coauthor Karl W. Giberson, *The Language of Science and Faith: Straight Answers to Genuine Questions* (2011). From the section beginning with "What do atheists think of all this?" to the end of the chapter, Collins considers issues such as doubt, uncertainty, and the opportunity for a renewal of confidence in the veracity of authentic Christian faith. He is cautiously hopeful that a renewal of Christian faith is possible.

Finally, Collins explains that trust must be earned. This is done by showing others that you recognize the preeminence of truth, while humbly acknowledging your own limitations. Collins describes the four elements that he believes create trust: integrity, competence, humility, and aligned values. Some readers might find Collins to be defensive of the actions taken by himself and Dr. Anthony Fauci during the COVID-19 pandemic, but I found his explanation to be persuasive. Beyond COVID-19, other examples of how science has successfully answered scientific questions, and thus built trust in the scientific method, are particularly helpful in this book.

One question that remains vexing is how to handle disagreements based on fundamentally different views of how we know what we know. Collins's noble goal is that if we respect each other, and listen, we can lessen the acrimony and build understanding. But some people are holding tightly to dangerous views that are built on non-truths—e.g., that the risks of some vaccines outweigh their benefits, or that climate change is a hoax. This book is a good start to address the problem of deeply held disagreements, but there is much work to be done.

The Road to Wisdom will appeal to most readers of this journal. It is written at a level that does not need advanced knowledge of science or theology. I studied this book in a small group; this approach enhanced its value and increased comprehension. Incidentally, the high-quality illustrations included in the book were created by Collins's granddaughter. This book is another excellent contribution by Francis Collins, and it comes at a very important time.

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Theology

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CUCKOOS IN OUR NEST: Truth and Lies About Being Human by Iain Provan. Cascade Books, 2023. 258 pages. Paperback; $27.00. ISBN: 9781666768701.

According to Provan, retired professor of biblical studies at Regent College, Vancouver, today's most pressing question for Christians is "What is a human being?" He is particularly concerned about contemporary unbiblical responses to this question that have compromised our views. Like the cuckoo (a parasite and an assassin), that sneaks its egg into the nest of another bird that then raises the chicks, these concepts have infiltrated our faith communities. Christians need to be aware of these "cuckoos" and to reflect seriously on what it means to be human.

Provan addresses this problem in fifty short accessible chapters, and offers study guide questions on his website "The Cuckoos Consultancy." His audience is primarily Bible-believing Christians; for more-academic treatments of the topic, he refers readers to his previous books, especially *Seeking What Is Right* (2020), *Seriously Dangerous Religion* (2014), and *Convenient Myths* (2013). As a lecturer on theological anthropology, I did not find anything startlingly new in *Cuckoos in our Nest*, or anything I strongly disagreed with. However, Provan does offer a fresh framing of concerns for the contemporary church and much information for those not familiar with the situations and questions.

The first section of the book, "Finding Out," addresses how we can acquire reliable knowledge about the human person. In a world of dis- and misinformation, finding truth is challenging. Provan respects the process and products of science while acknowledging its imperfections. He notes the need to trust experts and to practice humility; both are uncommon in our world today. The critical question is "Whom shall I admit to my circle of trust, and why?" (p. 12).

The second section is a summary of Christian "Fundamentals" that sets the stage for later arguments. Provan tackles fourteen diverse topics in chapters ranging from "In the Beginning," "Animated Bodies," and "Whole Persons," to "Saved," "Hopeful," and "Confessing." He relies much on creation narratives, with a notable emphasis on embodiment. As bearers of the divine image, humans are whole beings, personal and material—"divinely animated matter" (p. 43)—having great value, dignity and beauty. We are called to be rulers and priests over creation, caring for and developing it. We are also called to be in relationship with God—faith involving more than just belief but total trust, love and obedience, right thinking, and right living. And we are called to live in community with our neighbors, caring for them. Provan is clear that the created order affirms the sanctity of life, gender binaries, and the rightful place of sexual intimacy within marriage—a covenant bond between man and woman. In dealing with our fallenness, he interprets idolatry broadly, noting that worship of self is common. He insists that we need to "embrace Christian truth *as a whole*" and "embrace it *as whole persons*" (p. 84).

In the third section, "Furthermore," Provan examines some implications of the Christian view he outlined in Part 2, including fifteen diverse areas of life in chapters such as "Worship," "Rights," "Life," "Death," "Gender," "Children," "Church," "Work," "Creation Care," and "Politics." As embodied beings, we worship with our whole selves and lives, reciting Christian doctrine through singing and meeting together in person. Churches need to practice hospitality but with clear boundaries based on sound doctrine. Being made in God's image, all persons have the right to life, a gift that begins in the womb, does not depend on capacities, and can only be taken away by God. Our bodies are temples of the Holy Spirit so their form should not be arbitrarily changed.

As per the creation mandate, work encompasses all areas of life, including care for creation and political engagement, and is done for the purpose of glorifying God. This may lead to material gains, which are not unbiblical, but wealth should be distributed wisely. With respect to loving one another, biblical love is not sentimental but enables us to "see things as they actually are" (p. 138) and act accordingly. Having compassion on others involves seeing them as image bearers rather than as helpless victims. As priests over creation, we are called to understand our fallen cultures while "very deliberately and counter-culturally" working out "the implications of our Christian anthropology in our lives" (p. 147).

Provan gets to the crux of his argument in the fourth part of the book, titled "Foreign Bodies" (chapters 36 to 50), that names the "cuckoos." These often follow contemporary ideologies that are rooted in traditional philosophies, are incompatible with the biblical story, and are often incomplete and incoherent. Some relate to the acquisition of knowledge; others offer competing "religions." For example, the Science Cuckoo (scientism) claims that science explains everything. The Look Inside Yourself Cuckoo, that follows notions from Romanticism, idealizes nature and encourages people to rely solely on gut feelings. The Freedom to Choose Cuckoo, following Nietzsche and others, emphasizes individualism. Ironically, many people demand their freedom but object to that of others when it affects them. Provan also points out much confusion in contemporary culture; for example, people may follow science for some things but favor feelings or choice when they don't like the science.

The God Cuckoo refers to deism, now popular as moralistic therapeutic deism, a religion that offers only comfort and convenience. The Platonic Cuckoo follows Gnosticism

in devaluing the material (thus sometimes coexisting with Romanticism and individualism). The Innocence Cuckoo, also influenced by Romanticism, looks back to a state of precivilizational bliss (in fact, ancient cultures were often violent and did not live in harmony with their environment); we are all basically good and can trust our feelings. The Information Cuckoo values narrow and practical education only, devaluing wisdom. Provan insists that good education has a strong social component and, therefore, should never be virtual.

Closer to home, the Worship Cuckoo distorts church liturgies. There is minimal scriptural content in sermons and songs, and singing is more of a concert than a communal activity: "one finds oneself singing, more than once, a composition that did not have very much to say to begin with" (p.196). The Justice Cuckoo, sometimes emphasizing individual rights, sometimes nature, sometimes utilitarianism, flounders because it has no grounding. Similarly, the Revolution Cuckoo overvalues social justice and group identity, and neglects individual responsibility.

Provan is creative and overall concurs with much broadly conservative thinking on contemporary disagreements. At times he is a bit dogmatic and too general; I would prefer a more nuanced approach with further detail and illustrations. For example, what does "unbiblical" mean? What happens when individual rights to life are in conflict? Should children obey abusive parents? I was also disappointed that a biblical scholar seldom addressed the complexities of interpretation. Provan also paid little attention to spiritual experience, common to contemplative and charismatic streams of Christianity. To be fair, he acknowledges the downside of short chapters; however, I wonder if he simply tried to include too much, sacrificing depth for breadth.

Nevertheless, *Cuckoos in Our Nest* offers an excellent introduction and overview of important questions that all Christians need to contemplate. I recommend it to those unfamiliar with or overwhelmed by contemporary cultural problems; it is also a good resource for students and Bible-study groups.

Reviewed by E. Janet Warren (MD, PhD), lecturer at Tyndale University and independent scholar in theology, Hamilton, ON.

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THE PROBLEM OF ANIMAL PAIN by Victoria Campbell, Elements in the Problems of God Series, Michael L. Peterson, ed. Cambridge University Press, 2023. 77 pages including bibliography. Paperback; $20.00. ISBN: 9781009270670.

In an era when the pet population surpasses the number of human children in some major cities, a renewed interest has been sparked in the relationship between the pain and suffering faced by animals and Christian theology. In the latest of the Cambridge "Elements in the Problems of God" series, Victoria Campbell, with doctorates in chemistry and theology and ordained by the Global Methodist Church, tackles the issue of animal pain through theological and scientific lenses. Recent years have seen excellent book-length treatments from philosophers and theologians, but few science-focused works. This very short contribution (only 63 pages) provides brief, often bullet-pointed, summaries of the problem of animal pain and of some responses, as well as providing her novel thesis, one based on the neurophysiology and ethology of natural pain mitigation.

As most philosophers and theologians who engage animal pain and suffering do, Campbell opens with William Rowe's classic argument from 1979 "against the existence of an omnipotent, omniscient, wholly good God" (p. 2) based on the idea of profound suffering in nature over billions of years of evolutionary history. If God exists and can prevent widespread and unnecessary suffering among created beings that are not themselves moral agents, why does he not do it?

Nearly all the major theistic responses to this question are summarized and evaluated, quite succinctly and (mostly) effectively. Campbell outright rejects the Neo-Cartesian premise that animals cannot feel pain; there is too much scientific proof that they can. She finds other arguments have their merits but are still insufficient, including "corruption of creation theodicies" (p. 15), in which pre-human, demonic forces caused primordial chaos, and those theodicies addressing animal afterlife or "saint-making theodicies" (p. 20), in which suffering is redeemed in an animal afterlife. Additionally, the author's treatment of chaos theory and kenosis is somewhat limited compared to recent scholarship, but her take on the strengths and weaknesses of arguments based on these ideas seems reasonable, at least as she frames them.

The crux of Campbell's theodicy seeks to affirm that animal pain exists, that an omnipotent and omniscient God also exists and is responsible for its presence, and that God is concerned for animals and cares lovingly for all creatures. Much of her argument is predicated on our knowledge of pain perception, particularly in vertebrates, the value of pain for survival and healthy longevity, and how natural means of pain mitigation reflect a loving, benevolent God. Campbell refutes arguments posed by Richard Dawkins and others that untold pain has plagued evolutionary history with incalculable cruelty, with her contention that about 99.5% of all species "will never experience the emotional distress associated with suffering" and "lack the physiological capacity to perceive pain" (p. 38).

Additionally, the author finds predation to be a means in nature to provide healthy ecosystems and to mitigate chronic pain or illness in animals. It is often the weak, injured, and infirm that are hunted, and the relatively quick death of prey species is mitigated by release of catecholamines and opioids that provide a sort of natural

anesthetic. Other troublesome issues, such as predatory behaviors of "killer" orcas and avian siblicide, are also addressed, with similar ideas that the benevolence of a creator God is expressed when a deeper scientific understanding of these processes is engaged.

In terms of critiques, the assertion that species apart from mammals and birds cannot feel pain will certainly be disputed by some; the difference between pain and suffering is never addressed, in that the terms seem to be used interchangeably throughout the book; and suffering is never explicitly defined. Though it adds valuable information to the discussion, this book is certainly not a comprehensive treatise on animal pain and suffering. Not all natural suffering experienced by animals is addressed. As a veterinarian who must contend with pain, disease and suffering in my patients, and who often serves a quasi-pastoral role in the corresponding anguish and doubts it creates in their human companions, I find that too many unanswered questions remain in this book. Excellent though the scientific answers are, a fully developed theodicy it is not; theological challenges remain that bring readers to face some of the same mysteries that Job ultimately embraced.

Nevertheless, this book is a worthwhile contribution to the literature on the problem of animal pain and is particularly useful to scientists who seek to make apologetic arguments based on empirical evidence. It expresses the power, wisdom, and goodness of God through revelations in biological science. Academics and lay readers alike will find the text highly engaging, and its brevity refreshing. *The Problem of Animal Pain* is highly recommended as an excellent, if partial, addition to what will continue to be a more robust conversation. A terrific bibliography offers many opportunities to explore the topic further. While not entirely sufficient as a stand-alone theodicy for animal pain and suffering, it is a buttress to a wider theistic response, and one that provides a much-needed, scientifically and biblically solid, voice.

Reviewed by Jerry L. Risser, senior medical director, Fall Creek Veterinary Medical Center, Indianapolis, IN 46256.

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ASTROBIOLOGY AND CHRISTIAN DOCTRINE: Exploring the Implications of Life in the Universe by Andrew Davison. Cambridge University Press, 2023. 406 pages. Paperback; $27.99. ISBN: 9781009303163.

From my experience in speaking to groups on science and Christianity, whenever I suggest that Christian faith needs to allow for the possibility that intelligent, agape-capable beings could possibly emerge not just on Earth but elsewhere in the universe, the conversation inevitably produces several related questions, such as whether Jesus's atoning work on Earth would apply to such beings elsewhere in the universe, or whether God would become incarnate elsewhere in the cosmos. Often participants convey a tone that such questions are hopelessly big for us, that the topic may be momentarily interesting but ultimately overwhelming and futile. There are also those who offer confident commentary denying that any such life could possibly exist elsewhere other than Earth.

It is into precisely these sorts of expansive questions that Andrew Davison—recently appointed Regius Professor of Divinity at Oxford—takes us with this marvelous volume. While the person in the pew may feel theologically at sea with such questions, Davison models the professional theologian taking on a challenging question, to offer the church a set of constructive responses that cohere with both current science and historic Christian faith (or, more precisely, doctrine).

With a hundred billion stars in just the Milky Way alone, the universe possesses "an astonishing number of potential cradles for life, and that, to my mind, changes everything" (p. 5)—a potential that includes not just biotic life but also *intelligent* life. Yet even without our current knowledge of cosmology, theologians have been writing about the possibility of "other worlds" (beyond Earth) since the thirteenth century and writing about "the theological implications of biological life beyond Earth" since the mid-fifteenth century (p. 7). Other worlds and intelligent life beyond Earth have not been central topics of theology over the centuries; however, Davison does a superb job of unearthing the many theological discussions that have taken place, both past and recent.

Davison's interest, though, is not merely historical but also constructive. "One motivation for a book such as this is to help the human community (and specifically, the Christian community) to be more ready to receive, process, and respond to any future signs of life elsewhere. Detection might come in a decade, centuries hence, or perhaps never, but if it does, it will be useful to have thought through the implications in advance" (p. 11). He holds a second motive: "after a journey—physical or intellectual—in unfamiliar territory, one can return home with fresh eyes … [O]ur theology can find useful provocation, even invigoration, by having life beyond our planet in mind … [A]spects of Christian faith shine in new ways once placed in a different light" (pp. 11–12).

Davison's method is to discuss the implications of life elsewhere in the universe for a range of Christian doctrines. For instance, do we have theological reason to believe there might be life elsewhere? Certainly, for "The cosmos is for life … the cosmos is for the communication and display of divine excellences (among which life is particularly significant). That, in turn, is seen to entail (or at least suggest) multiplicity and diversity, and therefore to undergird an expectation that life would be widespread and, perhaps, diversely realized" (p. 82). For Thomas Aquinas, multiplicity, or "the numerical plurality of things," is second only to

revealing "divine goodness" as the "summit of the divine plan for creation" (p. 84).

The range of questions that now follow is wide, and here I can give only a flavor of these. How would species elsewhere in the universe have knowledge of God or be able to speak of God? This is an important question because knowledge and language are always mediated contextually and through particular evolved neural faculties—and such faculties will have evolved very differently elsewhere across the universe. Consequently, what is the source of "continuity between how very different species [in different locations in the universe] might understand God as threefold?" (p. 115). The source would have to be revelation (rather than local versions of natural theology). "[T]he one God, boundless and creative, would be known [through divine self-revelation] in different but not incommensurate ways by different creatures … refracted and accommodated to their own distinct way of knowing" (p. 133).

Likewise with language for the Trinity. Creatures elsewhere would have their equivalent language for what we call "personhood," to reflect the three persons of the Trinity, particularly in the sense of generative relations (such as the Son being "eternally begotten"). Thus, creatures elsewhere would have language that reflects qualities of personhood as related to "generation, coming forth, and gift" in their form of creatureliness, and thereby be able to use these equivalents to speak of the persons of Trinity.

Would other creatures bear the image of God? There is no scriptural reason to think not. Beings elsewhere in the universe could converge on image-of-God qualities such as intelligence, memory, will, and morality, even though possessing these in local biological, morphological, and cultural forms. "What God gives freely on Earth, God may also give freely elsewhere … [T]he image of God is a finite reflection of boundless divine perfection … [which] suggests that the image need not be one thing only, or identical wherever it is found" (p. 165).

Do beings elsewhere also sin? Presumably at least some do—but if so, then does Jesus's atonement on Earth suffice for other beings elsewhere, or would God take on multiple incarnations for atonement everywhere intelligent life occurs? Over the past several centuries, arguments have been made both for and against—"theologians can argue the matter in good faith either way" (p. 225).

In the end, Davison leans toward incarnation anywhere in the universe where there are creatures bearing God's image. Davison recognizes that this is contentious: "We find no greater point of divergence in thinking about the theological implications of life elsewhere in the universe than over this idea of multiple Incarnations" (p. 192). The disagreement arises because "For some this idea appears … a denial of … the centrality of Christ [Jesus of Nazareth] to the whole cosmos" (p. 192). Davison agrees that one incarnation in one location of the universe could indeed atone for all beings throughout the universe. Nonetheless, he also argues that it would be "fitting" for God to take on multiple incarnations because remediation (atonement) is not the only reason for incarnation. For incarnation also provides other gifts of God's grace, including "to receive the highest dignity conferred by God" (by God's incarnational presence), receiving the deepest divine self-revelation (necessarily in person), and *theosis* (being spiritually united with God, in friendship with God) (p. 193). Davison also contends there could be non-sinful beings elsewhere in the universe, and these non-atonement reasons for incarnation would also apply in their cases.

Davison explores other questions, including the following: Would multiple incarnations all experience resurrection and ascension, and thus meet each other in heaven? Given that other image-bearing beings could emerge across the universe over vastly different time scales, and given that the New Creation is understood doctrinally to be cosmos-wide, then what are the implications for God's timing for the eschaton? And in the New Creation, how will different creatures relate to each other?

This volume is a marvelous tour of the craft of theology as it intersects with science, with the author deploying a rich range of theological resources. While he is among those science theologians today with a particular allegiance to Aquinas, nonetheless he employs resources from Patristics though the Scholastics, from the Reformers to contemporary theologians—Protestant, Catholic, and Orthodox alike.

My one significant quibble is with his Aristotelian assumption of intelligence as the primary human property. This assumption remains widespread even in secular circles today; it is illustrated, for instance, by SETI—the search for extra-terrestrial intelligence. But as I have previously argued, while consciousness and intelligence are clearly divine qualities, *agape*-love is more fundamental to the nature of God; thus, for Christians, the holy grail of astrobiology should be the discovery, not of intelligent life (as exciting as this would be), but rather the discovery of *agape*-capable life—beings capable of loving both fellow beings and God.

Regardless, I enjoyed this book immensely and recommend it highly. Scientists wanting to write on topics in science-and-theology would do well to understand the theological trade through this volume. More importantly, Christians should not worry about life being found elsewhere in the universe—indeed, such discovery would only reveal further the glory of God.

Reviewed by Chris Barrigar (PhD, philosophy), author of Freedom All the Way Up: God and the Meaning of Life in a Scientific Age. *He is based in Montreal, QC.*

Letters

Problematic Assumptions Made

Two of the articles in the March 2025 issue addressing gender incongruence (Gregg Davidson, "Human Sexuality: Logical Fallacies and the Shotgun Aim of Arguments from Nature," *PSCF* 77, no. 1 [2025]: 26–38; Tony Jelsma, "On Gender, Gender Incongruence, and Gender-Affirming Care," *PSCF* 77, no. 1 [2025]: 2–25) make problematic assumptions about what humans are and how Christians should care for those who experience gender dysphoria.

They assume what Davidson calls "a traditional model of binary human sex, fixed at conception" (p. 26) but do not defend this concept. Jelsma claims, "A fertilized egg has a biological sex but no gender" (p. 4). This seems to assume that all fertilized eggs are either XX or XY; this isn't true.

The "traditional model" draws from Genesis 1:27—"male and female he created them." Claiming sex is binary based on this verse is a literalist interpretation that asks a modern scientific question of the text. It's no different than young earth creationism. In Genesis, all of humanity is the *imago Dei*. "Male and female" is a merism—from A to Z, a spectrum that includes male and female and everyone in between. The text is not concerned with whether God created only two sexes, or whether sex and gender are identical.

Second, the "traditional model" is based on genitalia observable at birth. "Fixed at conception" is an anachronism the biblical authors never considered, having no knowledge of chromosomes or even fertilized eggs. The ancients, including Jesus, were familiar with babies born with ambiguous genitalia ("born eunuchs").

There is a danger that evangelical Christians might use Jelsma's conclusion that "the evidence surrounding gender-affirming care is weak" to favor legislation against gender-affirming care for adolescents. However, readers should keep in mind that Jelsma's conclusion (as he admits) runs counter to the scientific consensus of the American Psychological Association, the Endocrine Society, and the World Professional Association for Transgender Health.

On the other hand, I can only say "amen" to Jelsma's final word:

> [T]here is a danger of oversimplifying when trying to gain an understanding of this complex issue. Disagreements will persist, but we need to be united in the goal of acting in the best interests of those who suffer from this condition. (p. 17)

Acting in the best interests of transgender individuals means having compassion on their suffering. Even if I grant Jelsma's contention that gender dysphoria is a mental illness, psychological pain is just as real as physical pain, and if doctors treat the latter with drugs and/or surgery, why isn't it just as legitimate to treat the former the same way? Pain is pain and deserves treatment, even if the treatments we've discovered so far aren't as effective as we'd like.

Jay D. Johnson
ASA Member

Davidson Responds to Johnson

Johnson's letter primarily references Jelsma's paper, though his criticisms are broadly applied to both of our papers. I have divided the critique into four categories below, with brief headings highlighting the nature of each challenge or complaint.

1. Assumption that all fertilized eggs are either XX or XY.

   My paper devotes substantial discussion to the occurrence and significance of intersex children, including those with genetic conditions that vary from the normal XX or XY design, and how they fit within the *image of God*. A strictly either/or model at the chromosomal level is neither assumed nor suggested.

2. Traditional binary model of sex is based on an unjustified literal interpretation of Genesis 1:27.

   I do not explicitly cite this verse or its interpretation in my paper, but its association with the traditional view warrants addressing here. Johnson claims that the proper interpretation of "male and female he created them" is as a merism that includes a range of human sex, supported by biblical recognition of eunuchs as an example of sex on a spectrum. He argues that a literal reading imposes a modern scientific question onto the text—equivalent to young earth creationism.

   I would argue that it is the merism interpretation that derives from a modern Western worldview overlain onto an ancient text. It requires first accepting that the narrative of sex-on-a-spectrum is true and then finding ways to make scripture fit. Johnson's reference to Jesus and eunuchs serves as a useful example. In Matthew 19:12, Jesus referred to people who were made and who were born eunuchs (εὐνοῦχοι). The only way a eunuch was *made* was to take a male child and remove his testicles. Given that the same word is used for people *born* eunuchs, the most obvious understanding is a child born with a birth defect of missing testicles. The latter is a legitimate example of a biblical reference to an intersex condition, but there is no contextual or historical reason to believe those listening would have understood the second use of εὐνοῦχοι to refer to a third or intermediate sex. That meaning has to be imposed on the text based on a preconceived system of belief. Ironically, this is exactly what young earth creationists are accused of doing, starting with the answer and imposing it on the biblical text.

3. Limiting gender-affirming care runs counter to scientific consensus.

   This raises two critically important issues. First, in our era of increasing polarization, "scientific consensus" is often code for "don't question the white coats." It is a way of isolating ideologically driven policies from scrutiny, in the apparent belief that scientists are incapable of bias. The organizations Johnson mentions have embraced an ideology that is not unambiguously supported by actual science, as Jelsma's paper robustly brings to light. Indeed, when the International Association of Applied Psychology publishes an official statement that a woman is someone who identifies as a woman (defining a term by the same term), science is no longer at the helm (citation #86 in my paper). Second, more generally, admonishment for questioning "scientific consensus" is arguably *anti*-science. Major advancement *requires* challenging consensus understanding.

4. Pain is pain; if gender dysphoria is a mental illness, why limit medical solutions?

   Johnson stops short of conceding that gender dysphoria is a mental illness but asks why those who do view it this way would prevent the use of drugs or surgeries to alleviate that pain, even if treatments "aren't as effective as we'd like." The quoted segment is important, for it reveals an assumption that the only solution for this pain is to affirm the perceived gender. No awareness is offered that it is possible for proffered cures to cause greater harm, or that the misalignment between perception and reality could be the problem that needs fixing. Jelsma's paper offers many examples of harm from puberty blockers and the increasingly challenged claim of improved emotional health. In my paper, I draw attention to the incongruence between what sex transition surgeries claim versus what they actually achieve. From my perspective, truly loving a person is not found in affirming their confusion.

Gregg Davidson
ASA Fellow

Jelsma Responds to Johnson

My thanks to Jay Johnson for reading and carefully analyzing the arguments I made in my recent review. We both share a concern for those individuals who are distressed by gender incongruence. Allow me to respond to some of his concerns.

Johnson quotes me as saying, "A fertilized egg has a biological sex but no gender," suggesting that I assume all fertilized eggs are either XX or XY, which isn't true. I agree and freely acknowledge the existence of intersex conditions due to variations on the usual pattern. However, the focus in this section—and indeed the entire paper—was on gender, not sex, so this criticism seems out of place. Moreover, people with intersex conditions generally identify as male or female, not something in between.

Johnson goes on to argue that the reference to male and female in Genesis 1:27 is a merism, which includes not only males and females but everything in between. Again, my paper was about gender, not sex. I am familiar with merisms in scripture, but I don't think this is one. Generally, the context of a merism makes it clear that the passage refers to everything in between, for example, the heavens and the earth in verse 1 is a merism because the text goes on to describe the creation of everything in between. In contrast, scripture consistently describes humans as existing as two complementary sexes. Even the reference to those who are eunuchs from birth (Matt. 19:12) is in the context of men for whom it is better not to marry. Thus, Jesus describes these individuals, who might be intersex, as males.

I fully acknowledge that my conclusion that the evidence on gender-affirming care conflicts with the position of the American Psychological Association, the Endocrine Society, and the World Professional Association for Transgender Health (but not the Cass Review). That is the reason why half my paper is dedicated to showing how I disagree with those organizations and that the evidence (I gave several examples) does not support their position. My goal in this paper was to provide Christians with a balanced review of the science surrounding gender incongruence and gender-affirming care. Legislative actions are beyond the scope of this paper and my expertise, but I did state in my abstract that some cases might be best treated by transitioning.

Finally, I concur with Johnson when he urges that these individuals receive compassionate treatment for their psychological pain. However, we need to understand the underlying causes of this pain before assuming that medicalization is the best course of action. In the second half of my paper I argued, not that gender-affirming care is not as effective as we'd like, but that it was not effective *at all* because the psychological benefits can be accounted for by the placebo effect. Unnecessarily treating these individuals with hormones and surgeries instead of helping them through a traumatic adolescence through counseling is not acting in their best interests.

Tony Jelsma
ASA Fellow

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