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Statement of Perspective. The word *zygon* means the yoking of two entities or processes that must work together. It is related to *zygote*—meaning the union of genetic heritage from sperm and egg, a union that is vital in higher species for the continuation of advancement of life. The journal *Zygon* provides a forum for exploring ways to unite what in modern times has been disconnected—values from knowledge, goodness from truth, religion from science. Traditional religions, which have transmitted wisdom about what is of essential value and ultimate meaning as a guide for human living, were expressed in terms of the best understandings of their times about human nature, society, and the world. Religious expression in our time, however, has not drawn similarly on modern science, which has superseded the ancient forms of understanding. As a result religions have lost credibility in the modern mind. Nevertheless some recent scientific studies of human evolution and development have indicated how long-standing religions have evolved well-winnowed wisdom, still essential for the best life. *Zygon*'s hypothesis is that when long-evolved religious wisdom is yoked with significant recent scientific discoveries about the world and human nature, there results credible expression of basic meaning, values, and moral convictions that provides valid and effective guidance for enhancing human life. *Zygon* also publishes manuscripts that are critical of this perspective, as long as such papers contribute to a constructive reflection on scientific knowledge, human values, and existential meaning.

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Editorial

This issue begins with an Editorial essay by Jon Paul Sydnor, titled "The Big Questions: Thinking across Science, Religion, and Philosophy." Below, you will find a brief overview of the articles included in this issue, both in the general articles section and in two thematic sections, as well as an overview of books reviewed in the latest edition of *Reviews in Science, Religion and Theology*.

Articles

This issue contains six articles in the general articles section:

- Oluwasegun Ogunnaike, "Moral Bio-Enhancement and the Question of Bio-Politics in Afrofuturism"
- Hasan Shahab and Cipta Bakti Gama, "Ibn Sīnā's Philosophy as Framework for Understanding Artificial Intelligence: Ontology, Epistemology, and Machine Cognition's Boundaries"
- Cayla Bleoaja, "When Chaos Collaborates with God: John Schneider's Aesthetic Theodicy and the Darwinian Problem of Evil"
- Charles Pickles, "Intelligibility, Scientific Explanation, and the Metaphysical Space of the Science–Religion Debate"
- Jacquie Lindsay Bay et al. "Exploring the Potential for Strengthening Faith–Science Dialogue: Design and Implementation of Deliberations with Anglican Bishops"
- Jeffrey Koperski, "Quantum Fundamentalism or Emergence? A Reply to Harris"

ISSR 2025—Lived Ecology: Between the Sciences and the Religions (by Niels Henrik Gregersen and Celia Deane-Drummond)

Much like *Zygon*, the International Society for Science and Religion (ISSR) takes a broad-scale view of the multiple interactions between the sciences and the religions, including spiritualities. Physics, biology, philosophy, and theology were the overarching disciplines when ISSR was formed in 2002, but during the last decades these important disciplines have been supplemented by the social and human sciences, often with psychology and the cognitive sciences as mediating disciplines alongside the history of science–religion interactions.

In the Fall of 2024, ISSR made the formal decision to prioritize two research areas with vital practical importance for human life and current global concerns: Health Sciences and Ecology. The focus on ecology led to the Swindon Conference, held in UK from June 30–July 3, 2025, titled "Ecology Between Religions and Sciences." Selected papers from this conference are introduced below. We heartily thank the editor of *Zygon* for agreeing to host an ISSR section in the journal.

When the planning of the Swindon conference took off, the idea was to focus on the sciences of ecology, which had been relatively neglected in ecotheological literature that has often focused on climate change. Eventually, however, the perspective of *lived ecologies* and their social and political importance became undercurrent of the conference. How did it come about that only specific branches of ecology sparked the interest of philosophers and theologians? And what might be the inspirations and barriers for the way ecologies are lived out on the ground?

In "Religion and Ecology, Integral Ecology, and Scientific Ecology: Shared Worldviews, Constructive Cooperation, or Divergence?" Susan Power Bratton (Baylor University) asks this question. She points to the commonly forgotten fact that the field of "religion and ecology" takes more interest in big scale questions of climate change than in practical ecologies supported by ecological sciences that work for the restoration of, say, a wetland or forest ecology. It is a question of scale, and the microscales are often missing in elevated views of ecotheology.

Regarding the cultural emphasis in lived ecology, Panu Pihkala (University of Helsinki) analyzes the intense debate on climate emotions. The Climate Emotions Wheel (2023) is a popular visualization of human emotions, ranging from joy and anxiety to shame, indignation and sadness. In "The Climate Emotions Wheel and Polycrisis Emotions" Pihkala analyses important debates on the effectiveness of the Wheel model taking place among philosophers, health workers, scientists, and religious leaders. He gives special attention to how science and religion interact with climate emotions, both on their own and in interaction with each other.

In "What Can Ecotheology Learn from Science-Engaged Theology?" Timothy A. Middleton (University of Oxford) points to eight potential lessons to learn from the idea of science-engaged theology, including a commitment to empirically testable claims, an awareness of the instability of terms like "ecology" and "religion", the rejection of overarching typologies, and the desire to see science, including scientific ecologies, as a source for theological engagement. What can and should be learned, and what perhaps not?

Peter Manley Scott (University of Manchester), writing on "Religious Materialism and Ecology", argues against the assumption that religion and materialism are pole opposites and so are incompatible. He develops a procedural "religious materialism" that epistemically connects religion and ecology in the geological era of the Anthropocene. He thus argues that transcendence can and should affirm materiality, and resists the charge that transcendence requires the

humiliation of matter. Religions themselves, when interpreted correctly, can be viewed as repositories of material commitments.

In "Dual Cognition, Spirituality, and Environmental Sensitivity", Fraser Watts (Lincoln Bishop University) points to the difference between two modes of human cognition, one conceptual, and the other more intuitive and embodied. While science shows impressive achievements of conceptual cognition, it requires a detached approach to nature that has itself contributed to the present environmental crisis. This calls for the need to complement conceptual with intuitive ways of approaching nature. Spiritual practices exemplify *embodied* modes of cognition that may provide a helpful basis for cultivating greater environmental sensitivity.

The following two articles point to what can be learnt from indigenous forms of lived ecology. In "Eco-Ethical Knowledge from the Indigenous Amazon and the Reimagining of Nature", Miguel Farias (Coventry University) et al. combine historical reports and contemporary ethnographic findings. Indigenous communities, in the past as well as today, view plants, animals, and spirits as intentional beings within networks of reciprocity between humans and nonhumans. The authors suggest that this indigenous worldview invites a reimagining of human–nature relations in today's lived ecologies.

Indigenous communities are not only remote but occupy urban contexts. Nicola Hoggard Creegan (Laidlaw College and Graduate School, Auckland) points to the living interaction between Western and Māori populations in New Zealand. In "Culture and Ecotheology in Proximity to *Te Ao* Māori", she shows the interweaving between the Māori worldview and language and the dominant Western culture. Often experienced as an interruption to standard modern life, the indigenous presence makes provision for nature's powers and spirits to be appreciated in everyday life, including complementing what is commonly taught in the science curriculum and the churches. Interruptions and inter-weavings are instituted by a Treaty for the purposes of justice, but Creegan argues that they also open up a space for new integrations between science and faith—both challenging the reductionism of Western science, and encouraging a metaphysics more favorable to faith and ecotheological concerns. She argues that Western theological language thereby becomes enlarged, restored, and reframed.

The last article, "Planetary Thinking in a Time of Crisis: Active Evolution and Fractured Universalism in Cosmic Religions", examines the failures of universalist frameworks and narratives associated even with well-meaning planetary concepts like the Anthropocene and the noosphere. Lisa H. Sideris (University of California, Santa Barbara) investigates the rise of fractured forms of planetary and cosmic orientations in Silicon Valley tech cultures. Sideris suggests that we find unanticipated levels of meaning and enchantment intrinsic to technological worldviews while a techno-determinism allows its adherents to evade ethical responsibility. Sideris thus argues that Tech culture's religious-like teleology has similarities to the blend of science, magic, and religion known in historical versions of Russian Cosmism, and also has parallel structures to ideas

of a noospheric evolution in the vein of the work of Jesuit priest and scientist Pierre Teilhard de Chardin. By seeing the quasi-religious and spiritual dimensions of today's technocracies, often coupled with ethno-nationalism, we may be better equipped to resist their narratives.

This section on lived ecologies thus brings the reader from scientific ecologies to potential models of a more symbiotic approach to living in response to the pressing issues of eco-social devastation that is currently threatening people, planet and living ecological systems.

Does Science Need Theology? (by Joanna Leidenhag and Myron A. Penner)

This collection of articles on the relationship between science and theology was prompted by Laplane et al.'s 2019 opinion article published in the *Proceedings of the National Academy of Sciences* titled "Why Science Needs Philosophy." Authored by several prominent philosophers of science, the Laplane et al. article gives recent examples of philosophers contributing to both bench and theoretical science by using philosophical tools including conceptual analysis, logical precision, and demonstrating links between abstract concepts and concrete phenomena in laboratory settings. Discussion about Laplane et al. between Myron A. Penner (philosopher) and Joanna Leidenhag (theologian) revolved around the question of whether a similar sort of argument could be made about the necessity of theology for science. Does science need theology?

Penner and Leidenhag organized a multidisciplinary panel discussion on this topic at the 2024 American Academy of Religion meeting; contributors included Mark Harris and Andrew Torrance, both included in this thematic section. Alongside Harris and Torrance, we solicited additional contributions from Peter Harrison and Justin Barrett (both of whom were in the audience at the original event). In their own ways, each of the contributors indicate that yes science does indeed need theology, at least in the sense that the scientific enterprise suffers when it pays no attention to theology.

Harrison develops an historical argument, noting that the development of empirical methods in the seventeenth century was grounded in theological commitments supporting the rationality and value of scientific inquiry; albeit unacknowledged, both assumptions are still in place in contemporary science. Similarly, Barrett argues that science needs theology to ground its epistemology; Barrett further argues science needs theology to ground methodological providentialism (as opposed to methodological naturalism) and to facilitate good stewardship of science. Torrance argues that science needs theology both for navigating pluralistic cultural spaces and for demarcating different sorts of meaningful and legitimate explanation. According to Harris, theology allows physicists to view the world described by quantum mechanics as both creation and gift; this theological perspective supports, and resonates with, the "vague realism" adopted by many working scientists.

The diverse affirmations of these four thinkers to the question, "does science need theology?" is a remarkable extension of Christian theology's growing boldness within interdisciplinary discussions over recent decades. That theology has its own intellectual credibility within the academy should no longer be in doubt; but whether the sciences have anything to gain from engagement with theology (or lose from a lack of such engagement) is a question that has, until now, scarcely dared to be asked. We (Penner and Leidenhag) are delighted that four such prominent thinkers in the field of science-and-religion have taken up our prompt, and we hope that their contributions simulate further discussions on this daring question.

Books reviewed in *Reviews in Science, Religion and Theology*

Reviews in Science, Religion and Theology is a quarterly joint publication of the European Society for the Study of Science and Theology (ESSSAT) and the International Society for Science and Religion (ISSR) and is distributed free to all members of ESSSAT and ISSR. Here is the list of books reviewed in the *Reviews* issue of June 2026:

- Elmira Akhmetova, *Muslim Women in Science, Past and Present*, Cambridge: Cambridge University Press, 2025
- Leo XIV, *Magnifica Humanitas: On Safeguarding the Human Person in the Time of Artificial Intelligence*, The Holy See, 2026.

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Editorial

The Big Questions: Thinking across Science, Religion, and Philosophy

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This Editorial essay explores the big questions resident within human experience, arguing that science, philosophy, and religion must cooperate to address them adequately. The essay begins by emphasizing the inevitability of existential questioning and the importance of reflective, epistemologically aware living. The discussion then examines key questions: Why is there something rather than nothing? Who am I? Do persons have rights? Does God exist? How should we live our lives? Is there an afterlife? And is life understandable? Across these domains, the essay argues that scientific methods, while powerful, are limited to testable claims and cannot resolve ultimate questions of meaning, value, or origin. Such questions often lead to "mystery," areas of human inquiry that are immune to resolution. The essay concludes that responsible thinking requires epistemological humility, openness to multiple ways of knowing, and a commitment to ongoing dialogue in the face of ambiguity.

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> *Even if there is only one possible unified theory, it is just a set of rules and equations. What is it that breathes fire into the equations and makes a universe for them to describe? The usual approach of science of constructing a mathematical model cannot answer the questions of why there should be a universe for the model to describe. Why does the universe go to all the bother of existing?*
>
> — Stephen Hawking, *A Brief History of Time*

The big questions are unavoidable. Life poses certain questions to us: Will you live your life selfishly or generously? Will you prioritize interesting experiences, personal relationships, or professional achievement? Will you be a pragmatist or dreamer?

We inevitably answer these questions by the living of our lives. Even if we never think about them, we still answer them by what we do. Some people dedicate themselves to advancing themselves; others dedicate themselves to improving the world. Yet many, perhaps most, make these choices without consciously asking: Should I prioritize myself over my community, or my community over myself? Many of us act subconsciously (Plato *Gorgias*, 500c–d).

Because the quality of our answers influences the quality of our lives (how our lives feel), philosophers have insisted that reflection is an essential component of a good life. To live skillfully, we must think deeply. Only then will we pursue the goals that grant fulfillment (Plato *Apology*, 38a).

But what is fulfillment? What should we pursue? The answers to these questions vary. Over the millennia, thinkers have identified our highest good as the accumulation of money, experience of beauty, acquisition of power, service of God, loyalty to tribe, physical pleasure, satisfying relationships, professional achievement, political struggle, etc. Some advocate lives of safety, others advocate lives of danger. Some advocate conformity, others nonconformity. To choose the life we live, we must select from an array of possibilities.

Which life is best? And how can we know? Questions of knowledge are questions of epistemology, the philosophical discipline that discusses or analyzes (Greek: *logos*) knowledge (Greek: *episteme*). It addresses fundamentally important concepts such as truth and how it is discovered, as well as opinion and how it is justified. Regarding the beliefs we hold, epistemology considers to what degree we should be certain or skeptical of them, if our convictions should be relatively stable or constantly changing (Plato *Meno*, 87c–89a).

Epistemology may sound like an abstract, even irrelevant, discipline, but it has important consequences for how we live our lives. Some people confuse their opinion with fact and propound it with absolute certainty. Others hold their opinions lightly and change them frequently. Which practice is healthier for the individual? Which is better for society?

Our personal epistemology influences the quality of our relationships because it influences how we agree and disagree with others. And the epistemology of

any society, that is, how that society interprets its own beliefs and values, affects the quality of relationships within that society because it affects how that society treats dissenters, iconoclasts, and rebels—those whose novel ideas may propel their society into a better future. Frequently, in the evolution of thought, today's heresy becomes tomorrow's dogma (Gregg and Mahadevan 2014, 13–14).

Epistemology calls into question what we think, but it also calls into question how we think. This subdiscipline is called methodology. Methodology considers, analyzes, and attempts to improve the methods by which we arrive at truth, or some approximation thereof. Methodology considers how we think so that we don't just think but are aware of how we are thinking.

For example, one powerful way of gaining knowledge is via the scientific method, which, in its idealized form, gathers data, proposes a hypothesis to explain the data, then tests that hypothesis by gathering more data. Some scientists, such as chemists and biologists, use the experimental method, in which carefully controlled experiments produce focused results that apply to a specific hypothesis. Then, based on the results of the experiment, these scientists can reject, revise, or further refine their hypothesis.

Over the past few centuries, the scientific method has proven so powerful that some thinkers have advocated for its exclusive application to all areas of human inquiry. In other words, they propose that people should only think scientifically, applying the scientific method to every aspect of human existence and every claim someone makes. Even political, moral, and aesthetic claims should be produced by science and science alone.

According to these advocates of imperial science (science that takes over other, formerly nonscientific realms of thought), for the scientific method to apply to a claim, that claim must be testable. That is, it must be verifiable (provable as true) or falsifiable (provable as false). If a claim is not testable, that is, capable of being proven or disproven, then it isn't even worth discussing. It is meaningless (Ayer 1952, 31–36).

In philosophy, this belief is called logical positivism. In popular culture, it is called (somewhat controversially) scientism. To the advocates of scientism, such a rigorous mode of thinking would produce a new age of international peace, consumer abundance, and informed rationality. To the opponents of scientism, its triumph would neglect much of what makes us human, such as art, literature, and even religion. The claims of these three areas of human exploration are important but untestable, consequential but unverifiable.

The discussion of epistemological questions raises into consciousness how we come to our beliefs. Through this process, we can consider the reliability or unreliability of our ways of knowing. More importantly, we may come to suspect our ways of knowing, suggesting the need to revamp both how and what we believe. Some people will experience this process as frightening, others as liberating (Tracy 1994, 135–36).

Now, having laid the groundwork for our epistemological investigations, let us consider some of the big questions and the way those questions themselves inform the discipline of epistemology.

Big Question One: Why Is There Something Instead of Nothing?

On the one hand, this question can come across as purely scientific—a challenge to astronomers, physicists, and cosmologists (those who investigate our most fundamental questions about the cosmos). The prevailing explanation for the origins of our universe is the Big Bang, a theory that our universe began about 13.8 billion years ago when a tiny point of immensely dense energy suddenly expanded, then slowly cooled, producing the universe of space, time, matter, and energy that we know today.

But we can ask: What produced the Big Bang? If the Big Bang is a stand-alone event, and this universe is the only universe there is, then we can find no testable explanation for why time (the particular arrow of time within which we exist) started, nor can we explain the source of that dense point of energy. We can speculate about these questions using mathematical physics, and some speculation will account for the data and be more mathematically rigorous (and hence plausible) than other speculation, but we will not be able to test those speculations.

Today, some cosmologists propose a multiverse, a sprawling foam of universes that spontaneously generate new universes, including our own. But we can ask: What produced the multiverse? If it had a beginning, then we have no access to that beginning, as it happened in a different universe. If it has always existed, and there is no beginning, then we have no explanation for why the multiverse is existing rather than nonexisting. Even more perplexingly, we cannot account for the source of the physical laws that make the multiverse so prolific. What causes causality? Once again, we cannot know why there is something rather than nothing.

In other words, when asking ultimate questions about the origin of our universe, we end up with an infinite regression—the questions just keep coming, implying that the question is unanswerable, and our quest offers no resolution.

While the history of our universe is an excellent candidate for scientific investigation, we may never know scientifically why there is something rather than nothing. The question might be transscientific or metascientific—beyond the competency of science alone to answer (Hawking 1989, 174). In other words, the question "Why is there something rather than nothing?" may push us beyond science into the realms of philosophy and theology.

Big Question Two: Who Am I?

The question "Who am I?" is closely related to the question "What is a person?" Our answer will have important implications for how we live our

lives. Historically, some traditions have asserted that we are souls trapped in bodies and that salvation is the release of the soul from the body. In this view, material existence is dangerous and painful, but purely spiritual existence offers rescue. Through the techniques of religion and/or philosophy, we can rise from the material to the spiritual, from suffering to bliss, thereby realizing our true nature.

Other traditions have argued that only matter (or the natural universe) exists and that such concepts as soul and spirit are mere illusions. Worse, these illusions distract us from the vividness of physical reality, trading metaphysical abstraction for concrete stimulation. Such philosophers call their orientation materialism, naturalism, and/or physicalism. Materialism asserts that only matter matters, naturalism rejects all reference to the supernatural, and physicalism prioritizes the physical universe over against any spiritual reality.

For adherents to these schools, religious referents like "soul" and "spirit" only confuse thought, muddying analysis and hindering our understanding of life.

Concepts such as matter/spirit, body/soul, and brain/mind draw attention to two aspects of human existence, the exterior and interior. That is, human beings participate in an external realm of matter (the physical universe) and an internal realm of thought, feelings, and emotions (the private self). Generally, these two realms are considered objective and subjective, respectively. One consists of objects, or things. The other consists of subjects, or persons (Barbour 2002, 80–82).

These two realms—the objective and subjective, the exterior and interior—are quite different. The exterior, objective world lends itself to quantification and measurement. For example, we can very precisely measure the height and width of a painting and state that measurement in units of our choice, such as square centimeters. But it is impossible to measure the beauty of the painting or quantify beauty with units. Our measurement of the painting is quantitative, but our experience of beauty is qualitative. Because our experience of beauty is internal and subjective, it resists quantification (Trifonas 1995, 82–83).

Moreover, the objective world is public, while the subjective world is private. We can know material facts about a person by measuring them, such as their height and weight. But we can't know for sure what a person is thinking or feeling in that moment. This inability may disappear over time through advances in brain scanning, but for now, most of our thoughts remain private unless we choose to reveal them (Ward 2008, 169–71).

To a certain extent, we reveal our internal experience through our behavior and facial expressions. Evolutionary theorists speculate that we have sclera, or the whites of our eyes, so that we can more easily determine where others are looking and better understand their interests and intentions. This increased knowledge of one another allows better social functioning. Still, a deceptive

person can fake an inner life, pretending to weep when they are not grieved or laugh when they are not amused. An expressive person may reveal their emotions, while a repressed person may hide them. Public facts are obvious, but sharing our interiority with one another is a murky endeavor.

Any discussion of the question "Who am I?" will have to address these various aspects of existence: interior and exterior, private and public, qualitative and quantitative. Our final answer may prefer one aspect to the other. For example, we may prefer soul to body or body to soul. Or, to use a more modern example, we may prefer mind to brain or brain to mind. Our final answer may even embrace one aspect to the exclusion of the other: we may affirm the material universe but deny the spiritual universe, or vice versa.

To really complicate things, our final answer may fully embrace every dimension of human experience, believing that we are embodied souls in a divinely created universe. Or, to use less religious language, we could affirm that we are both bodies and minds in a universe of both matter and feelings. Since this choice unites interiority and exteriority into one person, it demands nuanced thought. To think across this fullness of personhood, we would have to think quantitively about the material world and qualitatively about our inner lives, then unite this quantitative and qualitative reasoning into one perspective. The resulting worldview would be quite subtle. If formulated skillfully, it will be plausible, but no excellence in formulation will make it compelling. Within our epistemological situation, important decisions are unavoidably ambiguous and hence always open to challenge. If we want to think well, which is to think together, then the debate will never end (Gadamer 2000, 221–24).

How we answer the question "Who am I?" will influence how we live our lives—what goals we prioritize, what values we cherish, and what friends we seek. Life offers us no predetermined answer, so we must provide our own. Even within such ambiguity, whatever answer we provide will be consequential, both for ourselves and those around us.

Big Question Three: Do Human Beings Have Rights?

Just as an individual must answer the question "Who am I?" to organize their lives, societies must answer the question "What is a person?" to organize their body politic. For example, in any society, you either can or cannot freely criticize the ruler. During World War II, Americans could scoff at FDR, but Germans couldn't scoff at Hitler. America ascribed to her citizens the right to free speech, but Nazi Germany did not. America had decided that dissent was a boon to the nation, sparking intensified discourse and better decisions. Nazi Germany had decided that dissent posed a threat by creating division. These decisions produced very different ways of thinking and acting in the two countries. Americans had to work together while acknowledging their disagreements; Germans had to operate under coerced uniformity.

Should citizens be able to criticize their leaders or not? Do people have the right to freedom of speech? Science alone does not seem able to answer this question. Certainly, we can reason about human freedom, as America's founders did when they wrote the Constitution and Bill of Rights. And we can gather facts about human freedoms, comparing societies that grant rights to societies that don't.

As we do so, we may try to determine which societies produce the most human flourishing, or the most powerful military, or the most equality, or the most cultural creativity, or the greatest wealth, or the lowest crime. But which of these social goods is most important? Freedom or equality? Strength or creativity? Now, we have raised the question of values. This question demands rational analysis but seems to elude scientific analysis. Philosophers call the contemplation of values axiology.

Science investigates matter, but neither rights nor values can be found in the material universe. Rights and values are immaterial. They're not made of matter, so they cannot be located, measured, or experimented on. For example, contrast human rights with the element iron. Iron is a given; it existed before us to investigate. But human rights are attributed; we posit them (or not) to create the society we want to live in. Science discovers; political philosophy chooses (Smith 2010, 436–38).

Thus, political philosophy is analogous to scientific investigation, because both disciplines gather facts and then reason about those facts. But in the end, political philosophy differs from scientific investigation because its answers aren't objectively testable. We can assert that people have rights and provide an argument for our assertion. Then, we can compare the outcomes of our different polities by comparing different societies and debating which results are preferable, which society we would most want to live in. But we can't prove that persons have rights, as astronomers have proved (provisionally) that the universe is expanding. Axiology and cosmology are distinct intellectual arenas that demand distinct intellectual methods (van Huyssteen 1999, 141–43).

Big Question Four: Does God Exist?

The concept "God" may have as many different interpretations as there are people. To some, God is a strict enforcer of moral standards, to others a nurturing presence. To some, God is all-powerful, to others God is all-loving. God plays the part of warrior or peacemaker, strict father or pure intelligence, Supreme Being or being itself.

So, when discussing God, we must follow Aristotle's advice and first define our terms. If someone says that they're an atheist, they are disbelieving in a certain concept of God (Schleiermacher 1996, 18–25). Many LGBTQ+ persons, for example, were raised in churches that preached a wrathful God intolerant of gender and sexual difference. To fully accept themselves, these

persons must either change their concept of God or abandon the concept altogether. On the other hand, if someone says that they're a theist, they may believe in an inclusive, all-loving God who would never reject a person based on their gender or sexual difference. In other words, one person's atheism may be another person's theism, and vice versa. The term "God" has an extremely large range of meanings.

Nevertheless, despite the elasticity of the word "God," we can debate whether there is any transcendent presence beyond the universe, or immanent presence within the universe, or both. We can contrast theism (belief in God) with naturalism (belief exclusively in the natural universe). A naturalist denies the existence of anything supernatural, such as spirit, souls, or God. A theist affirms that supernatural entities exist and must be considered when determining the meaning of human life.

These contrasting worldviews will produce different interpretations of life. For believers in a Creator God who summons the universe into being, life comes with a preexisting meaning provided by an all-knowing deity. Humankind flourishes when they live in accord with this meaning, variously interpreted as obedience to God, service of God, love of God, love of neighbor, etc. For nonbelievers, the universe does not come with a preexisting meaning. They must either reject the possibility of any meaning, which is called nihilism (belief in nothingness), or create their own meaning, which is called humanism (belief in humankind as the measure of all things). Thus, disbelief in a Creator God poses a creative challenge to disbelievers (Blessing 2013, 113–16).

Theism and atheism also produce different interpretations of the universe itself. For the theist, the universe is creation—the gift of a Creator. For atheists, the universe is a glorious accident—mathematically improbable, startling in its intricacy, yet open only to naturalistic investigations that presume no supernatural influences. Both the atheist and theist may experience awe at the cosmos, but they will differ over whether the cosmos itself is a divine gift or improbable event (Flanagan 2006, 444–49).

Of course, there remains the option of agnosticism. Agnosticism derives from the Greek root *a* (not)-*gnosis* (knowing). Agnostics believe that we cannot know whether God exists or not. Since the existence of God cannot be proved or disproved beyond a reasonable doubt, agnostics refuse to take a stance on the issue. Some agnostics believe that this epistemological situation is permanent and we can never know if God exists; others are open to future evidence that might change their mind.

Although agnosticism differs from atheism philosophically, they resemble each other in practice. Theists tend to have a set of practices that express their theism, such as prayer, rituals, reading scripture, participation in a religious congregation, etc. Atheists and agnostics, however, tend to avoid such practices.

What is the best way to go through life—as a theist, as an atheist, or as an agnostic? Well, that is a controversial question over which thinkers have spilled infinite barrels of ink. There are a vast number of ways someone can be a theist: fundamentalist, progressive, Muslim, Jew, Christian, militant, pacifist, etc. So, there is no single experience of theism. Likewise, there are a vast number of ways someone can be an atheist: conservative, liberal, capitalist, communist, environmentalist, etc. So, there is no single experience of atheism. (The same goes for agnosticism, of course). Any analysis of a person's worldview and its influence on that person's quality of life would necessitate a tremendous amount of detail about that person's way of being in the world. Any judgment without such detailed analysis would be presumptuous. Unfortunately, those who read extensively in these fields encounter much presumption.

Big Question Five: What Should I Do While I'm Here?

"How should I live?" Everyone asks themselves this question at some point in life (Plato *Republic*, 352d). We human beings not only live, we also know that we live. We don't just act, we are aware that we are acting. This awareness gives us a freedom that amoebas and bacteria lack: the freedom to respond to our environment rather than react to it. That is, given a certain situation, we can survey a range of options, deliberate regarding the various courses of action available, and choose the one that conforms to our principles and/or promotes the best outcome. We can shift our decision-making process from instinct to intellect, from reflex to analysis.

This freedom comes with a cost, or a benefit, depending on your perspective. When we shift from instinctive activity to deliberative activity, we also shift from certainty to ambiguity. Ambiguity is a state in which no obvious decision presents itself, so that multiple decisions are possible (Tracy 1989, 550). A foodie in a fancy restaurant with a long menu faces an ambiguous choice. A guest being served dinner at a friend's house faces no ambiguous choice.

Given the ambiguity of so many of our decisions, whenever we decide, we become aware that we could have decided otherwise and might have decided better. We can regret our decision or celebrate it. We can doubt our ability to make good decisions or overestimate that ability. We can fear making a mistake and hand over our decision-making responsibility to an external authority. Or, an external authority might make decisions for us that we should make ourselves, causing us to resent that authority. With awareness comes freedom, and with freedom comes ambiguity, and with ambiguity comes an entirely new set of possible emotions. Consciousness comes with tremendous potential, heightened intensity, and inevitable difficulty—as well as reward.

What are some of the choices we must make as we decide how to live? Let us consider a few, presented as polarities, or binary choices. But as we do

so, let us recognize that all choices lie on a spectrum and polarities are always simplifications. Life is complicated, as are the choices that we make as we negotiate life.

How selfless or selfish should we be? Should we dedicate our life to the service of others (altruism) or primarily advance our own interests (egoism)? Cold calculation suggests that accumulating money and power for oneself is the obvious choice. Many historical figures pursued precisely this path, which society tends to celebrate. Yet religious teachers and philosophers through the ages have frequently advised otherwise, and contemporary psychologists are finding evidence that the more generous a person is, the more life satisfaction they report (Collett and Morrissey 2007, 8–10). Therefore, the decision to be an altruist or an egoist is an ambiguous one.

Somewhat related is the question of practicality and passion. One social group facing this decision is college students choosing their majors. For example, a first-year student might take a course in philosophy and fall in love with the subject. Should they then go ahead and major in business as they had planned? On the one hand, by studying philosophy, they might feel academically inspired throughout their college career, which tends to produce a higher GPA. On the other hand, business majors tend to have higher incomes upon graduation, which might help to pay down any student debt.

This choice between practicality and passion extends into choice of career. A college student might love math and want to share that love with others. They are considering becoming a high school math teacher but know that accountants make more money. They love teaching but want to have their own kids and worry about how to put them through college. Which path should they choose? Meaning is a wonderful gift in life, and if you do what you love, then work doesn't feel like work. But money is powerful. It allows us to shelter our family, educate our children, and provide them with quality medical care. Once again, the choice is not obvious, which is why people make different decisions on these issues (Hagmaier et al 2018, 151–54).

People also make different choices regarding ease and challenge. No one's life is easy, and every human life is effortful. Nevertheless, some people are more attracted to challenge and adventure than others. Mountain climbers scale Everest; hikers take a walk through the woods. One soldier enlists to serve thirty years and retire; another is determined to become a Green Beret. Two nurses graduate: one wants to go home to where they grew up and work in a medical practice; the other wants to serve as a medical officer in refugee camps. One child wants to take over the family farm; the other wants to captain ships for the merchant marine. None of these choices is better than any other, and each person must make the best choice for themselves. Still, some existential philosophers argue that we are the sum of our decisions, so we should make all choices with care (Sartre 1948, 34–37).

The question "How should we live?" has a unique property: it is unavoidable. We must answer the question, because how we live our life is our answer. The next question then becomes: Should we answer the question consciously, after deliberation, with heightened awareness? Or should we just live our lives unconsciously, acting instinctively on the values that we inherit from our family and culture? The Greek philosopher Socrates famously asserts that the unexamined life is not worth living, implying that answering these questions explicitly offers significant benefits (Plato *Apology*, 38a). But historically, many governments (totalitarian, authoritarian, etc.) have deliberately suppressed discussion of different life options, preferring a unified populace that acts on national instinct. Such governments always generate an underground resistance of those who value the free exchange of ideas. Such resistance generally fears governmental brainwashing as harmful to the national intellect, damaging to its collective character, and dangerous to its future wellbeing.

Big Question Six: What Happens After We Die?

To the best of our knowledge, all biological organisms eventually die. Amoebas are relatively unbothered by this fact; humans more so. While we are alive, we can contemplate a time when we will be dead, when the world will be without us. Stated philosophically: We *are*, but every moment that we *are* is permeated by the realization that we will *not be*, at least with regard to this life as we know it, our current situation and relationships.

This realization has varying effects on people. Paradoxically, some find an awareness of their own eventual demise to be lifegiving. Realizing that life doesn't last forever, they resolve to celebrate every moment as precious. Others find the idea of death terrifying. Life for most is enjoyable overall, and we are programmed with an instinct to survive, so the thought of our own demise can be quite disturbing. To avoid this disturbance, some avoid the consideration of death, turning their attention (sometimes addictively) to this-worldly things, pursuing the fame, glory, or money they hope will propagate their name beyond their own lifespan. Those who practice death denial may dismiss their death-accepting peers as morbid, while the death-accepting may dismiss the death-avoidant as shallow (Becker 1973, 65–67).

Whatever approach to death we choose, avoidance or acceptance, we will all end up at the funeral of a loved one, asking the question "Where are they now?" Historically, different cultures have given a vast range of answers to this question. Some have proposed that death leads to personal extinction, while others have allowed for a dim, shadow existence. Some propose that at death the soul is freed from the body, while others insist that the soul will be reincarnated into a new body. Some believe in an embodied afterlife not unlike our current life, perhaps with our ancestors. Many cultures have asserted that people are judged for their good and bad deeds and rewarded or punished accordingly. This punishment

and reward can take place through the person's next incarnation (pleasant or unpleasant), in heaven or hell, or in some kind of ghostlike existence.

The range of possibilities matches the range of imagination. Some materialists (those who believe only in matter) point to religious disagreement about the nature of the afterlife and insist that personal extinction is the only plausible viewpoint. All other scenarios are just avoidant fantasies, ways to deflect the terror caused by our mortality. In a sense, recent developments in neuroscience have buttressed their position. Changes in our consciousness seem to be inextricably linked to changes in our brain. If the brain produces the mind and its consciousness, then it makes sense that the death of a particular brain would result in the death of that particular consciousness. Thus, that particular person and their particular personality would be extinguished (Atkins 2006, 128–29).

But materialism faces its own philosophical challenges. How do we know that matter exists? On the one hand, its existence seems obvious: we would all step out of the way of an oncoming train because we trust that the material train would do great damage to our material body. On the other hand, we have no direct experience of matter. We can have the sensation of matter; we can feel the ball of wax in our hand, for example. But we experience that sensation in our mind. The mind can only access sensations of things, not things in themselves, from which we are epistemologically cut off (Descartes 1985, §7:32–33).

Consider the brain and the mind. The brain is material: we can measure its weight, volume, and density, and we can state those measurements in units. We can locate it in space-time; it is somewhere specific. But the mind is immaterial: it has no weight, volume, or density, and it can be anywhere, fantasizing about a beach when it should be at work, worrying about work when it should be enjoying its children. The mind has qualities: it may be conscious while working, semi-conscious while daydreaming, and unconscious while sleeping, but we cannot measure these qualities precisely, so we cannot express them in units.

Problematically for the materialists, all our measurements of the brain occur in our mind. Since all our experience and knowledge of matter occur only in our mind, some philosophers insist that we can only know that the mind exists, not matter. This perspective is called mentalism (Berkeley 2003, §1.3).

But then, if the brain dies, could the mind survive? Is there an afterlife? Many thinkers entertain the possibility. At the same time, they sometimes assert that the question itself, as well as the realm of thought into which it casts us, is a mystery. A mystery is a question of great importance that forever disallows any indisputable answer. A mystery, by its epistemological nature, resists conclusive investigation and consigns all answers to the realm of opinion. Mysteries reveal the limits of our understanding, since they deny us certainty about our answers. Some sects may claim certainty for their answers, such as the belief that there is a heaven and a hell, that we are rewarded or punished for our this-worldly actions in an afterlife. But that certainty is not based on facts and reason alone.

It may arise from our community, or strict indoctrination, or a lack of awareness of other possibilities, but it does not arise from a disinterested analysis of the situation, and no argument for the position can logically compel someone to adopt it. The big questions that we have been discussing in this essay are, in the opinion of many, mysteries. The existence of mystery implies that existential reality is inescapably ambiguous and all certainty is manufactured. Mysteries allow investigation but disallow resolution. They are realms of honest disagreement, if not always civil disagreement.

Big Question Seven: Is Life Understandable? Is Reality Intelligible?

Alas, the concept of mystery can be abused. That is, some people can advance an extreme skepticism, declare reality fundamentally unintelligible, and then make claims that contradict facts and reason. A humble epistemology will admit that we can't know very much for certain. Extreme skepticism takes this admission and asserts that we can't know anything at all—so we can think whatever we want to think and, by way of consequence, do whatever we want to do. We can't know with absolute certainty that human beings are causing climate change, so why do anything about it? Why not just consume as we have always consumed?

An honest appraisal will concede that almost nothing can be proven beyond a shadow of a doubt. But this admission does not mean that all claims are equally true. Even without certainty, some claims are more reasonable than others, some are more factual than others, some are more practical than others, some are more humane than others. These qualities make them probably true. But extreme skeptics deny that there is any spectrum of probability. In rejecting certainty, they reject probability, and in rejecting probability, they reject the usefulness of dialogue (James 1992, §2–3).

One example is Young Earth Creationists, who assert that the biblical story of Genesis is literally true as both a historical and scientific text. They also assert that the Bible, as the Word of God, is infallible—without mistakes, utterly trustworthy and correct in all matters, including science and history. They then use data from the Bible, such as various genealogies found there, to count the generations between Adam and Jesus. Using a few anchor dates, some very specific birth narratives, and assigning about twenty-five years to each generation, they estimate that the Earth is 6,000-10,000 years old.

Their method presents its own ambiguities: both the gospel of Matthew and gospel of Luke list the generations from David to Joseph, the father of Jesus. But Matthew has twenty-seven whereas Luke has forty-two, with almost no overlap between them. More importantly, Young Earth Creationism involves a wholesale rejection of most science. Its claims do not cohere with those of astronomers, biologists, chemists, geologists, physicists, et al. Some Young Earth Creationists justify this contradiction through extreme skepticism: we cannot even determine with certainty if the external, material world exists, so

how can our studies of it produce reliable knowledge? We would be better off trusting the Bible instead, since its provenance is God's mind, not the human intellect (Martinez 2005, 2008–10). (While Young Earth Creationists express a profound distrust of science when discussing the origins of the universe, they express a profound trust of science when flying in jets.)

Problematically, the concept of mystery can be used by extreme skeptics to deny the value of all investigation—scientific, philosophical, theological, etc. Such extreme skepticism can be dangerous since some other authority will inevitably step in to replace rational investigation and informed debate. Authoritarian rulers, infallible scriptures, or rigid tradition always seek to fill epistemological vacuums.

Critics of extreme skepticism, fearful of a decline into irrationalism, sometimes denounce any reference to mystery as mystification—the assertion that certain beliefs lie beyond the reach of critical analysis and thus are immune to all scrutiny. And they have a point: mystification rejects rigorous, disciplined investigation as useless. In contemporary language, an appeal to mystery may very well be an act of gaslighting, of discouraging people to examine a claim. Gaslighting occurs when a claimant knows full well that their claim cannot withstand scrutiny. Gaslighting is a tool of authorities who demand that we believe not what facts or reason warrant but what they deem to be true, because the designated authority is more trustworthy than any individual conscience, especially your own.

In nuanced thought, not all reference to mystery endorses mystification. Cosmologists can study the age of the universe (science), but they can't determine why there is something instead of nothing (mystery). Neuroscientists can study near death experiences (science), but they can't determine if there is an afterlife (mystery). Physiologists can study the human body (science), but they can't determine if it hosts a soul (mystery). Thus, science and mystery can coexist without any resort to mystification. Scientists can forever plumb nature, while philosophers and theologians can forever plumb mystery (Turner 2019, 133–46).

Some advocates of scientism have asserted that science is omnicompetent—completely able to answer all the meaningful questions of human existence (Atkins 1995, 132). But mystery may be an indelible characteristic of the cosmos, even to science. Physicists, for example, have long sought to discover and describe why things do what they do. With varying degrees of success, they have theorized why objects fall to Earth, why lightning flashes, and why radium glows in the dark. In their quest, scientists have discovered that elements are made of atoms; atoms are made of electrons, protons, and neutrons; protons and neutrons are made of quarks; and quark behavior is governed by quantum chromodynamics (QCD), a well-established theory of physics.

But why does quantum chromodynamics have the laws it does? How does it produce the behaviors it produces? QCD does an excellent job describing the behavior of the quantum universe, but it has a hard time explaining why the

quantum universe behaves as it does. So beguiling is the question of why, and so imponderable, that some physicists have simply retreated from the question with the pragmatic motto "shut up and calculate" (Mermin 1989, 9–11). For physicists, who practice a natural science that attempts to understand the cosmos, this may very well be good advice.

Nevertheless, some physicists find the question of why the universe behaves as it does to be irresistibly attractive. We have discovered many laws of nature. But what is the source of the laws of nature? Where do they come from? We observe that if we drop an object it falls to the ground. We observe this behavior repeatedly. In fact, we observe it every time. Therefore, we infer that there is a law enforcing this observed behavior. But we can't observe the law; we only observe the behavior. We assume that there is a necessary connection between the cause and effect when, in truth, we only see one event repeatedly follow another (Hume 2004, §1.3.14). To use language borrowed from the philosophy of science: behavior is an observable; law is an unobservable.

Let us hypothesize that there are in fact physical laws that govern the behavior of matter in our universe. This view is called realism. If physical laws govern the behavior of matter in our universe, then where exactly are they? Utilizing the methods of physical science, it would be difficult to determine if they are within matter, beneath matter, or beyond matter. What is the nature of their existence? Since they govern matter, they would seem to be immaterial, but the material sciences aren't well-equipped to study immaterial forces.

Relentless questioning, even the most rigorous questioning by the natural sciences, seems to reach a limit. At this limit we reach a brute fact, beyond which questioning is at best speculative, at worst fruitless. For example, the strong force in physics binds quarks into neutrons and protons, then holds those together in the nucleus of an atom (as the strong nuclear force). If the strong force coupling constant (its measured strength) were slightly weaker, atomic nuclei would fall apart (or simply never form), and there would be no chemistry. If it were slightly stronger, the universe would have produced helium or heavier elements right after the Big Bang instead of hydrogen. In this scenario, hydrogen-based stars would never have formed, and the stellar lifetimes needed for life to evolve would never have been reached. In other words, if the strong force coupling constant were slightly weaker or slightly stronger, you would not be reading this essay right now (Barnes 1994, 64).

Why is the strong force precisely as strong as it is? That question, although scientific, may be scientifically unanswerable. That is, the strength of the strong force may be a brute fact of physics, the cause of which we cannot fathom. Quantum chromodynamics describes how the universe works but cannot explain why it works that way. Scientifically, we may have advanced to the edge of mystery. If so, then the nature of mystery itself becomes a big question, and one worthy of pursuit, even if such pursuit may never achieve resolution.

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The author declares that they have no competing interests.

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Moral Bio-Enhancement and the Question of Biopolitics in Afrofuturism

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There are discussions regarding the promotion and integration of transhumanist ideas in Africa, aligning with African cultural ethics. One such idea is moral bio-enhancement, which employs pharmacological and genetic technologies to improve moral dispositions. This article mainly emphasizes pharmacological enhancement rather than radical genetic technologies to avoid the significant shifts associated with genetic engineering. Although there is limited literature on moral bio-enhancement in Africa, the article highlights two concerns: first, biopolitics, a futuristic concern about possible outcomes of moral bio-enhancement; and second, the argument that any integration of moral bio-enhancement with African cultural ethics must consider religio-ontological moral determinism. Religio-ontological moral determinism, as part of religio-ontological morality, indicates that morality—whether in predisposition or action—derives not only from biological nature but also from a cosmic–spiritual relationship with forces in Africa. The article further suggests that, to avoid biopolitics, values within African cosmology should be adopted, and it concludes that relationships with spiritual forces are prima facie to moral actions in Africa.

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Introduction

In Africa, several works have stressed the importance of applying transhumanist ideas, especially in overcoming the continent's limitations (Mbessa 2020; Igwe 2021; Ibanga 2024) without compromising Africa's cultural elements. African societies face corruption, conflicts, and political instability, creating an urgent need for solutions that respect Africa's cultural context. One possible solution is using pharmacological, neuro-behavioral, and genetic engineering technologies to improve moral attitudes in Africa (Fayemi 2018). It is believed that these methods can influence human behavior, addressing moral shortcomings, particularly those linked to societal issues. These technologies could potentially reshape behavior, making people more ethically conscious, unlike traditional moral development methods that depend on education, socialization, and lived experience, which have been less effective lately. Ingmar Persson and Julian Savulescu (2013, 124–31), advocates of moral bio-enhancement technologies, argue that this approach could make humans more consistently ethical, helping to resolve complex social–moral dilemmas that conventional education has struggled to address. This suggests that people enhanced by these technologies will demonstrate consistent integrity, effectively eliminating behaviors like corruption that hinder societal growth and progress.

However, the issue of biopolitics introduces a new form of neo-colonialism through the commodification of enhancement drugs, with Africa's reliance on these drugs to be morally fit. This poses a risk of bio-technological dominance and moral dependency. In line with the idea of reaffirming the importance of integrating African spiritual ethics into moral bio-enhancement, this article further introduces the concept of religio-ontological moral determinism, which is helpful for the development of bio-enhanced morality in Africa. The article argues that religio-ontological morality offers a strong moral foundation for African consciousness, highlighting the deep connection between physical and spiritual realities. Without a connection or relationship with spiritual entities in Africa, moral bio-enhancement risks becoming ineffective.

The article is organized into six sections. The first is the introduction; the second is a conceptual guide using Yamikani Ndasauka's (2024) theories of "technologizing traditions, or traditionalizing technology" and "spirit in the machine" to explain the relationship between religio-ontological moral determinism and transhuman moral bio-enhancement in Africa. The third section discusses the impact of biopolitics on Africa through moral bio-enhancement. The fourth section defines and explores religio-ontological determinism in Africa. The fifth section develops a convivial argument.

Theoretical Guide

This article draws on Ndasauka's (2024) theories of "technologizing traditions, or traditionalizing technology" and "spirits in the machine," in which African

spirituality and tradition shape modern scientific and technological innovations, to discuss how religio-ontological moral determinism can influence or affect the efficacy of moral bio-enhancement to achieve optimized results in Africa. Although Ndasauka's view applies generally to the term technology and not directly to transhumanism—the underlying ideology behind moral bio-enhancement—the concept fits the purpose of integrating both frameworks. The benefits of Africa's cultural ethics to transhumanist ideologies are substantial. The article highlights religio-ontological morality, a moral framework rooted in African spirituality and cosmology, where moral development is intertwined with communal and spiritual order rather than solely biological optimization. This approach aims to reinvent Africa's culture and prevent the eruption of colonialism through biopolitical control. Clearly, there is a necessity to integrate moral bio-enhancement with African spiritual ethics. Ndasauka (2024, 71) explains that Africa's diverse artistic, linguistic, social, and knowledge traditions are undergoing complex transitions amid rapid technological change. As digital tools and paradigms expand across the continent, careful negotiation is required to embed them into enduring cultural fabrics. Technologies developed without regard for local contexts risk eroding rather than supporting Africa's rich heritage.

Without careful negotiation, the danger extends beyond undermining local contexts to include the potential reinvention of colonial frameworks through biopolitical control. This concept of careful negotiation aligns with Francis B. Nyamnjoh's (2024) description of "incompleteness, mobility, and conviviality," providing ontological grounding for a dialogue between Western biotechnological rationality and African cosmological ethics. This article asserts that for transhumanism to thrive in Africa, it must be compatible with African metaphysics. In Africa, moral bio-enhancement is incomplete without recognizing the interplay between biological and cosmological elements. Without this synergy between spiritual and biological, emergent actions may be ineffective and fail to produce the desired utilitarian outcomes. This religio-ontological perspective resonates with Thaddeus Metz's (2022, 8) African normative ethics, which emphasizes relational morality over individual autonomy. Transhumanist ideologies are drawn from a different value set—primarily Western individualism—as Metz (2020) notes, and the values shaping technological innovation are individualistic. Metz (2020, 37) argues that the individualistic normative theory posits that intrinsic properties of an individual determine moral status, thereby entitling beings to moral treatment. Moral bio-enhancement is a form of moral treatment aimed at treating the individual for a desired utilitarian outcome, justifying it as a Western ideology. Although transhumanist visions are global and applicable to everyone, their underlying values reveal radical principles with trans-Western implications (Igwe 2021, 125).

However, while transhumanism can transcend any cultural ideology, framework, or worldview because it questions the universal human limitation

without necessarily conflicting with these worldviews (Igwe 2021, 121), it risks eroding Africa's robust knowledge foundations (Ndasuaka 2024, 72), including Africa's moral knowledge. Consequently, it is vital to conduct a thorough evaluation of the moral framework behind transhumanism to understand the risks it poses to alternative worldviews. This is why Ndasuaka (2024, 72) notes that for this integration to be actualized in Africa, "[m]indfulness is needed to strengthen communal control over if, when, and how technologies interface with African worlds." Western epistemology, in which technology serves as a major channel, carries a spirit of domination (Mbessa 2020, 445) or cultural imperialism through purportedly neutral tools (Ndasauka 2024, 72), transforming other epistemologies and cultures. Therefore, due to the differing moral frameworks of the West and Africa—such as individualism versus relationalism, spiritualism, and communalism—and the spirit of dominance, it is essential to incorporate an African moral theory.

The Need for Moral Bio-Enhancement in Africa?

Moral bio-enhancement cannot be fully understood without a brief discussion of transhumanism. The idea of transhumanism, which aims to surpass human limitations, applies to all aspects of humanity, whether ontological or cosmological. Anders Sandberg (2014, 4) summarized this with his three-part description of "individual transhumanism," "terrestrial transhumanism," and "cosmic transhumanism," all focused on improving human life both within and beyond the universe. The aspect of concern here is the ontological–existential. Transhumanism challenges our traditional understanding of human existence and interaction. It raises questions about what it means to be human, as technological enhancements may alter core aspects of human nature, such as consciousness, identity, and the body. The pursuit of transcending moral limitations has led to what is called moral bio-enhancement, achieved through neuropharmacological or genetic means.

Proponents such as Ingmar Persson and Julian Savulescu (2008, 2012, 2013) and David DeGrazia (2012, 2014) suggest that using moral bio-enhancement technologies could play a crucial role in overcoming the limitations of human moral nature—limitations that traditional education methods have historically struggled to address. Unlike conventional education, which aims to shape moral behavior through instruction, experience, and socialization, moral bio-enhancement technologies offer the potential to directly influence and improve moral capacities on a cognitive, biological, or genetic level (Kudlek 2022, 24). This approach could lead to more consistent ethical behavior and offer solutions to complex moral dilemmas. By intervening at the core of moral decision-making, these technologies may provide a more effective and reliable way to develop moral integrity and reduce harmful behaviors in society.

Situating the argument on balance, Karolina Kudlek (2022, 25) explains that in the enhancement debate, two extreme viewpoints stand out. Bio-conservatives advocate extreme caution and oppose the development of nearly all human enhancement technologies, arguing that such technologies could harm individuals and society in various ways. In contrast, transhumanists believe that we should actively pursue the development and availability of these technologies to improve and expand valuable aspects of individual lives, such as health, cognition, and emotional wellbeing. Many moderate perspectives fall between these extremes, suggesting that while enhancements should not be universally banned, they should be approached with significant caution and evaluated on a case-by-case basis. These enhancements aim to improve human dispositional attitudes, encouraging individuals to always choose actions beneficial to humankind. However, there are some important points to consider, as highlighted by Inmaculada De Melo-Martin and Arleen Salles (2015, 226), such as, would it be a motivational and dispositional enhancement or simply a self-evident enhancement? For example, imagine an individual who intends to be empathetic. After taking the necessary enhancement pill, he finds it difficult to assist a person attempting to steal a masterpiece. In this instance, failing to help would show the drug's limitations. If he chooses to help, fully aware of the thief's intent, he has not acted in a self-evident moral disposition. This illustrates that empathy alone is not enough for moral behavior; one must consider the feeling of empathy for the right person in the appropriate circumstance (cited in De Melo-Martin and Salles 2015, 226). In other words, motivation and willingness to take the drug are essential; without such willpower, eradicating fundamental moral evil remains impossible.

It can be argued that forcing individuals to take drugs is inherently unethical because it involves coercion. If the outcome leads to morally upright behavior or increased motivation, individuals should not be credited for these actions, since they are not driven by their own free will (De Melo-Martin and Salles 2015, 227). Second, what will the level of enhancement be? Will it be perfect or semi-perfect? Given the nature of man-made drugs, which have limitations in terms of validity, durability, and strength, one cannot expect bio-enhanced drugs to be completely flawless or free of side effects. The main question here is whether negative emotions are inherently harmful. For example, if I had to resort to extreme aggression and force to kill a serial killer to protect minors, does that mean my actions were out of control? It is important to understand that negative actions driven by negative emotions are not always harmful, just as positive intentions from positive emotions can sometimes lead to negative outcomes (Wasserman 2014). This ethical dilemma highlights the tension between intent and consequence. Furthermore, one can argue that one's negative emotions often outweigh good intentions or feelings, with proponents of moral bio-enhancement insisting it is easier to destroy than to save. Consequently,

regardless of the ongoing debate, supporters of moral bio-enhancement aim to produce morally improved individuals who are always motivated to act rightly and not wrongly (De Melo-Martin and Salles 2015, 224). This means they would be good people who do what is right for the right reasons, avoiding murder, theft, unjust discrimination, or even littering. They would be appropriately compassionate, loyal, honest, kind, and courageous, and they would help build a just society (De Melo-Martin and Salles 2015, 224). According to supporters of moral bio-enhancement, morally enhanced individuals would possess unwavering integrity, seemingly immune to corruption—a trait that pushes the limits of human nature and redefines our ethical boundaries.

The significance of moral bio-enhancement in Africa has received limited attention in the literature, unlike transhumanism and artificial intelligence (Fayemi 2018; Mbessa 2020; Igwe 2021; Abdul 2023; Attoe and Chimanokam 2023; Metz 2023; Ofana 2023; Wareham 2023; Carman and Rosman 2023; Ibanga 2024). Transhumanism and moral bio-enhancement are both still relatively new in discussions about conflicts and tensions between science, culture, and religion in Africa. However, Ademola Kazeem Fayemi's (2018) concept of "Afrofuturism" has served as a key platform for developing this article's objectives, offering strong justification for the importance of cultural collaboration between transhumanism—particularly moral bio-enhancement—and Africa's cultural and metaphysical views of personhood, especially the Yoruba ontological aspects of personhood. Although Ojochogwu S. Abdul (2023, 107) also explores Afrofuturism in relation to transhumanism, singularity, and the meaning of human life in Africa, he argues that the human desire for enhancement is not foreign to Africa, as demonstrated by myths and stories of humans seeking immortality and heroic displays of superhuman powers, body- and mind-enhancing practices, physical modifications, and the use of stimulants for mind alteration and intelligence enhancement.

The examples provided by Abdul involve using local remedies for memory loss, such as *Ogun isoye* (a memory enhancement drug), a traditional form of nootropics used by Ifa trainees to boost memory, and *Ajidewe* (waking up and feeling younger or remaining youthful forever), which can be seen as the concept of the "elixir of life" in African understanding, or what is known today as life extension, common among the Yoruba of Nigeria. In African animist culture, where statues are believed to house energies that perform tasks like robotics or the creation of animated and artificial beings, statues were historically brought to life through ritual ceremonies known as the "opening of the mouth," found in ancient Egyptian and Nile Valley traditions. Abdul (2023, 108) therefore advocates for developing a uniquely modern African transhumanist and singularity philosophy that integrates traditional African ideas to promote human flourishing in today's African context through reason, science, technology, the concept of progress, and dialogue with other philosophical traditions outside

Africa. Nonetheless, he suggests that by applying Metz's ideas of community (or Ubuntu), which regard human life as more meaningful when it fosters community and vitality—using vital force to improve others' quality of life—it is possible to construct a forward-looking transhumanist interpretation of human life in Africa.

Fayemi, on the other hand, emphasizing how moral bio-enhancement can be beneficial in Africa, argues that there is an urgent need for enhancement on the continent, especially considering the political corruption that has significantly affected its sociopolitical landscape. He suggests that since a person's character is connected to their psychological self (*inú*), improving this through technology could encourage moral behavior among Africans. He links "moral disorder" and "genetic defect," proposing that genetically modifying the gene responsible for moral disposition could fix these issues and promote moral bio-enhancement (Chimakonam 2021, 8). He explains that genes influence both the brain and the person. While some genetic defects contribute to moral issues, improving genes related to behavior could lead to better moral dispositions in individuals and strengthen the social fabric of society. Political corruption, often viewed as a reflection of moral tendencies, could thus be addressed through genetic engineering and other biotechnologies aimed at changing the genes responsible for moral behavior and biases (Fayemi 2018, 70).

In this situation, it is very likely that enhancing the psychological self (*inú*), the internal structure of a person, would not only strengthen individual selfhood but also benefit the common good by fostering a better sense of moral personhood (Fayemi 2018, 70). While transhumanism supports limitless evolution of human life and abilities beyond current forms, Hallen's idea of personhood, according to Fayemi, emphasizes a dynamic change in human essence, guided not only by life-enhancing technologies but also by non-evolutionary ontological values of existence. This suggests a potential conflict between the transhumanist push for evolution and Hallen's creationist view of personhood. A practical way to reconcile the transhumanist goal with the religio-ontological idea of personhood is to embrace Afrofuturism (Fayemi 2018, 70).

Afrofuturism has thus become synonymous with Africa's future, emphasizing its growth, development, and integration with technology while preserving its culture. Therefore, "Afrofuturism offers a critical African reimagining of a posthuman future, rooted in African history, culture, *religio*n, and philosophy, while also addressing the shifting dynamics of science, technology, and power in the global order" (Fayemi 2018, 70–71). Abdul (2023, 107) agrees with Fayemi, stating that "Afrofuturism explores the developing intersection of African and African Diaspora culture combined with technology, re-imagines the past, science, and the future from a Black and African perspective, envisioning what peoples of African origin can become." In his concept of Afrofuturism, Fayemi (2018, 68) emphasizes the importance of exploring whether emerging

trends in transhumanism can provide new theoretical insights that lead to a reevaluation and deeper understanding of African views on personhood. His exploration also involves examining both similarities and differences between the African perspective on personhood and the concept of the person in Western transhumanist discourses. Fayemi argues that moral bio-enhancement can improve normative personhood by making individuals more moral and better integrated into society. He suggests that moral bio-enhancement enables a person to foster more harmonious relationships within their community. This process, according to him, would expand "the capacity frontiers of humans as social and relational beings" (Chimakonam 2021, 7).

Biopolitics of Moral Bio-Enhancement in Africa

Before exploring this aspect of the article, it is important to commend scholars who have worked to integrate Western science, African bioethics, and culture in postcolonial Africa. While Denis-Ghislain Mbessa (2020), Leo Igwe (2021), and Ndasauka (2024) also discuss the importance of this synergy without dismissing Africa's culture, Fayemi's concept of Afrofuturism is particularly significant because it shows how the past and present can shape a brighter future for Africans. Indeed, Africa needs change, especially considering the serious challenges the continent faces, and transhuman moral bio-enhancement could be part of that change. Igwe (2021, 120) emphasizes this point: "[T]he idea of technology's ability to overcome the limitations of the human condition could have the greatest payoff for Africans." However, how we view technology in post-Western Africa—whether through techno-progressivism or Afrofuturism—depends entirely on whether we dismiss the possibility of a future without Western dominance. Omer and Lupo (2024, 77) clearly observe this: "One of the principal challenges of imagining the post-western is the way in which the liberal-secular-democratic assemblage is mobilized to dismiss any possibility of a future without the hegemony of the floating signifier of the West." Even when technology is incorporated into core African communal themes—as in moral bio-enhancement—neo-colonialism remains a risk. Ndasauka (2024, 17) reminds us of this:

> The exponential growth of technology across Africa demands philosophical engagement grounded in African knowledge frameworks. However, most technology designs and policies rest on individualistic assumptions that conflict with traditional African values centred on communal interdependence. Mainstream Western philosophy of technology often promotes values of efficiency, productivity, hyper-individualism, and technological solutionism in ways misaligned with African cultures. For example, technology designed within a capitalist framework can undermine social solidarity and reciprocity.

The term biopolitics includes techno-colonialism, bio-colonialism, and economic colonialism. Madianou's (2025, 5) use of techno-colonialism describes how digital innovation, data, and AI practices reinforce power disparities, creating new forms of structural violence and inequality between the Global South and Global North. Madianou states that "[t]echno-colonialism illuminates the convergence of digital developments with humanitarian structures, state power, and market forces, and the extent to which they reinvigorate and rework colonial relationships." Biopolitics explains how the human biological system is involved in these power disparities, perpetuating inequality, domination, and dependence through colonial relationships and Western market forces. Melinda Hall (2017, XVIII) describes biopolitics as a power regime, a modern pattern of power functioning through norms that divide populations into normal and abnormal to govern. Transhumanists use this concept to control bodies. This research also utilizes the economies of vitality, one of Nikolas Rose's (2007, 6) pathways of mutations shaping contemporary biopolitics. This speaks to the bio-economy, which pharmaceutical companies have transformed from science to stock markets. Through these ideologies, bio-economic exploitation expands (Rose 2007, 4).

Here, life—whether through biomedical techniques, capacity-enhancing drugs, mood modulation, emotion, desire, or intelligence—becomes part of these new economic relations, as vitality can be isolated, stored, accumulated, mobilized, and exchanged as value (Rose 2007, 1). These capacity-enhancing drugs are called moral-bio-enhancement drugs, which Parker Crutchfield (2021, 2) defines as "the improvement of a person's moral attitudes, motivations, or behavior through biological means." The core issue is how this impacts Africa, where the politics of moral bio-enhancement is prominent. Rose (2007, 8) asserts that "[a]s biopolitics becomes entangled with bio-economics, as bio-capital becomes open to ethical evaluation, and as etho-politics becomes central to our way of life, new spaces are emerging for the politics of life in the twenty-first century." Bio-economy is directly linked to bio-value, where biological organisms create value, either capital or food value, through the processes of manufacturing, distribution, and marketing. For the bio-economy to be mapped into a space to be governed or governable, it must be understood first as a system of processes to be studied and theorized. When defined this way, it becomes a medium that governments and corporations can use to strengthen their power and raise bio-capital to finance the project alongside private investors and corporations (Rose 2007, 33). This wave of politics is vital to processes of neo-colonialism in Africa through dependence on and extraction of capital value, where Africa lacks both the epistemological and scientific structures for independence.

Additionally, the challenge is not just to focus on an individual's psychology to motivate the choice of good over evil, which moral bio-enhancement aims to do; we must also consider the structural, social, cultural, political, and economic forces that foster evil. Hall (2017, XI) agrees, stating that enhancement is framed as a biological intervention, while the issues fueling the debates around enhancement are rooted in social and political factors. The epistemological divide is also a major concern. Questions about epistemic asymmetry further deepen the political divide, resulting in a broader and more resilient form of biopolitics. We must ask: Will knowledge about the production of these drugs be shared with Africans to prevent dependence or reliance on the Western industry? David McCoy et al. (2024, 133), in their analysis of recent drugs and global health, explain that these monopolistic and exploitative markets are forms of colonialism, calling for greater knowledge diversification. The challenge is that Africa is not on an equal technological footing with the rest of the world and has little or no influence in global techno-politics, biopolitics, and other human enhancement efforts, which leads to dependence (Igwe 2021, 121).

It is not new that the West depicts Africa with negative labels such as corrupt, disease prone, impoverished, and cognitively inferior. These labels can be seen as disabilities, which are central to human enhancement efforts (Hall 2017, IX). Whether through moral (cognitive or moral bio-enhancement) or physiological means, it is accurate to say that many corporate projects, especially those involving collective enhancement, are deliberately aimed at the Global South, including Africa. The term disability has been a powerful tool in biopolitics and biopower to differentiate the Global South from the Global North. Hall (2017, 35–48) argues that this is not only a biological issue but also a cultural and political construction of identity. This view suggests that perceiving Africa as a fractured continent with disabilities undermines everything emerging from the region, including its culture, philosophy, and ideology. Therefore, Africa's situation must be approached with care. Igwe (2021, 122) argues that

> [t]he global technological power play has consigned African countries to the margins of good life and development. While the application of existing technology has led to the discovery of cures to diseases, alleviation of poverty and suffering, increase in wealth and prosperity in many parts of the world, much of the good has not equally reflected on many parts of the globe. Existing techno-politics has created a world that has left most African countries trapped in poverty and as permanent occupants of the bottom sections of the Human Development Index. There is a tendency to adopt a conservative approach towards the project of human enhancement and its proposed benefit to humanity. This approach inclines one to be cynical and to dismiss transhumanists as neocolonial propagandists.

McCoy et al. (2024, 130) explain that colonialism can take different forms. One of these, according to the article, is commodification. Regarding the commodification of moral bio-enhancement drugs, who truly benefits from their sales—those in the Global South or the Global North? While we focus on morally enhancing ourselves with transhumanist ideas from the West, the West continues to gain significantly from selling these drugs. Most companies in the Global South simply act as distributors while earning millions for the Global North, where these drugs are shipped from. Using the term "soft neo-colonialism" suggests that moral bio-enhancement drugs do not openly reveal who the real beneficiaries are, since the users are morally enhanced. However, colonization persists through Africa's dependence on Western pharmacological and biological drugs to act morally, echoing Achille Mbembe's (2021, 226) view of colonization as trapping much of the world in a vast web of dependence. Mbessa (2020, 446) summarizes that the cumulative effect of technological progress is the infusion of Western culture—an impulse toward unification, patenting, monopolism, and commercialization of discoveries—spreading its ideas, visions, convictions, and practices under the guise of universal imperatives of rationality and morality intended to be binding on everyone, regardless of culture.

It becomes clear that the façade of this capitalist liberalism is the promotion of moral bio-enhancement and the promise of liberation from cognitive and moral limitations. Although Igwe (2021) has explained that we can combine Western technology with African culture without necessarily causing conflict, this must be done carefully, because what is Western technology without political, social, religious, and cultural domination (Hurtado Hurtado 2024)? Rose (2007, 16–17) clearly states what technology is. Technology is more than just conventional equipment or techniques; it is an assemblage of knowledge, instruments, people, systems of judgment, spaces, and institutions. Here, we can refer to the four Foucauldian concepts of technology for emphasis: technology of production, sign systems, power, and self, each representing different forms of domination (Foucault 1988, 18), especially technology of power and of self, which involve restructuring the mind, attitudes, bodies, and interactions with others. Technology rewires thinking, morality, behavior, and perceptions. It creates "knowledge monopolies," as Harold Innis describes (cited in Postman 1993, 9), or social order and construction (Kirkpatrick 2008, 3), making it difficult for other cultures to adapt. Rose (2007, 17) states that "[o]nce one has witnessed the effects of psychiatric drugs in reconfiguring the thresholds, norms, and volatilities of affects, cognition, and the will, it is difficult to imagine a self that is not open to modification in this way." This idea also applies to moral bio-enhancement drugs, which introduce a new sense of being with altered moral capacities to intervene upon the mind through manipulation of the brain to act, think, and behave as directed by the drug—a new biopolitics—neuro-politics (Rose, 2007, 22). Clearly, it becomes very difficult to distinguish

what is termed biopolitical power from the manufacturers behind the drugs, as this act of domination is intertwined with economic interests.

Companies supporting these innovative projects, whether in research or implementation, promote exploitation. Ebénézer Njoh Mouelle (2019, 7) clearly states that "in the context of triumphant capitalist liberalism, no one can prevent private firms from designing and funding research programs and then exploiting the results; they only aim to make their investments profitable and generate profit." Hurtado Hurtado (2024, 905) further explains that whether it is bio-technology—the modification of the mind—or digital-technology—the modification of the human body—these ideas, which are tools of techno-capitalism, shape capitalism's structural tendencies, including maximizing profits and commodifying social relations, by adapting to new technologies. According to Hurtado Hurtado, all these fit into a framework where the new spheres of an individual's life—mentally, socially, and physically—are simply means to further private capital accumulation, stripping away the intrinsic value of the person. As a result, these individuals rely on the drugs to act morally without using their true nature. This further suggests that surplus value is extracted from Africa in exchange for drugs that enhance moral cognition. This explains why Ndasauka (2024, 12) states that "the business models driving innovation seem laser-focused on profits and shareholders rather than addressing real African problems. Even technologies designed for Western consumer markets sometimes fail to meet local African communities' real needs and priorities." These ventures are driven not only by research but by the goal of achieving a return on investment. Meanwhile, with Africa being a lucrative market for many pharmaceutical companies—often referred to as pharmaceutical colonialism (Lyons 2009, 68)—the issue of competitiveness naturally arises between pharmaceutical exporters to Africa and the marketing firms associated with these Western companies.

Unless everyone in Africa and the West uses moral bio-enhancement drugs in the same context (Dinh et al. 2020, cited in Kostick 2020, 256) or the private companies that administer the drugs are themselves first enhanced (Crutchfield 2021, 130–31), the result is an ambiguous division of the nature of beings, where the motive of the companies is only profit-making, and the aim of the drugs produced is not necessarily to help the people they should help. This is what Mbembe (2021, 227) describes as the doctrine that prompted modern colonization. This could lead to the deliberate creation of supposed moral bio-enhancement drugs motivated only by profit, regardless of their effects—positive or negative. Rose (2007, 1–2) emphasizes this point, noting that in the context of transhumanism, many private investors hope these biomedical advances will create a highly profitable bio-economy, and pharmaceutical companies have faced criticism for selling drugs at inflated prices with false promises and ignoring potentially dangerous effects. This aligns with Crutchfield's (2021, 2)

view that we are collectively poor at thinking, acting, and achieving moral values. If we are to succeed, it must be through collective enhancement, involving widespread moral bio-enhancement.

Significantly, moral enhancement is agent-oriented and aims to treat the intrinsic nature of being (Torres, 2017, 6). It could be perfectly rational to promote others' moral bio-enhancement, such as the apocalyptic terrorists who believe that the only way to save the world is to destroy it (Torres, 2017, 7). For instance, if the Boko Haram and Iswap terrorists in sub-Saharan Africa were morally enhanced, they would become altruistic and less willing to harm others, which would benefit society. The danger here, however, is that moral bio-enhancement could also lead to the exploitation of the enhanced if they develop heightened empathy or an altruistic disposition that leads them to excessive self-sacrifice. This argument can be expanded by considering that, given the idea of the ultimate act of altruism, the enhanced may be motivated to sacrifice themselves, even at the cost of others' deaths, to save others from ongoing suffering, a form of strong negative utilitarianism (Torres, 2017, 10). This is why Torres (2017, 5) states that Persson and Savulescu appear less enthusiastic about the efficacy of moral bio-enhancement in terrorists. Regardless of the positive nature of remodifying or motivating agents to choose altruistic actions and prosocial behaviors over antisocial behaviors, this does not prevent the commodification and extraction of value from Africa to the West, with Africa relying on importing these drugs to stay morally alert. The future is speculated to resemble a "dystopian corporate control," where enhancement primarily benefits those who developed it (Dunagan et al. 2020, 2).

We must also recognize that the problem of unconceived alternatives (Stanford 2006) reminds us that the scientific claims behind any transhuman ideology are provisional and not the final truth, because current scientific truths are valid only until alternatives are conceived. Once these alternatives are imagined, as seen with past scientific theories, they are replaced. This is especially critical for Africa. Suppose Africa views transhumanism, especially moral bio-enhancement, as the embodiment of revolutionary truth for its situation. In that case, it risks depending on theories that will soon be discarded because alternatives are yet to be conceived. This highlights a dependency on bio-technology that will soon become outdated. When this occurs, Africa may find itself repeatedly accepting these alternatives. This is why decolonization is so vital. The pursuit of decolonization means "everyone can express him or herself purely in his or her own language" (Mbembe 2021, 224), where language symbolizes Africa communicating its moral epistemology—untouched and unmixed. However, an Afrocentric Afrofuturism that disposes of any Western ideology that can replicate neo-colonialism and completely replaces it with an African Indigenous approach (Moloi 2023, 71) is not a lasting solution in the wake of the fourth industrial revolution, where technology is shaping the future regardless of

culture. Accordingly, Afrofuturism must integrate African culture and Western techno-epistemology. Therefore, if there is a way out of this dilemma facing the African continent, it should not rely solely on Western techno-epistemology, which has partly contributed to the current African situation; instead, it requires integrating a more Indigenous approach with Western science and technology to eliminate any form of neo-colonialism. In the same vein, a critical aspect of this integration—religio-ontological moral determinism—must be carefully considered as it applies to African cultures and cosmological frameworks.

Understanding Religio-ontological Moral Determinism in African Culture

Religio-ontological moral determinism is rooted in a religio-ontological moral framework. Religio-ontological morality emerges from religious consciousness. Making broad assumptions about religion in Africa can be risky, regardless of whether it is in the precolonial or postcolonial era. Homogenizing religion in Africa raises concerns about marginalizing other cultural philosophies not centered around the main religion. Therefore, any "attempts to construct unified doctrines a priori using decontextualized abstractions will collapse" (Ndasauka 2024, 21). However, not claiming that African religious moral culture is objective does not mean that most of Africa's culture is not rooted in metaphysics and religion. This provides the foundation for justifying religio-ontological morality as primary to African culture, which spans multiple cultures across Africa. Despite centuries of colonial disruption, cultural upheaval, and modernizing pressures (Ndasauka 2024, 169), including technological and transhumanist developments, this metaphysical framework has remained resilient and adaptable.

By religio-ontological morality, we mean a moral framework where human actions are deeply linked to religious beliefs and the perceived influence of supernatural beings. We can generally interpret the core of religio-ontological morality from Benson Ohihon Igboin's (2022b, 3) definition of religion: "[T]he awareness, recognition, consciousness of, and belief in, the existence of a supreme being to whom worship is due." However, one might also suggest that this awareness, recognition, and consciousness shape specific attitudes toward others in the community. This perspective holds that morality is not just based on human reasoning or societal norms but is rooted in the relationship between individuals and the divine. In this framework, the ontological essence of morality is seen as originating from the transcendent nature of supernatural beings, with human behavior influenced by spiritual beliefs, rituals, and divine commandments. Therefore, every moral action is a response to the divine will, a reflection of one's spiritual state, and a way to maintain harmony with both the physical and metaphysical worlds. This moral theology implies that individuals' daily actions are continually shaped by their relationships with supernatural entities, often interpreted through religious doctrines and teachings.

In cultures with a strong religio-ontological focus, morality is closely tied to religious practice, as people align their behaviour with what is seen as sacred. This perspective highlights accountability not only to societal standards but also to divine judgment, encouraging a sense of duty to follow moral norms as part of spiritual life. The African system is meaningful, with the existence of the Supreme Being and divinities who add value to human existence and purpose (Akande and Ogunbiyi 2022, 104). This suggests that people's daily actions in society are observed and organized. Dauda Umaru Adamu, and Amidu Elabo (2022, 273) further include ancestors as part of the hierarchies, although the lowest level in the spiritual plane is responsible for instilling moral awareness in Yoruba cosmology. Similarly, Igboin (2022a, 116) argues that despite modern influences, belief in ancestors still echoes in African community settings. Although his work mainly focuses on the criteria for being an ancestor in Africa, it supports Adamu and Elabo's view on the significance of the ancestors' role in society. The various perspectives mentioned here connect with the main modes of existence responsible for the cosmological, ontological order, and moral awareness of humans in Africa.

Apart from the Supreme Being, divinities, and ancestors, there are spirits who, like divinities, embody natural forces and human values, serving various roles such as guardians, tricksters, or ambassadors to the divine (Ndasauka 2024, 171). Additionally, magic and medicine (Dein 2025, 10) are used to re-engineer attitudes and actions. In the Yoruba worldview, for example, governance is not only about law and order but also a spiritual duty that aligns with divine will and the community's collective good. The moral awareness shaped by Yoruba religion encourages a form of leadership responsible to both the physical world and the spiritual realm. This accountability extends beyond the earthly and is believed to affect both seen and unseen worlds. The rise in corruption can thus be linked to the abandonment of this spiritual foundation. When African societies adopted Western systems that separated governance from spiritual responsibility, it created a vacuum in moral authority. The result has been a governance system where self-interest and greed often overshadow communal welfare and accountability. This shift has allowed corruption to thrive because the sacred duty of leadership—once upheld by a fear of divine punishment and ancestral disapproval—has been lost. Nelson Shang's (2016) argument corroborates this, stating that morality levels in postcolonial Africa have significantly declined compared to the highly religious moral life in precolonial Africa due to the influence of colonialism and missionary religions (cited in Igboin, 2022b, 7).

This ongoing comparison further sharpens our understanding of the morality in Africa relative to Western influence. The question arises: Since the West is partly responsible for the current state of affairs in Africa, how realistic is the hope that Western transhumanist ideology can free us from these shackles? We must also recognize that, with the future uncertain, transhumanism's potential could

either reduce us to animalistic instincts or truly resolve our present existential issues, as there is a very fine line between post-humans and animals. As Hill (2019, 2), the techno-futurist who envisions and reimagines self-development, emphasizes, it has the power to either tighten or loosen the threads that weave the fabric of human life. Marius Dorobantu (2024, 36) shares this perspective, suggesting that in our quest for science,

> [t]he most tangible manifestation of this alleged insidious spiritual decay is a decoupling of the power of reason from the more fundamental, deeply human aspects of our psyche. The logical, problem-solving type of intelligence, the one that is so illustratively typified in artificial intelligence, can breach into the absurd if left unchecked, with disastrous consequences for the individual and potentially for our entire species and ecosystem.

Obviously, disputes can arise concerning the nature of and differences between moral bio-enhancement and artificial intelligence, with only artificial intelligence being mentioned by Dorobantu as potentially leading to disastrous outcomes—unlike moral bio-enhancement. Moral bio-enhancement is drugs used for mental and psychological improvements, not artificial intelligence, which is unnatural. Artificial intelligence actively participates not only in designing drugs but also in testing them (FDA and EMA 2026), with these capabilities extending to pharmacological drugs aimed at moral bio-enhancement. Therefore, we ask: If artificial intelligence helps design or regulate moral bio-enhancement drugs, will people truly choose enhancement, or are their choices influenced by algorithms? If artificial intelligence-enhanced neuropharmacology increases intelligence or emotions, is the "self" still authentic? The real danger, however, stems from how we define human nature, structure, and body. If we view the human body as a toy or game, it could lead to dehumanization and moral decline, while unchecked power might open the doors to nuclear or algorithmic chaos (Dorobantu 2024, 38), as well as the commodification of human vitality. Rose (2007, 39) agrees with the latter:

> What is clear, however, is that the classical distinction made in moral philosophy between that which is not human—ownable, tradeable, commodifiable—and that which is human—not legitimate material for such commodification—can no longer do the work that is required to resolve this issue: that distinction is itself what is at stake in the politics of the contemporary bioeconomy.

From this, we can infer that, unlike science, religion ontologically represents humanity as sacred, not as toys or games, thereby supporting an ideal morality. However, to prevent our advocacy of religio–ontological morality from being dismissed as merely descriptive ethics or moral anthropology without

systematic evaluation (Molefe 2018, 20), it is crucial to highlight other unique qualities inherent in this moral theory. While religio–ontological morality is ontologically spiritual, it markedly differs from transhumanist ideologies, which are often described as individualistic. Religio–ontological morality relies on supernaturalism but also stresses the collective nature of people. This indicates that ethical behavior must align with the will of the gods and societal standards, emphasizing communal harmony. This argument reinforces our support for religio–ontological morality in moral bio-enhancement. It is also important to acknowledge that the long dominance of Eurocentric paradigms has influenced perceptions of African culture and philosophy, leading to the view that African philosophy focuses on rediscovering past belief systems rather than addressing current issues (Ndasauka 2024, 13), especially how these belief systems can help solve contemporary challenges faced on the continent.

The Case for Religio-ontological Moral Determinism in Moral Bio-Enhancement

Integrating technological morality within a cosmopolitical framework—where enhancement aligns harmoniously with both the visible and invisible realms, not just the individual—is crucial in Africa. If enhancement occurs without regard for the broader cosmological and spiritual order, individuals may struggle to adopt the right mindset. Therefore, any enhancement must consider this relationship. While the sacredness of life is vital to this divine order and should not be treated as a commodity, the question of moral determinism also distorts the individual's autonomy. Regardless, only through this integration can moral bio-enhancement be tailored to Africa's cultural and ontological development. Reincorporating these values into moral bio-enhancement could foster a system where leaders are spiritually accountable and empowered to embrace their enhancements freely. It is important to argue that without a synergy between the enhanced individuals and the spiritual order, such enhancements risk becoming ineffective rather than truly beneficial. The possibility of integrating religio-ontological morality with moral bio-enhancement challenges the core of transhumanism, which is based on a mechanistic view of being. This raises questions about how spirituality might be expressed digitally or through technological means (Fayemi et al. 2025).

Aribiah D. Attoe's (2020) African God-purpose theory of meaning further highlights the importance of combining religio-ontological morality with the ideology of moral bio-enhancement in Africa. According to Attoe (2020, 129), "God confers meaning in two distinct ways, namely through specific destinies, and through divine law and order." This indicates that a person's life lacks full meaning without God's purpose. It also suggests that biological, mental, and psychological interventions intended to promote good choices and moral

actions are limited by an individual's divine destiny. Moreover, divine laws and orders not only define relationships within a community but also among spiritual and metaphysical forces that ontologically communicate with and influence the physical realm. By extension, Motsamai Molefe's (2018, 23) view that the African understanding of reality is generally holistic, with all realities interconnected and interdependent, is relevant. Therefore, engineering morality by merely altering and stimulating the brain must be approached with ontological conviviality in Africa. Without a harmonious relationship between the enhanced individual and cosmic forces, actions and inactions can be complicated. Attoe (2020, 132) regards this harmony as both an ongoing process and a state—a continuous effort by the universe to maintain the delicate balance necessary for its existence without negating individual free will. This balance can be described as what Abdul (2023, 109) refers to as the Afrofuturistic perspective of transhumanist singularity and the meaningfulness of life, where Sandberg's individual, terrestrial, and cosmic transhumanism are unified and interconnected to foster an improved human condition.

It is important to situate this argument in a subjective narrative. Patrick Giddy (2023, 82) offers a more compelling first-person African mind–spirit narrative, suggesting that forces outside this subjective realm can influence someone in ways they might not notice. This indicates that actions someone perceive as their own are, at a deeper level, driven by the cosmic African reality beyond their control. It also shows that even if a person is altered pharmacologically, their sense of right or wrong can still be affected, rendering moral bio-enhancement ineffective. This influence is rooted in the ontological pluralism of beings, where entities are phenomenologically and ontologically distinguished by their experiential differences (Berstein 2021, 6) or Alfredo Pereira Jr's (2024, 6) metaphysics of consciousness, which posits that spiritual embodiments can influence consciousness within physical human nature and impact living things based on their multiple natures. Therefore, this moral foundation is undeniable, and Giddy's (2023, 81) point is worth emphasizing: "Denying this normativity, in the case of the philosopher, amounts to a performative self-contradiction, or self-stultification: you are in fact declaring yourself out of the game." The ability to control the mind or soul of the morally enhanced through negative forces, normative to African religion and spirituality, undermines the biological influence of moral bio-enhancement.

Thus, it should be noted that, as a result, the theory of moral limitation that transhumanists aim to overcome is likely to persist for Africans. Giddy (2023, 83) clearly states that freedom within the African framework of the human person remains at an abstract level, with its ethical potential unrealized, and that the social structures of centrifugal individualism are also tied to doubts about human transcendence. Humanity is just a part of nature and acts in relation to other natural forces. This act, rather than the definition of what the forces are,

is what defines the forces (Giddy 2023, 84). Ndasauka (2024, 178) emphasizes here that in many African cosmologies, the material and spiritual realms are interconnected aspects of a unified whole, where all phenomena are imbued with vital energy and consciousness. Therefore, engagement with technology is not only a utilitarian effort but also a metaphysical and moral endeavor that requires deep reflection, ritual attunement, and responsibility toward the greater community of life.

This nature of reality can be further supported by Attoe's (2022, 41) concept of "singularity complementarity." Attoe's view agrees that being is singular while also complementing others within the African cosmology. The singular existence of a being cannot be fully understood without its complementarity to all aspects of reality, making each aspect important for the whole (Attoe 2022, 51). Thus, the becoming of being into its full nature is not disconnected from its complementarity with other beings (Attoe 2022, 42), here referred to as biological and cosmological elements in the world. Attoe (2022, 42) notes that "[o]nce a being emerges as a new thing-in-the-world, it necessarily belongs to a community of things-in-the-world," and that socio-ethical principles are influenced by ontological principles, which supports the argument here that bridging the social ethical nature of persons through moral bio-enhancement is just a part of the restructuring of humanity's ethical nature in Africa. This must align with the ontological relationship with other aspects of the religio-ontological reality to reinforce its effectiveness. Besides the biological struggle between the mind and the conscience over what remains moral or immoral, there is, according to Cyril C. Okorocha (1992, 173), also a capricious spirit at odds with mankind at the center of the cosmos. This implies a continual battle impacting humankind's actions, will, disposition, and predispositions within the African cosmos. The dynamism of these powers and their magical influences shape actions, attitudes, and the effects of pharmacological enhancement aimed at fostering morally guided behavior. This nuanced understanding of the African cosmos is essential for the effectiveness and sustainability of moral bio-enhancement in Africa.

Conclusion

This article has argued that moral bio-enhancement is a crucial solution to human moral limitations. It assists humans in creating a meaningful and impactful presence and future for wellbeing and flourishing, whether in Africa or elsewhere. Improving moral dispositions can lead to significant growth compared to Africa's current level of development. This has become a benchmark for promoting applications, especially when combined with African values. The article has raised two concerns. One is related to biopolitics, where the commodification of bio-enhanced drugs results in the extraction of value from Africa through capitalism. The other is the effectiveness of

moral bio-enhancement in a religio-ontological Africa, where morality is not solely about improving the biological aspect of humanity but also involves spiritual and cosmological integration with all dimensions of the spiritual and physical for the success of moral bio-enhancement. The article concludes that both aspects of these concerns must be carefully examined to prevent neo-colonialism stemming from biopolitics and the ineffectiveness of the enhanced if there is no synergy between the spiritual and biological realms. How this integration occurs remains a gap for future research to explore.

Competing Interests

The author declares that they have no competing interests.

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As artificial intelligence (AI) systems become increasingly sophisticated, fundamental questions arise: Do they possess genuine existence? Can machines truly think? This article addresses these questions through Ibn Sīnā's (Avicenna, 980–1037) philosophical framework. Drawing on his distinctions between essence and existence, substance and accident, and natural (*tabīʿī*) versus artificial (*ṣināʿī*) beings, it argues that AI is fundamentally an artificial entity whose existence remains accidental, derivative, and externally dependent. Epistemologically, Ibn Sīnā's theory of intellect encompasses abstraction (*tajrīd*), intuition (*al-hads*), and illumination by the Active Intellect. Human intelligence, arising from the rational soul (*nafs*), enables understanding, self-awareness, and participation in intelligible realities whereas AI operates as a closed cognitive system incapable of genuine understanding, consciousness, or universal knowledge. While rejecting strong AI and machine personhood as metaphysically untenable, the article advances a constructive view: precisely because AI lacks consciousness and moral agency, it can relieve human cognition from instrumental tasks, enabling cultivation of theoretical intellect, practical wisdom (*ḥikmah*), and ethical responsibility under human governance.

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Introduction

The rapid progress in artificial intelligence (AI) compels us to ask not just how it works but *what* it truly *is*. This ontological inquiry seeks to understand AI's fundamental nature, moving beyond a simple description of its functions. The core philosophical questions remain: Can machines genuinely think? What and how is human intelligence different from AI? Can AI truly replicate human intelligence? And could AI become conscious someday? What standards can we use to judge the possibility of AI personhood and moral responsibility? The answers to these questions will shape how we think about AI ethics and regulation. This is not just a technical puzzle; it is a deeply philosophical one, because the very definitions of "intelligence" and "thought" are fraught with scientific ambiguity and carry profound moral, religious, and legal weight.

Even a seemingly straightforward definition of AI, like the one Google offers—a field of science dedicated to building machines capable of reasoning, learning, and acting in ways that typically demand human intelligence or handling data beyond human analytical capacity (Google Cloud, n.d.) —begs the question of what constitutes "human intelligence" in the first place.

More generally, AI is often described as a branch of computer science aiming to imbue computers with intelligence to assist humans (Cycleback 2018, 9). Modern AI systems typically incorporate a knowledge base, a network of interconnected facts, and an inference engine, which allows the system to draw conclusions based on data (Haenlein and Kaplan 2019). Some researchers define AI as "the ability of digital computers or computer-controlled robots to solve problems that typically require human beings' higher cognitive processing abilities" (Copeland 2026).

Looking at these various perspectives, it is clear that AI is both a science and a technology. While its scientific foundations have been in place for some time, the field of AI formally emerged in 1956 at the Dartmouth Summer Research Project on Artificial Intelligence, organized by John McCarthy and Marvin Minsky. Its technological development then accelerated alongside the advancement of computers as data processors operating on defined models (Haenlein and Kaplan 2019).

Fundamentally, AI rests on mathematical concepts like computation and algorithms, evolving into a technology driven by three key elements: processing power and infrastructure, programming paradigms, and, crucially, data (Alawijeh and Al-Mesilini 2025). The "cognitive" aspect, the defining characteristic of AI, is inextricably linked to the technology itself. Therefore, understanding AI as a technology necessitates examining the underlying and emerging scientific principles that shape it.

The debate surrounding AI often boils down to two opposing definitions: "weak AI," which acknowledges the potential for machines to act intelligently, and "strong AI," which posits that these actions constitute genuine intelligence,

even suggesting that certain artificial computations are thinking. This distinction highlights the deeply philosophical nature of defining intelligence in the context of AI, moving beyond purely technical considerations. The very existence of this debate reveals that operational definitions of AI focusing solely on its capabilities are insufficient to address the fundamental question of its nature. If strong AI proves to be correct, it would challenge anthropocentric views of intelligence and consciousness, with far-reaching moral, religious, and legal implications (Shareef 2023, 5–6).

Why Ibn Sīnā Matters in the Age of AI

Recent scholarship has increasingly called for the inclusion of non-Western philosophical traditions in contemporary debates on AI. For instance, Biliana Popova's (2020) article in *Zygon: Journal of Religion and Science* suggests that Islamic thought should inform discussions about AI development. She argues that more scholars from the Islamic philosophical tradition should participate in debates about AI development and its implications, particularly since many Muslim countries are leaders in AI development and its application in daily life. Islamic philosophy, with its diverse schools and related ontological, epistemological, and ethical beliefs, offers valuable insights for discussing AI development. However, Popova's account does not engage with the philosophy of Ibn Sīnā, whose systematic and far-reaching contributions remain underexplored in this context. Yet, as Peter Adamson observes, Ibn Sīnā is not just a compiler of Greek wisdom. He is a thinker of astonishing originality who reshapes everything he touches—from logic to science, from psychology to metaphysics. To understand philosophy in the Islamic world after 1100, you cannot avoid Ibn Sīnā. He is the most famous and influential philosopher of the Islamic world, whose thought came to define the philosophical tradition for both later Islamic thinkers and Latin Christian philosophers like Thomas Aquinas (Adamson 2016, 636–41; McGinnis 2010, 9–16).

This article explores questions surrounding AI through the philosophical lens of Abū ʿAlī al-Ḥusayn ibn Sīnā (980–1037), known as Avicenna. He stands as a key figure in the Greco-Arabic philosophical tradition, offering a comprehensive view of logic, physics, cognition, mathematics, psychology, and metaphysics, detailed in works like the *Kitāb al-Shifāʾ* (*The Book of Healing*) (Ibn Sīnā 1997) and *Al-Ishārāt wa al-Tanbīhāt* (*Remarks and Admonitions*) (Ibn Sīnā 2002).

But why turn to Ibn Sīnā when thinking about AI? There are at least two compelling reasons. First, given AI's interdisciplinary nature, Ibn Sīnā's thought provides a relevant framework for analyzing AI intelligence. Ibn Sīnā possessed extensive knowledge in philosophy, psychology, science, cognition, mathematics, and anatomy, especially brain anatomy (McGinnis 2010). Second, his comprehensive insights offer a strong foundation for examining the nature

of both human and artificial intelligence. Ibn Sīnā long ago discussed the differences between natural (*ṭabīʿī*) and artificial (*ṣināʿī*) entities.

Recent popular and academic discussions have begun to recognize this relevance. Abigail Tulenko (2024) wrote in *Scientific American* under the title, "What Philosopher Ibn Sīnā Can Teach Us about AI." Tulenko suggests exploring the thoughts of Ibn Sīnā to address some of the philosophical problems of AI. Ibn Sīnā's thinking presents a thorough framework for defining what it means to think and be conscious, a central question in current debates about the nature of AI. Ibn Sīnā developed an intricate philosophical system addressing reality, the soul, and knowledge. His philosophy regarding the soul, intellect, and how we gain knowledge proves particularly relevant. He delves into the essence of intelligence, consciousness, and cognitive processes (Norman 2021).

Beyond his detailed philosophical framework for science and technology, Ibn Sīnā considered the distinction between the natural and the artificial. Contemporary studies acknowledge Ibn Sīnā's relevance when comparing natural intelligence and AI (Alawijeh and Al-Mesilini 2025). He also discussed the subjects of various sciences, raising questions about the mode of existence for each science's subject matter. This includes discussions related to mathematics, which encompasses algorithms and computations—the core of AI intelligence (Ibn Sīnā 1960, 18–19; Marmura 2005, 249–56; Zarepour 2019, 95–126).

Nevertheless, the engagement of classical philosophy with AI is not unprecedented. Aristotelian frameworks have been employed to analyze AI ontology through hylomorphism and the natural–artificial distinction (Dreyfus 1992; Coeckelbergh 2020), while Kantian approaches have addressed questions of autonomy and moral agency (Vallor 2016). Phenomenological critiques, particularly Martin Heidegger's concept of *Dasein* and embodied cognition, have demonstrated AI's inability to achieve genuine understanding (Dreyfus 1992; Wheeler 2005). These approaches have generated valuable insights, yet they often remain confined to specific dimensions of the problem.

In contrast, this article argues that Ibn Sīnā's philosophy offers three distinctive contributions. First, it provides a systematically integrated framework where ontology, epistemology, and ethics are interconnected: AI's ontological status as *ṣināʾī* (artificial) necessarily entails its epistemological limitations and ethical implications. Second, Ibn Sīnā's detailed faculty psychology—specifying five internal faculties with precise cognitive functions—allows us to map which aspects of cognition AI can simulate (data processing, pattern recognition) and which it categorically cannot (estimation of non-sensory meanings, abstraction to universals). Third, his theory of the Active Intellect (*ʿaql al-faʿāl*) provides a unique metaphysical explanation for why AI cannot achieve universal knowledge: it has no access to the immaterial source of intelligibles.

Furthermore, unlike approaches that remain primarily critical, Ibn Sīnā's framework allows for a constructive reorientation of the human–AI relationship.

Precisely because AI does not possess independent agency or intellect, it can be understood as an instrument that supports human cognitive development. In this sense, AI may function as a means of cognitive extension, enabling human beings to redirect their intellectual capacities toward higher forms of theoretical knowledge as wisdom (*ḥikmah*) and ethical action.

While Aristotle provides a foundational hylomorphic framework for understanding form and matter, Ibn Sīnā extends this metaphysical structure by introducing a more rigorous distinction between essence (*māhiyyah*) and existence (*wujūd*), thereby allowing a more precise ontological classification of artificial entities such as AI. Furthermore, while Kantian philosophy locates the limits of AI in the absence of autonomy and moral agency, Ibn Sīnā's framework deepens this critique by demonstrating that such limitations originate at a more fundamental level—namely, in the absence of a metaphysical ground for intellect, self-awareness, and universal knowledge. This article thus demonstrates how a rigorously developed premodern Islamic philosophical system can address contemporary technological questions with conceptual resources that neither Aristotelian, Kantian, nor phenomenological frameworks fully provide.

Philosophical Framework of Ibn Sīnā and Contemporary Artificial Intelligence Systems

Ibn Sīnā's detailed theory of existence, with its careful distinctions between what something is and the fact that it is, between what must exist and what could exist, and between physical and non-physical things, offers a strong philosophical foundation for considering the nature of AI.

Our investigation begins by laying out Ibn Sīnā's basic categories of being. Then, we consider how modern AI systems might fit within this framework. The core question is whether AI can achieve the kind of real existence Ibn Sīnā ascribes to true intellectual beings, or whether AI is permanently limited to being a modification of existing things.

The Difference between Essence and Existence

A key point in Ibn Sīnā's philosophy is the difference between essence (whatness/*māhiyyah*) and existence (being/*wujūd*). For Ibn Sīnā, essence is what defines a thing—its fundamental nature. Existence, on the other hand, is the fact that the thing actually is (Ibn Sīnā 1960, 42; Belo 2009).

Ibn Sīnā believes that essence, in itself, is neither existent nor non-existent. The essence of "horse," for example, stays the same whether we are talking about a real horse, a horse in our imagination, or just the idea of a horse. Existence, therefore, is something added to the essence of things that do not have to exist (Sīnā 2002, 47; Marmura 2005, xxii–xxiii).

This idea is important when we think about AI. Do AI systems truly exist in a way that is distinct from their underlying structure—their code, architecture,

and data? Or are they just complex arrangements of essence without their own independent being?

Substance and Accidence

Ibn Sīnā's theory of categories draws a key distinction between substance (*jawhar*) and accidence (*'araḍ*). A substance exists independently and acts as the subject for accidents, while accidents are modifications or properties that exist within substances (Ibn Sīnā 1960, 71; Belo 2009). This distinction is crucial for considering whether AI systems can achieve genuine, independent existence or remain simply accidental modifications of their material components.

Beyond the technological aspects of AI hardware, it is important to examine the knowledge derived from human mental processing, where mathematics (computation and algorithms) form the foundation of AI. Ibn Sīnā categorizes theoretical knowledge into natural science (*ṭabī'iyyāt*), mathematics (*riyādhiat*), and metaphysics (*Ilāhiyyāt*) (Ibn Sīnā 1960, 11; Marmura 2005, xix–xx).

For him, mathematics is a distinct field with its own specific subject matter: quantity (*kam*). He defines quantity as something "abstracted from matter or from anything that has quantity" (Ibn Sīnā 1960, 4). This abstraction is significant because it directly separates mathematics from physics, which deals with objects in motion and at rest. Ibn Sīnā argues that quantities, both continuous and discrete, are fundamentally accidents, not independent substances (Zarepour 2019, 55). This means they need a substratum, a material object, to exist in the external world. For instance, "two" exists in "two apples" or "two books," not as an independent entity. In Ibn Sīnā's view, quantity is conceptualized (abstract concept) as an accident of matter; its existence depends on material substances. The process of "mental separation" (abstraction) is at the heart of how humans study these objects. Although mathematical objects are mixed with specific types of matter in the external world (e.g., an apple circle), the human mind can separate them from these particulars. One can understand a circle without it being specifically made of apple or ball (Ibn Sīnā 1960, 118; Marmura 2005, 84–87; Zarepour 2019, 71).

A tension arises here: How can an accidental property tied to a specific material instance (e.g., the "two" of "two apples") be a universal object of abstract thought? This highlights the vital role of the human mind's capacity for abstraction in Ibn Sīnā's philosophy. Mathematical objects have no autonomous extramental nonmaterial existence (Marmura 2005, xix). Numbers are not immaterial substances themselves, but human intellect makes them so through a process of mental detachment from their particular material embodiment, making universal mathematical study possible (Zarepour 2019, 141–52).

According to Ibn Sīnā's framework, mathematical objects, which are at the heart of AI algorithms, are fundamentally accidents (*'arad*). When we consider the origin and purpose of AI, and how its "intelligence" is interpreted, the role

of the human mind becomes fundamental. The algorithms, data structures, and architecture of AI are the result of the abstract thinking, reasoning, and creativity of the human mind. The mathematical concepts that underlie AI, such as logic, number theory, and probability, are products of human intellectual activity (Ibn Sīnā 1960, 18–19; Zarepour 2019, 152–58). AI's origins lie in human intellect, where mathematical and logical concepts take shape. The very essence of AI algorithms exists first as abstract ideas within the human mind.

When a scientist designs algorithmic architecture, the concept is present in his or her mind as an intellectual disposition. It is an accident inherent in the substance of the human rational soul. When the algorithmic code is executed on a silicon chip, its ontological status changes completely. It ceases to be "knowledge" and becomes a particular matter arrangement. Based on Ibn Sīnā's principle that mathematical objects (such as the binary numbers 0 and 1) cannot be separated from materiality, the algorithm and data here become accidents that are completely dependent on hardware. AI, in its functional form, is an accident of the hardware that runs it. The functional existence of AI technology depends on its hardware. Without silicon and other physical components, algorithms and data cannot operate or manifest. Therefore, the hardware substance, like silicon, provides the material support for AI's functional existence.

Natural versus Artificial Entity

Even though Ibn Sīnā lived long before we started thinking about AI, his ideas provide a basis for telling the difference between things that have their own internal drive (like nature or a soul) and things that are made by external forces. Ibn Sīnā draws a critical line between natural entity (*ṭabīʿī*) and artificial entity (*ṣināʿī*). Natural entities have their own inherent nature (*ṭabīʿah*) that drives their motion, development, and how they become what they are. They exist according to their core characteristics and achieve their potential through these built-in drives (Ibn Sīnā 1997, 158–59; Alawijeh and Al-Mesilini 2025).

In his philosophy, Ibn Sīnā focuses quite a bit on natural entity (*ṭabīʿī*). He defines "nature" (*ṭabīʿah*) as more than just the physical environment. It is the main reason (*mabda' awwal*) natural things move and rest. This reason is part of what the thing is, not just something that happens to it from the outside. He clearly separates motion that comes from a thing's own internal drivers (like its nature or soul) from motion caused by outside forces or "violence" (think of a thrown stone versus a stone that falls on its own) (Ibn Sīnā 1983, 31; Arif 2007).

In the natural order, an object does not automatically have the ability to transform into any other object. Ibn Sīnā suggests that the potential to "become" implies an internal state within an object, propelling it toward realization and perfection. However, the composition of matter differs between artifacts and natural entities (Ibn Sīnā 1983, 34–37). For instance, a teak tree seedling possesses the inherent capacity to mature into a large tree,

yet it lacks the innate potential to transform into a chair. However, through human intervention, the seedling undergoes a series of transformations to become a chair. In essence, wood does not inherently strive to become a chair, and the chair's form is not the wood's objective; rather, it is the carpenter's objective (Mohaddes 2020).

In human-made objects (artifacts), form simply refers to physical shape or structure. When humans create something, they arrange pieces of matter and decide how these parts relate to each other. Many modern philosophers argue that nature works the same way—that natural things also have forms that are just arrangements of matter, similar to human artifacts. However, Ibn Sīnā believes that "form" in nature is something much deeper and more significant than mere physical shape. According to Ibn Sīnā, form in natural things represents a higher reality. The physical shape and organization we observe are actually just outward expressions or manifestations of this deeper reality. "The natural world is capable of a synthesis that leads to transformation, whereas the artificial world cannot achieve this, but rather, it can only aggregate" (Ibn Sīnā 1997, 158–59).

In artificial (human-made) things, what we consider the "essence" depends on the form, not the material. This is why artificial objects do not have a true essence—their composition is based on human convention rather than natural reality (Ibn Sīnā 1983, 34–37). Consider a wooden chair made of several pieces of wood assembled into four legs, a seat, and a backrest. If we take apart this wooden chair and rebuild the exact same structure using iron instead, we still call it a chair. The material changed completely, but because the form (shape and structure) remained the same, we recognize it as a chair. This shows that we identify the chair by its form, not its material.

Now, let us reverse the scenario. If we keep the same wood (the material) but change the form—for example, by reshaping that same wood into a blackboard—it is no longer a chair. The essence has completely changed, even though the material is identical. In human-made objects, the creator (the "agent") is responsible for creating the form, not the material. For example, a carpenter creates the form of the chair but does not create the wood itself (the material). Wood exists independently of the carpenter's work. The connection between a chair's shape and its purpose is a connection only made up by the minds of the maker. This connection is true from the perspective of the maker who created the shape for this use, not from the perspective of the shape (form) itself or what it is really used for (Mohaddes 2020; McGinnis 2025).

Artificial entities exist because of outside forces and human skill. They do not have their own internal drives for motion and change. Instead, they depend on external agents for their shape and function and how they keep working. While artificial entities are real, they are a different kind of being—one marked by dependence, being a tool, and external control (Marmura 2005, 218, 295).

Based on these parameters, an artificial (*ṣinā'i*) object is defined as the result of a volitional act (derived from the choice of an external agent), yet uniform in its operation. *A clepsydra* (water clock), for example, is an artificial entity (*ṣinā'i*). Its creation involves human will and intelligence, but once the clock is completed and running, it operates automatically and uniformly according to its mechanical design. It has no freedom to change its own rhythm (McGinnis 2025).

This difference is very important for making sense of AI systems. They clearly fit into the artificial entity category, created by human programmers and lacking their own internal ways to grow or become what they could be. Algorithm design highlights AI's dependence on human creators. Even when AI generates its own algorithms, these changes arise from externally induced variations (e.g., adjustments in model parameters, network weights, or new algorithm structures) driven by data input, the computing environment, or human-programmed objectives. This "accidental motion" is governed by external factors (humans, electricity, code) rather than "substantial motion" originating from within the AI itself. And AI automation is the result of actions that originate from the choices of external agents but are uniform in their operation.

Key Differences between Natural Human Intelligence and Artificial Intelligence

The approach taken by Roger Penrose is useful to begin this discussion. According to Penrose (2002, 28), "I would say that in ordinary usage the word 'intelligence' requires 'understanding,' and I would say that in the normal usage 'understanding' requires some 'awareness.' So, I would say that for an entity to be 'intelligent,' in the ordinary usage of the word, it would have to be aware, it would have to be conscious." This tri-conceptual framework resonates remarkably with Ibn Sīnā's ontological distinction between natural and artificial entities, developed nearly a millennium earlier.

1. Self-awareness and self-discovery

Ibn Sīnā argues that natural intelligence, at its highest level (human level), is self-aware. Ibn Sīnā draws a parallel between the human body (material) and the soul (nonmaterial/spiritual) to elucidate self-awareness. He likens this relationship to that of a body and its clothing. The difference, however, is that clothes can be removed when not needed, whereas the body cannot. In *al-Shifā'*, Ibn Sīnā (1997, 324–25) writes:

> We are not accustomed to detaching the body from ourselves. Even if one does not consider the entire body as the self, they still believe that certain organs—such as the head, hands, or feet—are part of the self. If one were to consider the entire body or its organs as the self, this feeling should be constant.

> However, in reality, humans do not always perceive their body or its organs as themselves. For example, we do not feel the presence of the heart or brain. We learn about these organs through study, information, or direct observation during surgery. We do not inherently feel that these organs are the self.
>
> The body and its organs are not essential, as we do not always perceive them as part of ourselves. Therefore, the "I" is not the body. The "I" is something whose presence must be constantly felt because it is essential. It is the "I" that moves, walks, and acquires knowledge. The unified and indivisible self is the "I." If one is convinced that there is an 'I' within them, then what is this "I"? Is it the soul? "I" is the soul because it aligns with the attributes of the soul. Even if we do not know the precise term, we understand its essence. The substance with these characteristics has been proven to align with the definition of the soul.

To illustrate that the human soul is a spiritual (nonmaterial) substance, Ibn Sīnā proposes the "flying man" thought experiment. Imagine a person created instantaneously, without any interaction with the external environment. This person would lack experience, memories, and imagination, as these depend on the physical world and sensory input. Despite this deprivation, Ibn Sīnā contends that the "flying man" would still be able to affirm their own existence, demonstrating consciousness. This suggests that the soul, which affirms its own existence, must exist beyond physical substance and possesses the capacity to gain broader knowledge (Ibn Sīnā 2002, 233–35). Consciousness must exist first in order that it may become self-consciousness (self-awareness), which is aware of being in the surrounding environment.

Ibn Sīnā's philosophy places the soul (*nafs*) at the core of human existence, an immaterial (spiritual) and eternal substance that uniquely inhabits the body. He divides the soul into three interdependent and hierarchical levels: the vegetable soul (*nafs nabātiyyah*), responsible for basic functions such as nutrition, growth, and reproduction; the animal soul (*nafs ḥayawāniyyah*), which adds sensory perception and movement; and the rational soul (*nafs nāṭiqah*), which is at the top of the hierarchy of souls and unique to humans, encompassing the faculties of intellect (*'aql*) and will (Ibn Sīnā 1997, 54–70). For Ibn Sīnā, artifacts categorically lack consciousness because they lack souls (Ibn Sīnā 2017, 13–14; Ṣadrā 2002, 153–56). AI, as an artifact built on nonliving hardware, denies the existence of a soul and therefore lacks this self-awareness. This highlights a core difference in consciousness and challenges the purely materialist view of AI (Alawijeh and Al-Mesilini 2025). From the perspective of Ibn Sīnā's thought, AI is an artificial entity whose principle of motion is external and uniform, so it does not have a "container" for self-awareness, which is a prerequisite for understanding.

2. Understanding

According to Ibn Sīnā (2002, 237–43), human understanding involves abstraction (*tajrīd*) from particular forms to universal concepts. Through the faculty of estimation (*wahm*), humans grasp "non-sensory meanings" (*maʿnā*)—such as goodness or bothness—that cannot be perceived by the external senses (Rahman 1981, 30–31).

Modern AI, on the other hand, operates by manipulating symbols and statistical patterns without understanding the essence or intentionality behind them. Natural intelligence's understanding is substantial (changing the cognizing soul), while AI's "understanding" is merely an accidental adjustment of data positions on hardware.

Through the "Chinese Room" thought experiment, John Searle concluded that machines cannot have "understanding," regardless of how intelligent or humanlike the program is. They do not truly "understand" or "believe" anything in the way humans do because they lack real intentionality (Searle 1980).

Another perspective can be explored through Ibn Sīnā's concept of knowledge. He regards knowledge as an essential attribute of its subject matter (*mawḍūʿ*). According to Ibn Sīnā, the subject matter of a specific branch of knowledge or science is the central problem that defines that field. The subject matter serves as the genus with the broadest scope, encompassing all the particular issues addressed within that science. What distinguishes one science from another is the difference in their subject matters. If the subject matter of a particular science is discussed in another field, it becomes a problem within that other science. The properties or predicates (essential accidents) attached to the subject matter become the specific problems examined within a given science. For example, the subject matter of natural science (*ṭabīʿiyyāt*) is bodies (*ajsām*, sing. *jism*) considered from the perspective of their motion and rest. The issues addressed in natural science are the accidents that befall bodies in terms of movement or stillness. Thus, concepts such as *jism* (body) as being, substance, matter, and form are not the focus of natural science, as these belong to a different domain. When the subject matter of a science is not addressed within that science itself, it must be examined by a higher science—namely, metaphysics. Meanwhile, the problems discussed in natural science are predicates (accidents) related to moving or stationary bodies (*ajsām*, sing. *jism*), such as mineral science, composites, plant science, animal nature, the study of the soul, senses, sense objects, chemistry, and other issues that remain within the scope of natural science (Ibn Sīnā 1983, 4–10).

Mathematics, which encompasses algorithms and computations, is concerned with the study of quantity (*kam*). However, the task of proving the very existence of "quantity" lies beyond the scope of mathematics itself; this is a question reserved for metaphysics. If mathematics were to attempt to prove the existence of quantity by relying on the concept of

quantity, it would result in circular reasoning, which is logically untenable (Ibn Sīnā 1983, 4–10). AI, operating within the boundaries of computational cognition and algorithms, is limited to processing the properties (essential accidents) of quantities as data. In contrast, humans possess the capacity for metaphysical or philosophical thought, enabling them to *understand* the existence and nature of data—an ability that extends beyond the current capabilities of AI.

This aligns with Penrose's view that computational algorithms, no matter how powerful, cannot produce genuine understanding. Penrose uses Gödel's incompleteness theorems to support this. These theorems state that in any sufficiently complex mathematical system, there are true statements that cannot be proven within the system. Penrose argues that the human mind can grasp and prove these statements, suggesting that human understanding involves non-algorithmic processes that computers cannot replicate (Penrose 2002, 106–9; Penrose and Severino 2022, 33–34).

Human understanding allows us to "see" truths that lie beyond the reach of any formal system. Therefore, if human intelligence involves the ability to understand these non-computable truths, then intelligence itself cannot be algorithmic (Penrose and Severino 2022, 41–43). AI merely borrows human intelligence through algorithms. AI is a functional extension of human reason, not an independent intellectual agent. Without the capacity for understanding rooted in consciousness, AI will always be a pseudo-"intelligence"—a simulation without a subject.

Supported by Penrose's thinking, AI ontology, from Ibn Sīnā's perspective, positions AI as an entity that will never attain true intelligence. Because AI is ontologically purely algorithmic matter, it is cut off from the chain of consciousness–understanding interdependence. AI remains a *ṣinā'ī* (artificial) entity—a highly sophisticated functional illusion that mimics the results of human intelligence without ever possessing the essence of understanding itself. This also refutes the possibility of strong AI occurring.

3. Intelligence

Consequently, what appears as cognition in AI is better understood as formal manipulation rather than intellectual apprehension. In Ibn Sīnā's metaphysical framework, intelligence represents the actualization of the rational soul's potential. The rational soul's highest goal is *sa'ādah* (true happiness), which is achieved through self-perfection and the actualization of one's intellectual potential. This view provides a clear teleology to ethics, where noble character (*akhlāq*) is not merely a set of rules but an essential means to achieving spiritual perfection (Ibn Sīnā 2024, 5). This teleological framework distinguishes natural from artificial entities. Natural beings possess intrinsic ends; artifacts have only extrinsic purposes assigned by makers.

This perfection of the rational soul occurs through a gradual process, which Ibn Sīnā describes through four stages of human reason. This process begins with '*aql hayūlānī* (material intellect), which is the pure potential for thought, similar to a blank slate ready to be written on. The next stage is '*aql bi al-malakah* (intellect in talent), in which the intellect has acquired the "first intelligible" or indisputable fundamental principles, like the axioms in mathematics. The intellect then develops into '*aql bi al-fi'l* (actual intellect), which possesses universal knowledge but does not actively think about it. The culmination is '*aql mustafād* (acquired intellect), a state of full actualization in which the intellect actively and consciously considers the intelligible it has accessed (Ibn Sīnā 2022, 34–37).

The human rational soul (*nafs nāṭiqah*) that begins from '*aql hayūlānī*, which is a potential intellect, has two paths to reach a high level ('*aql mustafād)*, namely *fikr* (reason) and *ḥads* (intuition), owned by people whose intellect is already very strong. If *fikr* still uses rational–logical procedures, *ḥads* is able to produce the middle term in a syllogism without compiling a major premise and a minor premise (Ibn Sīnā 1997, 300–4).

This process of intellectualization does not occur spontaneously but is enabled by the external intervention of '*aql fa'āl* (active intellect), the tenth intellect in Ibn Sīnā's cosmic hierarchy of emanations. The active intellect functions as the "giver of form" (*wāhib al-ṣuwar*), that is, the eternal and perfect metaphysical entity responsible for actualizing the human intellect (Ibn Sīnā 1997, 332–33). Active intellect illuminates human intellect, enabling it to move from potentiality to actualization and attain universal intelligibility. This process is called "contact" (*ittiṣāl*) or "divine effusion" (*fayḍ ilāhī*). The active intellect eternally considers all intelligible, which then flow into the human intellect that is ready and actively seeking them (Rahman 1981, 68–69).

To understand how the human mind attains universal knowledge, Ibn Sīnā outlined the role of internal faculties tasked with processing sensory data before the rational mind acts (Sīnā 2002, 239–41). Ibn Sīnā believes perception involves both external and internal senses. Perceptions from external and internal senses produce particular knowledge. The external senses are touch, smell, taste, sight, and hearing. The internal senses, located in the brain, include:

a. common sense (*ḥiss mushtarak*): integrates sensory data
b. imagery/fantasy (*khayāl*): retains sensory images
c. memory (*hāfiẓah*/*dhākira*): preserves meanings and judgments
d. estimation (*wahmiyah*): evaluates meanings and forms opinions
e. imaginative faculty (*mutakhayyila* or *mufakkirah*): analyzes, synthesizes, and manipulates forms to derive meaning (Sīnā 2002, 239–41; Silva and Yrjönsuuri 2013, 101).

Estimation captures the non-sensory meaning of partial sensory objects, such as the faculty that determines that wolves should be avoided (the reception of *ma'ānī*). It is located in the back of the brain's mid-cavity. Estimation perceives meaning in particular things such as love and respect for a person, fear of an animal, pain, friendship, enmity, and so on (Rahman 1981, 30–33).

Mutakhayyila is a kind of "processor" that processes forms obtained from outside that are captured by the senses, while *mufakkirah* is a kind of "processor" that processes meanings that are universal in nature, not obtained from outside but used by the human intellect. The *mufakkirah* is unique to humans and allows for rational thought, judgment, and insight. Through this faculty, humans can process abstract ideas beyond sensory perception (Sīnā 2002, 240–41). The combination of these faculties allows the human process of intellectualization to culminate in *tajrīd* (abstraction), where the human intellect extracts the essence or universal form of matter for thought.

Ibn Sīnā highlights the importance of imagination in the creative process. He sees imagination as the ability that allows humans to form images and ideas not directly perceived. This imaginative power is essential for both artistic and scientific creativity. Ibn Sīnā describes creativity as a process involving both intellect and imagination. Intellect provides the structure and principles, while imagination brings these principles to life by forming new and unique combinations. This interaction between intellect and imagination allows humans to create art, literature, and scientific theories. Intellect plays a vital role in creative endeavors, enabling humans to grasp complex concepts and generate new ideas or innovations (Sīnā 2002, 246–47).

From the aforementioned description, Ibn Sīnā's theory of intelligence can be explained as the transformation of knowledge acquisition from its lowest degree to the highest through a universal agency (the Active Intellect) and through ethical and spiritual practices that shape the function of human intelligence. The term intelligence has different scopes between humans and AI. In humans, it encompasses reason, intuition, understanding, wisdom, moral conscience, analytic, and aesthetic judgment, whereas in AI, it only refers to the analytic function of computation.

Although AI may appear to be able to perform similar processes through feature extraction and pattern recognition, these processes are very different. Abstraction in AI is a process in which a model learns to identify and discard information deemed "irrelevant" based on a predetermined goal (Lin 2024). This abstraction is built from specific data and statistics with validity in the training domain but that can fail in other domains. Because the model only generalizes to the extent that patterns emerge in the data, it does not produce universal knowledge, only local representations useful for specific tasks. The model can change if the data and parameters change.

AI is a fundamentally closed cognitive system, operating on data and algorithms designed by humans. Its source of knowledge is limited to curated datasets, which are essentially collections of partial and ephemeral empirical information (Lin 2024). AI has no Active Intellect or eternal and perfect external entity to relate to. Consequently, AI can never achieve true '*aql mustafād*, or pure universal understanding, in Ibn Sīnā's sense.

AI operates primarily at the levels of exploratory and combinational creativity. AI can explore existing datasets and combine elements, but it lacks the capacity for transformational creativity, which requires intuition, inspiration, and the ability to transcend existing paradigms (Sautoy 2019, 7–15). Data cannot produce output until it is converted into code and algorithms. It suggests that true creativity requires something beyond complex computation (Sautoy 2019, 10). AI is a tool for creativity, not creativity itself. While AI can assist in generating ideas and exploring possibilities, it cannot replace the human capacity for genuine, transformative creativity that produces groundbreaking innovations, often arising in rare "eureka" moments that change the world (Jordan 2019). For example, AI can compose music by studying a large number of existing pieces and spotting patterns, but it does not create something from true inspiration or emotional depth (Newblom 2026).

It seems that AI can only imitate and amplify sensory functions and some inner senses related to sensory or material objects. Meanwhile, objects from within the mind, such as dreams, feelings (such as fear or love), and inspiration, cannot be captured by AI. While AI imitates the structure of the material brain and some cognitive functions, it has not yet replicated the full complexity of the human brain, let alone the human intellect. No matter how sophisticated brain-boosting technology or interfaces support nervous system function, it will never reach human intellect.

What about deep learning? Machines seem to "learn" on their own. The "learning" process in AI is just a change in numerical values (weights) in memory. For Ibn Sīnā, this is not the "achievement of knowledge" by the machine but rather accidental movement (*ḥarakah 'araḍiyyah*). These weight values are accidental quantities changed by the optimization algorithm. The machine does not become "wiser," it simply becomes more precisely configured to map inputs to specific outputs. Learning in humans is the transformation of the soul from potential to actual, while AI "learning" is simply the adjustment of positional and quantity accidents in silicon by external agents (initial data and algorithms).

Decision-Making: Artificial Intelligence Recommendations and the Nuance of Human Wisdom

AI offers decision-making support by leveraging extensive data and algorithms. Generally, larger datasets lead to more accurate AI-driven recommendations. AI excels quickly and accurately, processing vast amounts of data, identifying

patterns, and making decisions based on statistical analysis. It can analyze data and reach decisions much faster than humans, and free from fatigue, a real advantage in time-sensitive situations (Martin 2023).

AI can function as a civilizational instrument that relieves human cognition from excessive preoccupation with particular repetitive and instrumental tasks. Much of modern human life is absorbed by managing fragmented data, procedural decisions, and technical operations that burden the brain while leaving little space for the higher operations of intellect (*ʿaql*). In this context, AI can serve as a form of cognitive offloading, assisting the brain's operational functions and allowing human intelligence to reorient itself toward theoretical reflection, ethical judgment, and the pursuit of truth.

For Ibn Sīnā, the highest function of human intelligence lies not in mechanical problem-solving but in the actualization of the rational soul through theoretical understanding and practical wisdom. When human beings are liberated from excessive engagement with the accidental and the particular, they are better positioned to cultivate *ʿaql naẓarī* (theoretical intellect), which apprehends universals and seeks truth, and *ʿaql ʿamalī* (practical intellect), which guides ethical action (Ibn Sīnā 2022, 31–33; Marmura 2005, 2).

In this sense, AI—precisely because it lacks consciousness, understanding, and moral intention—can become an assistant tool rather than a rival, provided it remains subordinated to human intellectual and moral governance. The ethical task, therefore, is not to endow AI with moral agency but to ensure human beings retain and strengthen their own capacity for wisdom (*ḥikmah*), thereby guiding technological power toward the realization of the good (*khayr*) and the true (*ḥaqq*).

Conclusion

This article has examined AI through philosophical dimensions drawing on the comprehensive intellectual framework of Ibn Sīnā. Within Ibn Sīnā's ontology, his distinction between natural (*ṭabīʿī*) and artificial (*ṣināʿī*) entities provides a powerful lens through which to understand AI's fundamental nature. AI, however sophisticated, is properly classified as a *ṣināʿī* (artificial) entity, an accidental configuration of matter whose operation depends entirely on external agents, material substrates, and human intentionality. As such, AI lacks the ontological conditions required for genuine intelligence in the classical sense.

The analysis demonstrated that human intelligence, in Ibn Sīnā's philosophy, is inseparable from the rational soul (*nafs nāṭiqah*), self-awareness, abstraction, and the teleological movement from potentiality to actuality. Intelligence is not reducible to computation, pattern recognition, or statistical optimization but is the actualization of an immaterial subject capable of understanding universals and orienting itself toward truth and perfection. AI systems, by contrast, operate exclusively within the domain of quantity, algorithmic manipulation, and

accidental change. Their apparent "learning" and "creativity" remain functional simulations rather than manifestations of understanding or consciousness.

From this perspective, claims concerning strong AI, machine consciousness, or artificial moral agency are metaphysically untenable. No increase in computational complexity or data scale can bridge the ontological gap between artificial systems and natural intellectual beings. AI does not possess an internal principle of life, will, or intentionality and therefore cannot be a bearer of moral responsibility. Ethical accountability must remain fully with human agents—designers, developers, institutions, and users—who employ AI as an instrumental extension of human reason.

Ultimately, Ibn Sīnā's philosophy offers a critical and constructive framework for this task, reaffirming the uniqueness of human intelligence while resisting both technological reductionism and anthropomorphic projections onto machines. In the ongoing dialogue between religion and science, this Avicennian perspective underscores a central insight: technological power advances with ease, but wisdom advances only insofar as human beings remain oriented toward truth (*ḥaqq*) and the good (*khayr*).

Competing Interests

The authors declare that they have no competing interests.

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When Chaos Collaborates with God: John Schneider's Aesthetic Theodicy and the Darwinian Problem of Evil

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Theodicy is the attempt to provide a rational account of how belief in a good, omnipotent, and omniscient God can be maintained in the face of the existence of evil and suffering. Theologian John Schneider engages directly with the most pressing challenges contemporary evolutionary theory presents to the classical theistic God. His work engages with the Darwinian interpretation of nature, which gives rise to what he calls the "Darwinian problem." Unlike moral evil, which arises from human agency, natural evil emerges from impersonal natural processes. Following Schneider, the term natural evil is used to refer to suffering resulting from both biological processes (e.g., disease, predation, extinction) and physical phenomena (e.g., tsunamis, hurricanes, earthquakes). The central question is how suffering and destruction can exist in a world created by an all-powerful, all-knowing, and perfectly good God. This article considers how chaos theory informs Schneider's interpretation of God's role in animal suffering and the Darwinian problem of evil. It presents an overview of Schneider's argument for an aesthetic theodicy followed by an introduction to chaos theory, highlighting its central insights and relevance for questions of divine action and natural processes. Finally, it addresses the limitations of Schneider's approach and considers how a more rigorous treatment of chaos theory might strengthen the theological response to natural evil.

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Schneider's Argument

In *Animal Suffering and the Darwinian Problem of Evil,* John Schneider (2020) addresses nature's deep history of suffering, which he calls the "Darwinian World." He identifies four defining features of the Darwinian World that intensify the problem of evil: (1) the vast timescale of evolution; (2) the existence of multiple successive worlds throughout Earth's history; (3) the presence of microscopic organisms that cause widespread suffering; and (4) the deeply embedded nature of suffering in evolutionary processes. These characteristics indicate that much of the suffering due to natural evil—this is, evil emerging from impersonal natural processes—predates human existence, occurring long before the possibility of a human-caused Fall-event, and cannot be attributed to human sin. While this rules out human-Fall theodicies, it does not by itself exclude lapsarian accounts that appeal to an angelic Fall. Schneider treats angelic-Fall explanations as lapsarian accounts and argues that, like human-Fall theories, they cannot plausibly explain the deep-time scale, systemic character, or vast distribution of prehuman natural evil (Schneider 2020, 45, 82, 88). Instead, this suffering seems intrinsic to nature's design, prompting a reexamination of God's responsibility for animal suffering in the evolutionary context. Schneider thus rejects lapsarian theodicies, which are God-justifying approaches for explaining evil as a consequence of the Fall, such that the existence of suffering is tied to human free will and sin. He contends that the implications of evolutionary theory demand a nonlapsarian theodicy in which evil precedes the emergence of humanity. While earlier Christian thinkers often looked to cosmic harmony and balance as evidence of divine design, the Darwinian World appears instead to be shaped by violence and instability—marked by mass extinction events, the collapse of ecosystems, and the absence of any lasting equilibrium in evolutionary dynamics (Schneider 2020, 30–35). Can such a world plausibly reflect the design of a supremely good Creator?

Schneider critiques two common strategies for addressing the Darwinian problem. The first, neo-Cartesianism, denies that animals truly suffer, while the second, skeptical theism, argues that we are incapable of judging whether apparently unjustified evils are morally justified. Schneider finds both positions unconvincing: the evidence for animal suffering is too compelling, and the argument that God would remain silent about the reasons for permitting suffering undermines divine goodness. One prominent solution is the only-way theodicy proposed by Christopher Southgate, which claims that evolutionary processes were the only or best means for God to bring about the range of creaturely values that actually exist. It should be noted that Southgate's argument is not premised on the primacy of human benefit; the creaturely values it invokes are distributed across the whole of the living world. Schneider's (2020, 136; 2025, 217) critique targets a narrower version of this claim, questioning whether the goods of evolution, which he reads as accruing primarily to

humans, are sufficient to warrant the suffering borne by nonhuman creatures. This criticism therefore engages a construal of the only-way argument that Southgate himself would not endorse, and this point should be borne in mind when evaluating the force of Schneider's objection. Additionally, Schneider (2025, 135) acknowledges that only-way goods "somewhat reduce the atheistic force" of Darwinian evils and should "be taken into account in debate," even though he does not accept the thesis as sufficient. He explicitly says the only-way goods "do considerably increase the plausibility that the Christian God would create life by the Darwinian means," but his quarrel is that on their own, they cannot meet the three moral conditions all persons, including God, must meet in order to be justified in permitting evil (Schneider 2025, 231).

The first of these moral conditions, the necessity condition, stipulates that a morally good being allows evil only when it is unavoidable. The second, the outweighing condition, stipulates that any permitted evil be counterbalanced by a greater good. The third, the rights condition, stipulates that an agent has the rightful capacity to authorize necessary evils. Further, Schneider draws from Roderick Chisholm to introduce an additional criterion, the defeat condition, which holds that evil is justified when it becomes part of what makes possible the good of the integrated whole. Thus, God is morally justified in permitting evil not by necessity but by ultimately overcoming it, i.e., integrating it into a greater, more meaningful reality that could not exist without it. Schneider points to Chisholm's observation that though the defeat condition is seldom applied in human moral contexts, it is a common feature in art, where the incorporation of aesthetic "evils"—ugly elements—is justified by the overall beauty of the finished piece. While human moral agents are not afforded this latitude, Schneider suggests that God, who is not an ordinary moral person but is in a unique moral position as a divine moral agent, could be. In this way, Schneider moves away from a conventional theodicy toward an aesthetic one, claiming that a theodicy defending God's actions based solely on moral grounds is unlikely to succeed.

Schneider's (2020, 162–63) aesthetic model of God as Artist offers two significant explanatory benefits compared to a strictly ethical view of divine moral agency. First, viewing theodicy through an aesthetic rather than an ethical framework allows for a modification of the moral conditions used to justify the allowance of natural evil, extending to God a distinctive moral freedom not available to human persons and legitimating a divine prerogative not bound by conventional moral limitations. Second, the narrative and aesthetic structure of evolution offers grounds for interpreting nature as a site of divine presence. In making these arguments, Schneider refers to Alfred North Whitehead's and Wendy Farley's virtue–ethical arguments for the God-justifying role of tragic moral beauty. Whitehead (1978), founder of process theology, proposes that God's aim in creation is the production of "major

beauty," which arises from cosmic conflict and what he terms "conformal intensity," a depth of aesthetic value superior to the "minor beauty" of mere harmony. This aesthetic vision treats natural evil not as something to be eliminated or merely outweighed but as defeated through its contribution to a higher artistic whole. For Farley, the tragic character of nature derives from the structurally inevitable tensions between its constituent goods. "The beauty of the world lies in its variety and diversity," she writes. "From these conflicts, sorrows, and losses emerge the fierce beauty of creation . . . Creation is tragically structured, but tragedy is neither the barrenness of nothingness nor the wickedness of evil. Tragedy is the price paid for existence" (Farley 1990, 60–61). Farley suggests that the evolutionary emergence of compassion and justice functions as a redemptive counterbalance to the evils inscribed into the world's design. Both Whitehead's and Farley's aesthetic models shift the requirement from the necessity condition to the defeat condition, in that the presence of evil is justified if it ultimately contributes to a more meaningful or "beautiful" whole. Yet Schneider concedes that the suffering of sentient beings is too great to be vindicated by aesthetic gain alone and thus there are insufficient grounds to believe that a morally perfect God would use sentient beings as instrumental means towards aesthetic ends.

Seeking firmer grounds for developing this line of thought, Schneider considers how sacred canonical sources might engage the Darwinian problem. Turning to the book of Job, he interprets the divine speech as articulating an aesthetic theodicy in which God works with nature's seemingly disordered and chaotic phenomena toward intelligible and redemptive ends. Rejecting the prevailing interpretation of God as one who "conquers" chaos, Schneider instead presents a God who deliberately makes space for and incorporates chaos into the cosmic structure. He suggests that the text reimagines chaos as generative and embedded into creation rather than a threat to be eliminated. Further, he intimates that suffering and destruction function as essential components in God's creative activity rather than anomalies within it. Schneider (2025, 11) refers to this picture as the "messianic sublime," an awareness of God working "in and through Chaos, rather than simply over and against it."

Schneider repeatedly invokes chaos throughout his work. He cites Job's (3:26 NRSV) declaration of distress at the *rōgez* that has overcome him, a word often translated as "trouble," referring to external or internal disturbances. *Rōgez* functions as a thematic marker in Job, symbolizing the intrusion of "anti-cosmic chaos." Job (3:8) invokes the Leviathan, a mythical sea monster, which assumes a symbolic role as the embodiment of the primordial chaos active within the ordered structure of the cosmos. The imagery cited recalls the mythopoetic language in Psalm 74:13–14, which depicts God's defeat of chaotic forces by dividing the sea and defeating the Leviathan. Job's outcry is directed against the unexpected intrusion of the Leviathan, or the experience of chaos, by which the

boundaries between ordered creation and primordial disorder have collapsed. Schneider identifies the erosion of traditional distinctions between chaos and order as the "Joban Problem," observing that this Joban world mirrors the Darwinian picture of life unfolding amid chaos and apparent divine absence. In light of all this, Job demands a moral explanation for his undeserved suffering.

At the conclusion of the Book of Job, the divine speaker responds by directing Job's gaze toward the wild animals and the sea, which denote the intractable and incomprehensible dimensions of reality. In ancient Hebrew tradition, the sea specifically—perhaps as an extension of the Leviathan—functioned as a symbol of threatening forces that God subdued and contained within fixed limits marking the boundaries of their influence. What distinguishes this passage is the divine speaker's affirming engagement with the sea as a generative part of God's good creation. Rather than depicting the sea as God's adversary in a cosmic battle (see Pslams 74:13–14, 89:10–14; Isaiah 51:9–10), the text portrays God as a midwife, birthing the sea into being and swaddling it with darkness and cloud (Job 38:8–11). This unprecedented tone of admiration and protection signals a radical reconstruction of the relationship between God and the sea. This reimagining transfigures the sea's adversarial or antagonistic power into a life-giving one, reframing its boundaries as a form of divine guardianship. The implication is that God affirms the presence of this anti-cosmic force within creation as intrinsically good. This reversal extends to the animals invoked by the divine speaker, most of which are associated with the barren and hostile domain of the wilderness in symbolism of defiance and resistance to domestication. Yet, in emphasizing God's care for these creatures (see Job 38:39–41; 39:5–8, 26–30), the text subverts conventional binaries between chaos and order, recasting these untamable beasts as integral to the divine economy of creation. For instance, although canonical Hebrew tradition often regarded predation as a deviation from creation's original harmony, the divine speaker declares that God himself actively hunts for the lion and provides it with prey (Job 38:39–40); and although death was regarded as a corruption or anomaly, the divine speaker depicts God as supplying carrion for the ravens (Job 38:41). These depictions present death and predation not as aberrations of a fallen order but as integral expressions of divine providence through which God sustains life and draws cosmic order from the depths of chaos. Job, conditioned by a worldview expecting a messianic resolution of chaos into cosmic order, is led to a reimagined understanding of divine presence amid disorder.

In this way, Schneider proposes that God's creative work unfolds not against chaos but by way of it: it is integral, not antithetical to the divine creative process. Schneider (2020, 189) suggests God has a "covenant" with the archetype of chaos. He argues that God is the origin of chaos but not of evil, recasting chaos as a morally neutral or even generative aspect of creation rather than an evil one. The divine speaker strategically employs a series of rhetorically

structured images to expand Job's imagination. They reveal God as actively present within hostile realities and powers, utilizing them as agents of creative and transformative cosmic good. Schneider evaluates the theodicy presented in Job against contemporary criteria for successful God-justifying accounts, arguing that it fulfills the epistemic standard required for rational acceptance as a causa Dei. God is accomplishing more than the traditional Deuteronomic act of crushing "Leviathan"; God is astonishingly incorporating chaos into the formation of the cosmos (Schneider 2020, 197). Thus, Schneider argues that God's ongoing work to realize the messianic realm crucially involves "defeating" evils in Chisholm's sense rather than merely expunging them. Although Schneider frequently invokes the concept of chaos, he does not explicitly connect the reimagining of the chaos–cosmos relationship with scientific chaos theory. It is important to note that throughout this account, Schneider's invocation of chaos remains metaphysical and theological in character, rooted in ancient Near Eastern cosmological traditions and their biblical reception rather than in chaos theory as a scientific discipline. These are distinct registers, and their relationship to one another is a question this article takes up in subsequent sections. In the remainder of this article, I examine whether chaos theory can offer insight into Schneider's claim that God creates through, rather than in spite of, evolutionary suffering.

Chaos Theory

Before turning to the scientific concept of chaos, it is necessary to clarify the sense in which this article employs the term. In the biblical and ancient Near Eastern traditions on which Schneider draws, "chaos" denotes realities that resist or precede ordered form and must be contained, bounded, or transformed by creative divine activity (Gunkel 2006; Levenson 1988; Smith 2001). By contrast, chaos theory considers how complex patterns and forms emerge from systems that display irregular, seemingly unpredictable behavior. These two registers are not interchangeable. Even so, both construe a fundamental insight that order emerges through processes in which instability and contingency are productive. My argument therefore treats scientific chaos theory not as a literal equivalent of biblical chaos but as a conceptual framework that may help articulate the ontological intuition the ancient chaos traditions expressed in symbolic form.

Chaos theory, a field within mathematics and science, investigates deterministic systems that exhibit extreme sensitivity to initial conditions, where minute changes can lead to vastly divergent outcomes (Gleick 1987). Its roots trace back to Henri Poincaré's and Edward Lorenz's discoveries of the inherent indeterminacy of complex dynamical systems, which challenged the Newtonian assumptions of determinism, predictability, and the structure of natural systems (Polkinghorne 2000a). Contrary to implying disorder, chaos theory exposes hidden order within apparent randomness, providing a framework to

analyze complex, dynamic systems such as weather patterns, ecosystems, and evolutionary processes. This article limits the discussion of chaos theory to four key concepts: sensitivity to initial conditions, self-organization, strange attractors, and fractal structures (Oestreicher 2007). It considers how principles of chaos theory give rise to emergent complexity, offering insights into the unpredictable yet structured nature of life's development.

Chaos theory departs from classical physics by focusing not on linear systems, which behave predictably, but on nonlinear systems, where simple rules can generate complex, often chaotic dynamics. Linear systems are those in which the output is directly proportional to the input, and their components interact additively; their behavior is predictable, and solutions can be superimposed (Strogatz 2015). In contrast, nonlinear systems involve interactions where outputs are not proportional to inputs, and vanishingly small changes can lead to disproportionately large effects. The behavior of deterministic nonlinear systems exhibits sensitive dependence on initial conditions (hereafter SDIC), a phenomenon where infinitesimal differences in starting points can yield vastly divergent outcomes over time (Lorenz 1963). As a result, their future behavior is unpredictable for any finite intelligence, despite developing deterministically according to nonlinear mathematical equations. Chaos theory refers to this limit of prediction in deterministic systems, which arises not from ontological indeterminacy but from epistemic constraints. In other words, the systems are under-determined relative to our capacity to know them, not inherently probabilistic or acausal.

In many respects, chaos theory is a misnomer for SDIC (Polkinghorne 2000a). Chaotic systems are neither predictable nor random. While their behavior defies precise prediction, it exhibits an underlying structure: an ordered form of disorder. This phenomenon was first formally identified by meteorologist Edward Lorenz in 1961 while running a simplified model of atmospheric convection (Lorenz 1963). In a now-famous experiment, Lorenz re-entered initial data rounded to three decimal places instead of six, only to observe that the resulting weather simulation rapidly diverged from the original trajectory, despite the seemingly negligible change. The concept was later popularized through the now-famous "butterfly effect" metaphor (Lorenz 1972), in which the butterfly's wing represents a tiny perturbation that can alter the course of an entire system, making precise long-term forecasts infeasible (Lorenz 1993, 23). SDIC can be observed in climate systems, fluid dynamics, evolutionary and developmental biology, and ecological systems. In ecosystems, small environmental perturbations such as shifts in temperature, nutrient input, or the introduction of a single invasive species can cascade through food webs, reorganizing species distributions and altering ecosystem function, as visualized in Robert May's (1973, 1976) mathematical models of ecological stability. In evolutionary biology, minor variations in initial genetic

configurations or selective pressures can lead to radically divergent outcomes in species development, as demonstrated in Stuart Kauffman's (1993) models of self-organization and adaptive landscapes. Such manifestations of SDIC across natural systems gesture towards a universe shaped not by mechanistic predictability but by dynamic interdependence.

Chaos theory points to the structured patterns underlying nonlinear systems. Central to this is the concept of self-organization, the process by which coherent, large-scale patterns and structures spontaneously emerge from the local interactions of simpler components within a complex system without external direction or centralized control (Saha and Galic 2018). Self-organization often manifests in systems governed by nonlinear dynamics, where feedback loops and interactions among subsystems generate emergent properties that cannot be reduced to the behavior of individual elements alone (Nicolis and Prigogine 1977). Examples abound in natural systems: in physics, the formation of convection cells; in biology, the coordinated movements of bird flocks or the formation of cellular structures; and in ecology, the development of stable food webs and nutrient cycles. The hallmark of self-organization is that the system's macroscopic order arises endogenously through iterative, decentralized processes rather than being imposed from above. Kauffman (1993) expands this understanding in biological contexts, demonstrating how gene regulatory networks and evolutionary processes can self-organize into stable yet adaptive forms, leading to the spontaneous emergence of order in living systems. He proposes that life evolves at the "edge of chaos," where systems maintain a balance between stability and flexibility conducive to adaptation (Kauffman 1995). Such systemic order emerging internally from iterative, distributed, and decentralized processes undermines reductionist assumptions. Self-organization reveals a deeper, generative logic embedded in the dynamic relational processes of nature itself, in which creativity and order emerge from within.

Fractals are visible signatures of self-organization. They are intricate geometric structures characterized by self-similar irregularity across different scales, meaning their patterns repeat at progressively smaller or larger levels of magnification (see Figure 1). Unlike classical Euclidean shapes, which have integer dimensions (e.g., a line has one dimension, a plane has two), fractals often exhibit non-integer, or fractal, dimensions. The term "fractal" was coined by mathematician Benoît Mandelbrot in the 1970s, who demonstrated how these irregular yet patterned forms could model natural phenomena more accurately than traditional geometry. His foundational work, *The Fractal Geometry of Nature*, observed that coastlines, clouds, mountain ranges, blood vessels, and plant growth follow self-similar, scale-invariant patterns and enabled the precise quantification of natural complexity that traditional Euclidean geometry could not capture (Mandelbrot 1982). In biology, fractals describe the branching of bronchial trees and vascular networks (West et al. 1999); in ecology, they help

model forest distribution and habitat patterns (Milne 1992); and in physics, they capture the morphology of turbulent flows and crystal formation (Sreenivasan 1991). Because fractals emerge from recursive feedback loops and local interactions, they offer a conceptual bridge between micro-level dynamics and macro-level structure in the natural world.

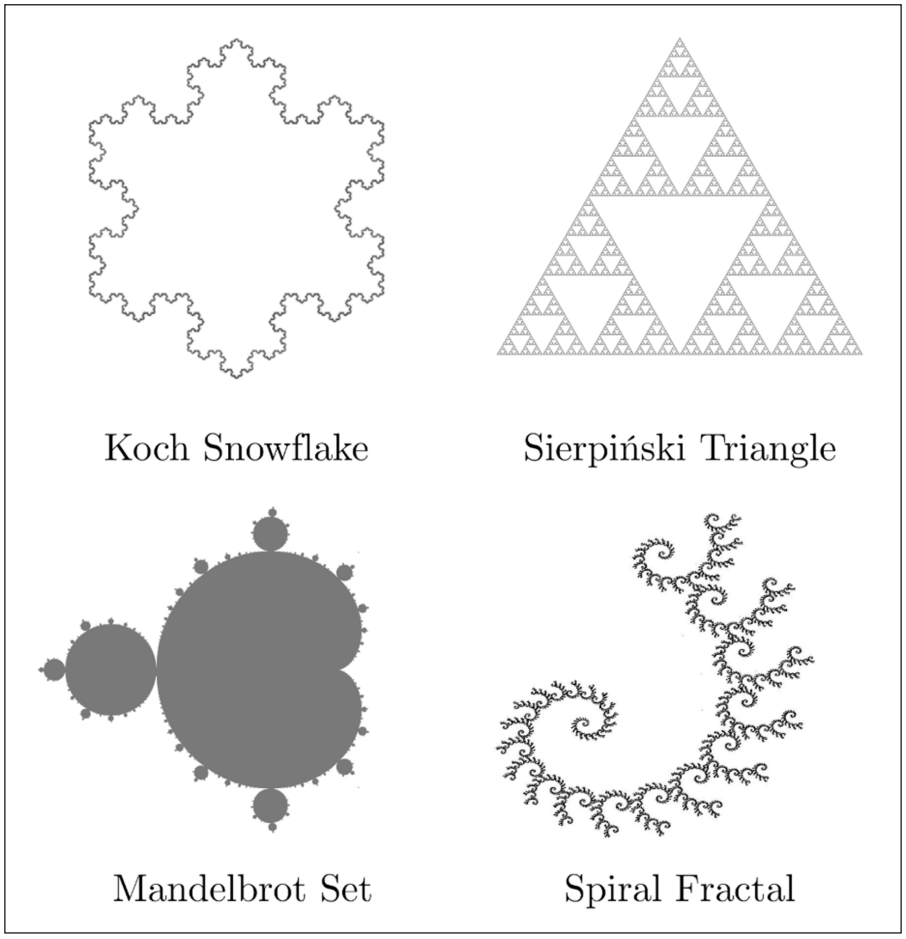


Figure 1: Examples of fractals.

The behavior of chaotic systems in their possible paths of development (the "phase space") can be described as either dissipative or conservative (Tiwari et al. 2024). Conservative systems maintain a constant volume in phase space, meaning energy is conserved. The trajectory of dissipative systems, in which energy is lost over time, will contract and converge in a pattern known as an attractor. An attractor is a set of states toward which a dynamical system tends toward over time, regardless of its initial conditions. It is a "strange" attractor if it has a fractal structure that never repeats yet it is bounded and patterned (see Figure 2) (Grebogi et al. 1987). Lorenz's (1963) simplified atmospheric convection model revealed a butterfly-shaped trajectory known as the "Lorenz attractor." Although the precise trajectory of a chaotic system does not repeat

exactly and cannot be predicted far into the future due to its sensitivity, the system's behavior remains confined within the geometry of the attractor. A strange attractor represents a form of organized chaos: while short-term behavior is unpredictable, long-term behavior is constrained and structured. Subsequent mathematical formalizations by researchers such as David Ruelle and Floris Takens introduced the idea that strange attractors underlie turbulence and complex fluid flows, linking chaotic dynamics to physical phenomena (Ruelle and Takens 1971). In natural sciences, strange attractors provide a framework to understand how systems as diverse as weather patterns, cardiac rhythms, neuronal firing, and population dynamics exhibit unpredictable, richly structured fluctuations within a well-defined geometric constraint. Their apparent randomness is governed by deeper mathematical structures, gesturing at order within chaos.

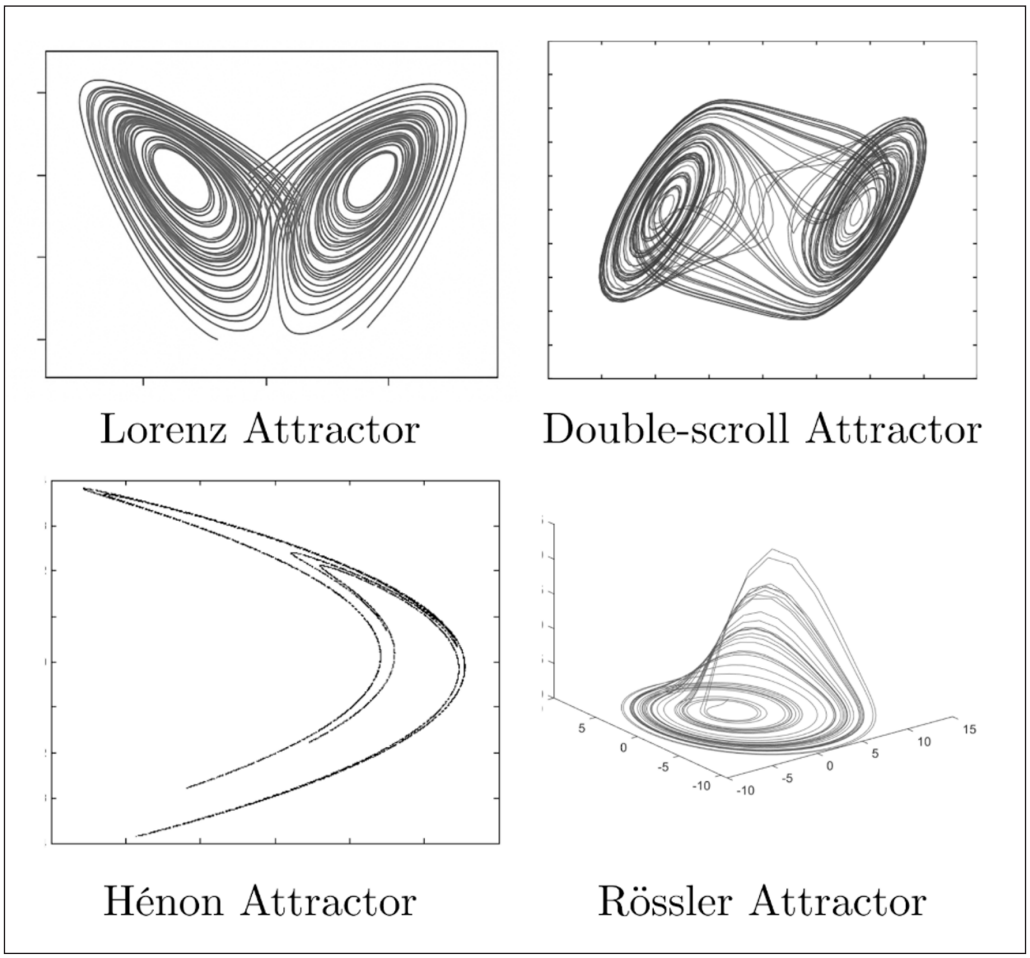


Figure 2: Examples of strange attractors.

In summary, chaos theory demonstrates how the unpredictability of small initial differences that lead to vastly different outcomes can give rise to self-organization. In such cases, complex patterns emerge spontaneously from local

interactions in the form of fractals, self-similar structures found across scales in natural systems. The long-term behavior of these systems tends to follow a chaotic trajectory that remains geometrically bounded within a structure known as a strange attractor. Collectively, these concepts reveal a cosmos in which complexity, order, and generative dynamics emerge intrinsically from within the system itself. This section has laid out a conceptual foundation for how Schneider's vision of the Darwinian World can be reimagined not in spite of but through the generative possibilities of scientific chaos—understood here, as throughout this section, in its technical and value-neutral sense.

Chaos Theory and Schneider's Aesthetic Theodicy

In Schneider's framework, natural evil is defeated when it becomes an integral part of a greater whole, the overall value of which not only outweighs the evil but depends on it for that very value. While the evil remains genuinely evil, it is rendered morally justified insofar as it contributes to a "good-making" totality, on which grounds God has ultimately defeated it. Despite its innovative approach, Schneider's aesthetic theodicy invites a range of critiques that challenge its theological coherence and implications. In the following section, I review the existing engagement with Schneider's position, which has been limited, leaving several critical dimensions unexplored. Thus, I examine the limitations of his approach, focusing on the narrow scope of his textual evidence and the absence of engagement with broader theological perspectives on chaos. Lastly, I seek to overcome these shortcomings by offering a more thorough engagement with chaos theory, following Arthur Peacocke and John Polkinghorne. Whereas Schneider treats aesthetic value as a general metaphysical category, my account ties it to the emergent, dynamic properties of chaotic systems, offering a more precise mechanism for how disvalue can be integrated into a greater whole.

Critical Assessment of Schneider's Account

This section undertakes a critical assessment of Schneider's argument while also surveying key theological critiques that have been raised in response to it. Schneider (2025) has since refined aspects of this position, though these refinements do not substantially alter the core commitments examined here. Before proceeding further, two clarifications are necessary. First, Schneider's theodicy is fundamentally eschatological. He argues that evolutionary suffering can be justified only if it is ultimately defeated for the animals themselves, not merely used to generate human goods (Schneider 2020, 117). Drawing on Chisholm's defeat condition, he envisions the eschaton as the arena in which God rectifies and transforms the "kenotic" suffering inscribed into creation, analogously to the redemptive pattern revealed in Christ's passion and resurrection (Schneider 2020, 244–45). In this future, animals are restored to flourishing and honored for their involuntary participation in the drama of

creation, receiving recognition within the messianic heaven (Schneider 2020, 267). For Schneider, this eschatological defeat is not optional but necessary for a *causa Dei* to succeed; without such rectification, the vast history of animal suffering cannot be morally justified (Schneider 2020, 245). Due to space constraints, this article does not address Schneider's eschatological resolution. Its focus is on the conceptual structure of his aesthetic theodicy and the ways in which chaos theory may clarify or extend it.

Second, it is necessary to clarify the limited and constructive role played here by the scientific–theological accounts of Peacocke and Polkinghorne. Peacocke's inclination toward "only-way" reasoning and Polkinghorne's free-process theodicy both rest on assumptions that Schneider explicitly rejects, particularly appeals to metaphysical necessity or to creaturely autonomy as grounds for justifying evolutionary suffering. Accordingly, this article does not adopt their theodical conclusions. Rather, their relevance lies in addressing a level of analysis Schneider largely presupposes rather than develops: the structure of natural processes through which divine creative action might operate in a world marked by contingency, emergence, and instability. Their work is therefore employed in a circumscribed manner as a source of conceptual resources for articulating the kind of world Schneider's aesthetic theodicy assumes—a world in which lawful openness and unpredictable dynamics are compatible with sustained divine creative action—without underwriting the moral justification of suffering Schneider locates eschatologically.

With these clarifications in place, the discussion can now turn to substantive theological critiques of Schneider's position. Reviewers of Schneider's book broadly agree that he forcefully articulates the challenge evolutionary history poses to traditional lapsarian theodicies, particularly given the scale and prelapsarian character of animal suffering over deep time (Vanhoozer 2021; Southgate 2021). At the same time, significant fault lines emerge. John Garvey (2021) questions whether Schneider's "Darwinian problem" introduces genuinely new theological challenges; he urges greater retrieval of classical categories of providence and mutability. Nicola Creegan (2021) and Christopher Southgate (2021), while more sympathetic to Schneider's nonlapsarian framing and his refusal to minimize animal suffering, express reservations about the justificatory burden placed on aesthetic considerations and Schneider's attribution of responsibility for natural evil to God. Southgate notably affirms Schneider's assignment of responsibility for natural evil to God, while raising questions about whether the aesthetic framework can bear the theodical weight placed upon it. Kevin Vanhoozer (2021) largely affirms Schneider's reframing of the problem and his turn from moral accounting to aesthetic defeat, while pressing critical questions about the extension of kenotic and eschatological categories to nonhuman creatures. Taken together, these responses suggest broad agreement about the seriousness of the problem Schneider identifies, alongside persistent

disagreement about how his proposal should be developed or delimited. Two further contributions deserve mention. Bethany Sollereder's (2021) review of Schneider's book offers an additional critical perspective that engages the implications of Schneider's position for animal eschatology. Southgate's (2025) essay in the Keltz volume provides a more sympathetic treatment of Schneider's argument, reading it constructively alongside other approaches to the problem of animal suffering. Southgate (2025, 557–58) acknowledges that Schneider's path "away from a pure only-way position" is more similar to his own than [he] previously recognized and is "very bold and makes an important contribution to the debate."

Against this broader critical backdrop, Creegan's account offers a particularly instructive point of entry, since it seeks to affirm the goodness and purposiveness of evolutionary creation while resisting Schneider's conclusion that God is responsible for the conditions of animal suffering. This hesitation reveals a theological ambiguity that Schneider's aesthetic theodicy aims to resolve. In *Animal Suffering and the Problem of Evil,* Creegan (2013, 128) addresses the challenge of accounting for God's goodness in the created order by appealing to Jesus's parable of the wheat and tares in Matthew 13. The parable depicts good and harmful elements growing together within a single field, and Creegan extends this image to evolutionary history, arguing that destructive and life-giving processes are inextricably intertwined within the same creative economy. Because evil is so entangled with the good, she contends that God cannot be faulted for not yet removing it. She points, for example, to the dual role of viruses in evolution: although they cause disease and extinction, they also contribute to the human genome, sustain the microbiome, and play key roles in nutrient cycling, ecosystem regulation, and rapid speciation. On this basis, Creegan (2013, 156) concludes that "evolution is characterized as much by love and cooperation and symbiosis as it is the opposite; it is as purposeful as it is seemingly random," and she urges Christians to approach nature with the expectation that "the creation will bear witness to the purposes of God if we know how to look" (Creegan 2013, 19). Schneider observes that Creegan stops short of identifying, in the parable, the identity of the "enemy" who planted the weeds and thus offering an explanation for evil. Creegan (2013, 128) upholds that "God must not be seen as affirming and endorsing all that happens in the evolutionary process. Nor must God be seen as using these evils as means toward an end (as in the best of all possible worlds), even if God does promise to bring good out of evil in the long run." Schneider insists that accepting Darwinian evolution as God's creative method removes the possibility of maintaining such theological ambiguity. He asserts that the "enemy" who instituted these conditions of existence is God (Schneider 2020, 32). Against Creegan's inconclusiveness, Schneider's claim that God instantiates cosmic chaos takes on its full explanatory weight.

Hans Madueme (2024; 2021) argues that the fundamental challenge with Schneider's evolutionary theodicy, shared by all nonlapsarian accounts, is that it risks attributing the origin of evil directly to God. He points to scripture as affirming God's holiness and presenting suffering "caused" by God (e.g., illness, pestilence, plagues, and death) as divine judgment for sin. Madueme maintains that while God brings about good from evil, moral responsibility for evil lies with creatures. Schneider, by rejecting a historical Fall, makes natural evil inherent to creation and implicates God in moral culpability. In his historical–literary reading of Genesis 3, he goes so far as to identify the serpent as "an animalized symbol of Chaos—anti-cosmic power—that God has for some reason incorporated into the original, 'very good' cosmic design" (Schneider 2020, 107). Schneider refers to John Goldingay's (2003, 134–40) association of the serpent in Genesis with Tiamat, the chaos-monster of Babylonian myth. This is underscored by the lack of support among Genesis scholars for interpreting the serpent as a symbolic or historical embodiment of the Devil, especially given its description as a creature of God (see also Ansell 2001, 37; Westermann 1994; Von Rad 1972, 87). Schneider holds that the serpent represents God's choice to incorporate chaos into his cosmic design, not as a divine rival but as one of his creatures. He argues that the book of Job's account of natural evil supports this nonlapsarian reading. Conceptualizing the serpent not as a fallen being but as a feature of God's creative intention brings into sharp focus the difficulty of absolving God from responsibility for evil's existence (see Ortlund 2021).

Following Michael Lloyd, Madueme observes a tension here between the God of creation and the God revealed in redemption: as Creator, God uses suffering and death to bring forth life through evolutionary processes; as Redeemer, God overcomes these very forces, restoring creation and eradicating suffering. Lloyd (1998, 151) believes it is contradictory to view God as "responsible for the suffering involved, but not culpable, because God is using it as an instrument in the pursuit of some greater good, be it aesthetic richness or human freedom." Schneider, however, resists framing human soul-making as God's end, since the good it yields accrues solely to humans and offers no justification for the cost borne by animals. Yet Southgate (2022) observes that Schneider also rejects only-way arguments, regarding them, like process thinkers do, as incompatible with divine omniscience and omnipotence. As a result, he overlooks theodicies that challenge these assumptions. Ultimately, Southgate criticizes Schneider's aesthetic theodicy as question-begging, arguing that it fails to justify why a benevolent God would choose to inscribe massive suffering onto creation. Taken together, these critiques expose a central instability in Schneider's theodicy, which, while theologically ambitious, remains underdeveloped.

A further challenge, raised by Southgate, concerns whether Schneider's aesthetic account constitutes a theodicy in the conventional philosophical

sense. Southgate (2025, 558) suggests that if it succeeds, it does so in the way scripture succeeds: not by demonstrating the righteousness of God but by insisting upon it through imagery and rhetoric that reshapes the imagination of the believer. On this reading, Schneider's project is better understood as cultivating what he himself calls "theistic sight," a disciplined way of perceiving divine purpose within the Darwinian world. This distinction has consequences for how the present article's chaos–theoretic extension should be understood. Its extension does not claim to close the philosophical gap Southgate identifies, nor does it render Schneider's account watertight in the terms of standard theodicy. Rather, it seeks to enrich the resources available for theistic sight itself, specifying the structural features of chaotic systems through which beauty, order, and generative value emerge from apparent disorder, thereby giving more precise content to the aesthetic perception Schneider invites but does not fully elaborate.

This discussion represents the current scope of published criticism concerning Schneider's argument. Beyond these contributions, the limitations of Schneider's argument remain underexamined. Following the assumption that Christian theologians can no longer attribute natural evil solely to the Fall, they must confront the troubling possibility that God intentionally used suffering-laden evolutionary processes to bring about the world. Schneider does so boldly, making natural evil an intrinsic feature of divine creation and thus imputing moral responsibility for suffering to God. However, I argue that Schneider's argument is not wholly successful, as it fails to convincingly demonstrate how God might relate to chaos beyond reference to the Joban account.

Limitations of Schneider's Account

In this section, I highlight two principal limitations of Schneider's argument. First, by appealing only to Job, Philippians 2, and Romans 8–11 to establish God's relation to chaos, Schneider relies on a narrow scriptural basis that provides limited support, thereby leaving his broader claims underdeveloped and unpersuasive. Second, although chaos is central to Schneider's theodicy, he neglects the more robust theological and scientific analyses of chaos by Polkinghorne and Peacocke. In what follows, I develop these critiques to lay the groundwork for my own attempt to address and remedy these shortcomings in Schneider's approach.

To begin, I assess the sources Schneider draws upon to support his argument. The core claim of Schneider's aesthetic argument is that God positively engages chaotic elements in the natural world, drawing on Samuel Balentine's and Carol Newsom's commentaries on the biblical book of Job. Rejecting the conventional reading of Job as a rebuke for questioning God, Schneider suggests that Job's encounter with disorder in creation presents a challenge analogous to the Darwinian problem, and that the divine speech offers a "Joban

theodicy" in which God is portrayed as engaging with chaos collaboratively, not adversarially (see Balentine 2006; Newsom 2003). For instance, chaos is depicted through the Leviathan and the sea not as a "mortal foe" but as an "ally in arms" (Schneider 2020, 198). Additionally, images such as that of God as midwife to the sea and protector of the Leviathan suggests chaos is nurtured within creation and made a "creative source of great goodness" (Schneider 2020, 183). Schneider (2020, 197) claims that God has a "covenant" with the archetype of chaos such that "God is working meticulously, artfully, and carefully to bring forth cosmic life from the chaotic realities of suffering, disorder, and death . . . by means of actions that entail defeat for evils, in Chisholm's sense, rather than by their mere removal from the world." Job's restored "theistic sight" emerges from seeing God's purpose within chaos, as God's "delight" in elements traditionally linked to chaos emerge as unlikely symbols of a new kind of cosmos (Schneider 2020, 186). In sum, Schneider's argument is an attempt to establish the following conditional: if God's Joban theodicy integrates chaos into creation, then God can likewise integrate natural evils into a divinely ordered world.

Turning to New Testament writings, Schneider (2020, 201) argues that canonical Christian theology supports the view of God as "intimately involved with the chaotic to create cosmic goodness for creatures." Here, I take Schneider's argument as an attempt to establish the following conditional: if God's kenotic, Christ-modeled self-emptying extends through Darwinian evolution, then even natural evils are integrated into a cruciform, redemptive process that invites all creatures into divine artistry. First, Schneider (2020, 202) invokes the idea of "Darwinian kenōsis" and suggests that the sacrificial dimension of evolution parallels Christ's self-emptying as described by Paul in Philippians 2:5–11. Then, Schneider follows Southgate (2008, 45) in borrowing Holmes Rolston's (2006, 144) characterization of the evolutionary existence of animals as "cruciform," by which they "share the labor of the divinity." In doing so, Schneider proposes that, by working through Darwinian evolution, God invites animals to participate in a creative and redemptive process analogous to the role assigned to Christ. Schneider (2020, 210) then draws on Paul's Romans 8–11 discourse,[1] which "provides explicitly positive canonical support for employing an aesthetic analogue of God as Artist in seeking to make sense of evils that are inexplicable on ordinary ethical-agency grounds." Schneider (2020, 212) argues that Paul's likening of God to "an unpredictable yet masterly potter freely shaping and making clay vessels at his own artistic discretion" seeks to show that God is not unjust but rather "divine justice is manifested in an extraordinary aesthetic form rather than in the straightforward ethical sense that one expects." Finally, Schneider (2020, 217) grants that such a kenotic comparison of divine election to evolutionary processes requires "theistic sight," or seeing through the eyes of a "messianic faith."

Before presenting my own objections, I will make note of three objections to the idea that evolution is cruciform and kenotic in character that Schneider explicitly acknowledges. First, Celia Deane-Drummond (2009, 172) objects that likening animal suffering to the crucifixion risks endorsing it as morally good rather than lamenting it as bad, thereby undermining motivation to alleviate it. Southgate (2025, 559) also presses this objection on different grounds: not that it endorses suffering as morally good (Deane-Drummond's concern), but that it misrepresents the voluntary character of Christ's self-giving. Schneider counters that recognizing the redemptive significance of evolutionary suffering does not imply endorsing the suffering itself as morally good, and that the Christian anticipation of divine triumph over evil encourages actively resisting evil, not remaining passive. Second, some might argue that Schneider's analogy implies that evolutionary suffering is necessary in the same way that the Passion was necessary for salvation. Schneider rejects this only-way assumption, invoking a Thomistic view of the Passion as "fitting" but not necessary, thereby preserving the possibility of divine freedom in choosing both evolutionary and redemptive means. Third, some might argue that animals cannot properly be said to engage in kenosis, since their participation is involuntary, unlike Christ's voluntary self-offering. Schneider concedes the difference but points to Mark's portrayal of Jesus's reluctance in Gethsemane to argue that even Christ's kenosis was, in part, involuntary. Schneider concludes that none of these ethical and theological challenges preclude a morally meaningful and theologically coherent reading of evolution as kenotic and redemptive.

While Schneider's treatment of these objections is compelling in part, I argue that several aspects of his account remain open to challenge. First, because Schneider's textual support is restricted to several scriptural passages (Job 38–41, Philippians 2, and Romans 8–11), his treatment of a crucial aspect of his theodicy—chaos—remains underdeveloped. Second, Schneider's omission of the theological treatments of chaos theory by substantial figures such as Polkinghorne and Peacocke weakens the explanatory power of his account. As a result, I argue that the explanatory force of Schneider's argument proves limited. He puts forward a provocative interpretation of divine collaboration with chaos, yet he fails to engage meaningfully with chaos theory itself, leaving a gap between his theological claims and the scientific frameworks they invoke. While Schneider attributes significant aesthetic and theological value to chaos, his model does not provide the necessary explanatory resources to discern where and how such value is instantiated in the world. In response to this conceptual gap, I develop Schneider's model by drawing on scientific understandings of chaos, thus strengthening its ability to satisfy the conditions he places on theodicy. I aim to clarify how value and meaning can arise from processes marked by death and disorder. Chaos theory, in this light, does not merely illustrate Schneider's model but provides tools to sharpen and extend it.

Extending Schneider's Account

In light of the identified shortcomings, I aim to develop a more substantiated and critically engaged account that strengthens the core of Schneider's theodicy. First, drawing on chaos theory, I demonstrate that chaos does not imply pure randomness but instead arises from deterministic processes that generate structured patterns within apparent unpredictability. Second, I observe that the evolutionary process operates within the interplay between chance and law, a dynamic held in delicate equilibrium "at the edge of chaos." Third, the "creative" capacity of evolutionary emergence brings forth the new through the death of the old. Fourth, I offer the fractal patterns of chaos as a visualization of God's kenotic creativity sustaining the universe from within. Lastly, I introduce value holism to show how my account better establishes how some natural evils are defeated. While I propose that Schneider's theological notion of chaos shares resonances with scientific chaos theory, I acknowledge that the two are not wholly analogous: Schneider's concept operates in a different register altogether—symbolic and metaphysical—and is not straightforwardly commensurable with the technical definitions of chaos theory. Indeed, Schneider does not invoke a scientific chaos framework at all; his treatment of chaos is drawn from ancient Near Eastern cosmological traditions and their biblical reception. Any engagement between his metaphysical chaos and scientific chaos theory must therefore be understood as a constructive theological proposal on the part of this article rather than an interpretation of Schneider's own intentions. The language of chaos Schneider employs nonetheless invites deeper engagement with the scientific discourse, and it is this article's contention that such engagement could enrich the theological implications he seeks to draw.

Before turning to these extensions, however, a methodological clarification is required concerning the sense in which chaos theory bears on the problem of natural evil. I do not claim that chaos theory explains suffering, that particular instances of harm are caused by chaotic dynamics, or that suffering is itself a chaotic phenomenon. Chaos theory contributes not by supplying a theodicy but by offering a scientifically grounded account of why generative natural systems cannot be optimized to eliminate harm without forfeiting the very dynamics that produce value. Its relevance lies in clarifying the structural limits within which natural causes operate in evolutionary contexts. Because evolutionary systems consist of living organisms, instability and unpredictability do not remain value-neutral features of system behavior but instead register as harm. Chaos theory helps to clarify why this harm should be expected in a world structured for open-ended creativity. It reframes suffering not as an anomaly but as a cost internal to the same dynamics that generate biological novelty and value. This reframing has a structural affinity with the only-way reasoning associated with Peacocke and Southgate, in which the same processes that give rise to biological value necessarily give rise to disvalue. It is important to

distinguish Schneider's position from that logic, however. Only-way arguments justify suffering by appealing to modal necessity: God could not have achieved the relevant goods otherwise. Schneider explicitly rejects this move, as noted. His justification is not that suffering was inevitable, but that it is ultimately defeated by being transformed and incorporated into a greater redemptive whole (rather than merely explained as the unavoidable price of creaturely value). On this view, the natural order reflects a structure God freely chose to establish rather than one imposed by a lack of alternatives. This is consistent with Schneider's transition from moral accounting to aesthetic defeat. Appeals to necessity or proportionality assume a degree of control and optimization that complex, generative systems do not afford. Of course, God's relationship to chaotic systems is not straightforwardly analogous to how creaturely agents relate to them. If God is not subject to these epistemic limitations, then criteria such as necessity or proportionality could still, in principle, apply to divine action and may even lend support to an only-way argument. While this article does not settle this issue, it notes that Schneider's own theodicy sidesteps the issue by placing the basis of justification in the eschatological defeat of evil rather than in natural processes, without appeal to what God could or could not have done. Chaos theory does not justify suffering but clarifies why justification, if it is to be coherent, must take the form Schneider proposes: not the prevention or explanation of suffering but its aesthetic integration and ultimate defeat within a larger redemptive whole.

With this clarification established, the relevance of chaos theory to Schneider's account can be specified more precisely. Schneider's theological construal of chaos as an integral, non-random element of divine creation exhibits a formal resonance with contemporary chaos theory's rejection of strict binaries between order and disorder. In his reading of Job, Schneider challenges the Deuteronomic expectation that divine order excludes disorder (see Deuteronomy 28:1–14, 15–68; 1 Kings 8:35–36; Quick 2017), emphasizing instead that chaos is not a force external to God's will but is incorporated into God's ongoing creative purposes. As he puts it, "there is no such thing as causally random chaos in God's world," and God is "incorporating Chaos into a forthcoming Cosmos," integrating rather than simply overcoming it (Schneider 2020, 176, 197). Chaos theory, understood in its technical and value-neutral sense, likewise undermines the assumption that unpredictability implies disorder or absence of structure. Twentieth-century work on nonlinear dynamics shows that deterministic systems can display sustained unpredictability while remaining constrained within stable patterns of behavior. As noted earlier, chaotic systems are not entirely random, as their behavior, though unpredictable, remains confined within a range of possibilities known as a "strange attractor." A key question is whether chaos and unpredictability stem from epistemic limitations or ontological features of reality itself. Classical Newtonian physics assumes the former, but given that its

laws themselves function as approximations for the real world, it is likely that unpredictability proceeds from the very structure of reality. This inference—that epistemological indeterminacy licenses a conjecture of ontological indeterminacy, or that "epistemology models ontology"—is Polkinghorne's (2000a; 2011, 87–88) own speculative proposal, and it attracted significant criticism in the Vatican/CTNS divine action project, where several contributors questioned whether the move from epistemic to ontological indeterminacy is warranted (see Russell et al. 1995; 2000). This article draws on the inference cautiously and does not treat it as established. Chaotic systems, where minute disturbances can radically alter system dynamics and result in drastically divergent outcomes, disclosing a form of natural order that resists reduction to mechanical determinism. Both Schneider's theological account and chaos theory resist the identification of order with complete predictability. Chaos theory indicates that unpredictability need not imply disorder, which supports Schneider's position that chaos can be a feature of, rather than a threat to, divine creative order.

Second, Schneider's theological picture of the chaos–cosmos relationship can be clarified at the level of natural process by drawing on the work of Peacocke and Polkinghorne. Both thinkers emphasize that the "creative" capacity of evolutionary systems arises from the interplay between two complementary tendencies: contingency and constraint, described by Peacocke (1993, 65) as chance and law, and by Polkinghorne (2011, 57) as chance and necessity. Chance refers to the openness of outcomes within a system, while law or necessity names the stable structures that constrain and channel those outcomes. In evolutionary contexts, this interplay is commonly described in terms of stochastic genetic variation and the regularities of natural selection, which together enable adaptive novelty without dissolving into disorder. Without chance, the cosmos would be rigid and unchanging; without law, it would preclude enduring form. Polkinghorne notes that contexts "in which truly novel possibilities can emerge are always 'at the edge of chaos', that is to say, they are situations in which contingency and regularity, Chance and Necessity, interlace in delicate balance with each other" (Polkinghorne 2011, 59; also Peacocke 1993, 118). Peacocke's and Polkinghorne's contributions function to specify process-level dynamics, without serving as grounds for theodical justification or metaphysical necessity. They articulate the kind of generative system Schneider presupposes: one in which order emerges through constrained openness rather than through the elimination of disorder. In this sense, Schneider's metaphysical portrayal of the chaos–cosmos boundary as fluid and productive finds a structural parallel in the behavior of nonlinear dynamical systems, in which instability plays a constitutive role in generating new forms of order.

Third, in both Schneider's theology and contemporary chaos theory, it is this dynamic of chance operating within a lawlike framework that underpins the "creativity" of the natural order, i.e., the propensity for emergent forms,

structures, and patterns. Research on dissipative systems demonstrates how, within thermodynamic constraints, complex order can emerge in open, nonlinear systems far from equilibrium (Peacocke 1993, 52–53). However, the processes that enable the possibility of life also permit congenital anomalies and cancers. Polkinghorne (2011, 59; 2005, 45) points out that "if there were no genetic mutations, there would be no new forms of life; if genetic mutations were too frequent, no species could become established." The genetic mutation that drives biological evolution also underlies disease and dysfunction, in that to allow for mutations that yield new forms of life is to accept that other mutations may result in malignancy. Both Polkinghorne and Peacocke reiterate that one cannot exist without the other. Rather, "God wills into existence the kinds of living creatures that depend on the operation of the same factors that produce those particular 'natural' evils" (Peacocke 1993, 126). It is the "necessary cost of the evolving complexity of life" (Polkinghorne 2000b, 22–23). It should be noted that this "necessary cost" language is characteristic of the only-way reasoning Peacocke and Polkinghorne themselves espouse, and which this article employs in a limited and circumscribed sense. As clarified earlier, their process-level descriptions are drawn upon here as resources for articulating the structure of the natural order that Schneider presupposes, not as endorsements of the theodical conclusions they draw from it. Chaos theory demonstrates that in nonlinear dynamic systems, order and disorder are intertwined such that stable patterns emerge amidst inherent unpredictability, and neither can be fully isolated from the other. This insight underpinned a major twentieth-century theological development that, by a kenotic act of self-limitation, God allowed creatures to make themselves (Polkinghorne 2001; see also the critical response by Coakley in Polkinghorne 2001, and Kilby 2020, for sustained critique of kenotic accounts of divine action). In this way, Schneider's aesthetic theodicy seeks to account for a God continually active within and through the ongoing processes of creation. That patterns and order emerge from apparent disorder supports a theological model in which God collaborates with chaos.

Fourth, fractal structure offers a helpful point of conceptual contact for thinking about how order can persist under conditions of constraint and self-limitation. In chaos theory, fractals describe patterns that recur across scales despite local irregularity, capturing how coherence can be maintained without centralized control or exhaustive determinism. They render intelligible how stable forms can arise and endure within systems that remain open, contingent, and dynamically constrained. This feature resonates with Schneider's kenotic account of divine creativity, according to which God does not secure order by overriding creaturely processes but by allowing them to unfold within limits that make genuine otherness and novelty possible. Read in this limited sense, fractal structure functions as a conceptual analogue for Schneider's depiction of divine action as immanent and patient, operating from within the processes

of creation rather than imposing order from without. It is worth noting that this use of fractal imagery as a window into divine creativity in evolutionary processes has a precedent in the literature. Sollereder (2019), in *God, Evolution and Animal Suffering*, develops what she describes as a fractal video mosaic as a means of visualizing how individual creaturely lives, however apparently peripheral or suffering-laden, contribute to a larger pattern of value whose coherence is only visible at a higher level of resolution. Southgate (2025, 559) himself draws an explicit connection between Schneider's project of theistic sight and Sollereder's fractal imagery, treating them as complementary attempts to render the Darwinian world perceptible as the work of a creator God. The present article's use of fractal structure operates in a similar register, as a conceptual resource for articulating how structured beauty can emerge from and encompass the disorder and suffering of individual components.

Lastly, any theodicy presupposes a basic axiology: an account of the kinds of value that could justify divine permission of evil. In particular, it presupposes value holism, the view that the value of a whole can exceed (or fall short of) the sum of its parts. In an additive model, goods and evils are treated as discrete units whose values simply accumulate. Holism, by contrast, holds that value arises from the integration of parts—what G. E. Moore (1903) calls the principle of organic unities. Moorean holism underwrites the theodical concept of defeat: evils are not merely outweighed by goods but included in a larger whole that has greater value because of their presence. This framework makes possible the view that a life, or world, that includes suffering may nevertheless be more valuable than one without it, depending on how the parts relate. I suggest that Chisholm, Adams, and Schneider all adopt this notion of defeat. Chisholm claims evils can be defeated if they are logically necessary for a greater good. Adams argues that horrors can be defeated through their integration into a personal narrative that becomes a great good for the person. Schneider locates defeat not in personal meaning but in aesthetic structure: the integration of suffering into a richly ordered, beautiful cosmos. My model builds on Schneider's by specifying how natural evils—such as entropy, extinction, and ecological fragility—function within generative chaotic systems to produce aesthetic and moral goods. In doing so, I clarify how chaos provides a scientifically robust framework for understanding defeat, and thereby strengthens the theological justification for divine permission of evil. It must be acknowledged, however, that value holism as a systemic framework is vulnerable to the objection that suffering is borne by individual creatures, and it is not obvious that a good accruing to the whole can justify it to the particular animal that suffered. This is Ivan Karamazov's point in Dostoevsky's *The Brothers Karamazov*: no future harmony can redeem even one child's tear. Applied to the present context, the objection is that no emergent aesthetic order, however beautiful, can justify the suffering of the individual creature whose pain contributed to it. This objection

is not dissolved by chaos theory, which strengthens the holistic dimension of Schneider's account but does not address the problem at the level of individual experience. It is important to note, therefore, that Schneider's theodicy does not rest on value holism alone. Crucially, it depends on an eschatological dimension: individual animals are not merely subsumed into an aesthetic totality but are themselves restored and honored within the messianic heaven (Schneider 2020, 267). It is this personal eschatological defeat—the rectification of suffering for the individual creature that bore it—that ultimately bears the theodical weight in Schneider's account, supplementing and grounding the holistic framework this article has developed. The chaos–theoretic extension offered here operates at the level of systemic and aesthetic defeat; Schneider's eschatological vision is what answers the Karamazovian challenge.

Schneider's aesthetic account treats the value of God-justifying beauty in general terms, whereas the chaos–theoretic framework specifies beauty through precise mechanisms like strange attractors and self-organization, demonstrating how natural evils are structurally necessary for the emergence of complex and valuable phenomena. First, fractal beauty shows how infinitely nested, self-similar patterns like coastlines or fern leaves emerge from micro-level irregularities contributing to macro-level coherence. Second, systems at the edge of chaos such as weather fronts or neural networks generate maximal diversity, adaptability, and aesthetic surprise unavailable in strictly ordered or random systems. Third, participatory creativity highlights how chaotic systems enable agents to co-create within dynamic environments (e.g., improvising in music or shaping ecosystems). Chaos theory enables the identification of distinct aesthetic goods by providing precise, interdisciplinary examples of how beauty arises from structured complexity and dynamic tension, moving beyond vague or purely abstract appeals to aesthetic value.

In summary, I have sought to strengthen Schneider's aesthetic theodicy by bringing it into critical conversation with chaos theory and thinkers such as Peacocke and Polkinghorne. First, I observed that chaos is not mere randomness but entails patterns within unpredictability. Second, I considered how Peacocke (1993, 65) and Polkinghorne (2011, 59) both attribute the generative capacity of the universe to the dynamic interplay between chance and law, held in delicate balance "at the edge of chaos." Third, I observed that a creative condition of the process of evolutionary emergence is the making of new forms of life through the death of the old. Fourth, I proposed fractal patterns as a visualization of God's kenotic creativity within the patterned chaos of becoming. Finally, I argued that value holism makes the defeat of evil conceptually possible by showing how suffering can contribute to a greater whole whose value exceeds the sum of its parts. While Schneider's appeal to aesthetic goods such as beauty is sweeping, the chaos-informed model anchors aesthetic value in specific phenomena and structures of reality.

Conclusion

This article explored how chaos theory informs Schneider's interpretation of God's role in animal suffering and the Darwinian problem of evil. First, I located Schneider's aesthetic theodicy within the landscape of responses to the problem of natural evil. Second, I introduced chaos theory and its relevance to nature's indeterminacy and order, with Polkinghorne's work providing a theological precedent. Third, I critically assessed Schneider's approach, arguing that although the concept of chaos is central to Schneider's aesthetic theodicy, his engagement with it is notably limited and insufficiently addressed. Lastly, to address these limitations, I developed Schneider's account by drawing on scientific understandings of chaos so that it is better equipped to satisfy the internal demands of his theodical project. My model refines Schneider's general account of aesthetic value by grounding it in the emergent patterns of chaos, thereby offering a clearer explanation for how disvalue contributes to overall goodness. I conclude by clarifying how the aesthetic picture and chaos theory each contribute to the problem of evil.

First, the aesthetic picture adds a distinctive dimension to the problem of evil by introducing irreducible aesthetic values—such as beauty, harmony, complexity, and artistic richness—that contribute to the overall goodness of the world independent of moral or purely experiential goods. In the context of theodicy, this means that some evils or sufferings might be permitted not only because they enable moral goods (like free will or virtue) but because they contribute to the aesthetic fabric or narrative depth of the world. The aesthetic picture thus expands the range of values God might prioritize, offering reasons to allow certain evils that are not reducible to moral or hedonistic calculations. For example, the existence of tragedy, contrast, or complexity may be necessary for the world to manifest certain aesthetic or narrative values that could not exist otherwise. This helps complicate traditional theodicies by showing that the presence of evil might contribute to a richer, more meaningful, or more beautiful whole, thereby justifying divine permission of evil on grounds beyond mere moral utility.

Second, chaos contributes to defeat by operating within the same deep mereological (part–whole relationships) structure that undergirds axiological holism. At the heart of both chaos theory and value holism is the idea that interacting parts can generate emergent properties that are not apparent in the parts themselves, nor predictable from them. In chaos, this takes the form of combinatorial complexity: micro-level unpredictability (e.g., sensitivity to initial conditions) gives rise to macro-level order, patterns, or structure. In theodicy, defeat refers to the idea that evils can be included in a life or world in such a way that the overall whole is more valuable than it would have been without them. Chaos provides a conceptual model for this: seemingly disordered or disvaluable components may contribute to a higher-order structure that possesses a kind

of emergent value inaccessible at the level of the individual parts. When chaos gives rise to aesthetic properties, it becomes a bearer of non-moral value. These properties emerge from or supervene on chaotic physical processes, grounding a distinct kind of goodness that can justify God's permission of such processes, even when they entail suffering. Thus, chaos enables disvaluable elements (e.g., predation, entropy, evolutionary dead-ends) to contribute to higher-order goods by integrating them into a valuable whole (e.g., narrative, aesthetic, or moral). I have shown that Schneider's theodicy rests on a pluralist, non-additive value theory in which divine creativity involves balancing tensions among diverse goods. On this view, the world's tragic and chaotic dimensions are not incidental flaws but integral to its final beauty and meaning.

Schneider appeals to aesthetic value in broad terms, whereas my account roots it in the emergent order of chaotic systems to show how disvalue is integrated into greater value. While Schneider's theological use of chaos extends beyond scientific definitions, the analogy between them offers fertile ground for theological engagement. Chaotic systems are not rare anomalies but fundamental features of reality, revealing the limits of determinism and the intrinsic unpredictability of nature. Once dismissed as mere disorder, these phenomena are now recognized as central to nature's emergent order—creation, it seems, arises from chaos. If so, then chaos does not stand in opposition to divine purpose but participates in it. In the continuous generation of novelty and form, chaos functions not as creation's adversary but its collaborator.

Note

[1] Particularly Romans 8:20–21: "[F]or the creation was subjected to futility, not of its own will but by the will of the one who subjected it, in hope that the creation itself will be set free from its bondage to decay and will obtain the freedom of the glory of the children of God."

Competing Interests

The author declares that they have no competing interests.

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Intelligibility, Scientific Explanation, and the Metaphysical Space of the Science–Religion Debate

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Contemporary work on science and religion no longer relies on simple models of conflict, separation, or accommodation. Recent scholarship has become increasingly attentive to the historical contingencies of both "science" and "religion," to the plurality of scientific practices, and to the philosophical and social assumptions that shape their interaction. Yet despite this growing sophistication, much of the debate continues to begin from an unexamined starting point: the intelligibility of empirical inquiry itself. Rather than proposing a new model of relation, this article shifts attention to a more basic condition shared by all empirical inquiry: intelligibility. Scientific activity, across its diverse methods and domains, presupposes normative standards of coherence, simplicity, unity, and explanatory adequacy that are not themselves delivered by empirical method. Such normativity is not merely epistemic or pragmatic but rather expresses an ontological structure by virtue of which reality is intelligible at all. Recognizing this structure reframes the science–religion debate by showing that questions of meaning, value, and purpose do not intrude upon scientific understanding from outside but instead arise from the internal logic of intelligibility itself. This does not yield theological conclusions, but it opens a conceptual horizon within which theological interpretation becomes a natural, though not compulsory, response to an intelligibly ordered world.

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Introduction

Debates about science and theistic belief are often motivated by a familiar tension. The central questions have typically concerned whether scientific accounts of the natural world leave room for divine action, whether theological claims conflict with empirical description, or whether one domain must ultimately displace or subordinate the other. This familiar picture of science and religion in the Western tradition as rival or adjacent explanatory domains is a relatively recent construction, often traced, among other historical and social developments, to late nineteenth-century formulations of the so-called conflict thesis, most notably in the work of John William Draper (1874) and Andrew Dickson White (1896), names now familiar to any scholar of science and religion. Their influential narratives helped to fix the idea that science and religion represent fundamentally opposed ways of understanding the world. Models of the relation since have sought to find ways of managing these two different pictures (Barbour 1998). Stephen Jay Gould's (1997) notion of "non-overlapping magisteria," for example, worked to defuse this opposition by assigning "science" and "religion" distinct explanatory jurisdictions, thereby preserving the authority of both while avoiding direct conflict. However, as Paul Tyson (2022) notes, "while on the face of it, [all] these approaches could hardly be more divergent, they share a common commitment to the idea that 'science' and 'religion' are valid trans-historical categories that capture more or less perennial features of human culture."

The present article approaches this landscape from a different starting point. It seeks not to adjudicate between competing explanatory domains but to clarify the conditions under which such domains—and the debates between them—are possible. The issue, therefore, is not simply whether the world is intelligible, but what must be the case for there to be anything like a world in which scientific and theological claims can be articulated, evaluated, and disputed at all.

Recent historical work has shown that many of the conceptual categories through which science and religion have been discussed are themselves contingent products of particular intellectual developments rather than stable features of thought (Harrison 2015, 2024; Harrison and Tyson 2023). Contemporary science–religion scholarship has developed a range of subfields, methodologies, and interaction models that move well beyond any simple categorical opposition (Finnegan et al. 2023; Spencer and Waite 2025). A distinct field of inquiry has emerged, concerned not only with adjudicating conflicts or compatibilities but with clarifying the conceptual conditions under which scientific and theological understanding can be meaningfully related at all.[1]

In the light of these complex developments, no single methodological starting point can claim priority by default. Nevertheless, because much contemporary science–religion scholarship treats scientific results and methods as a shared

point of reference, one place—among others—at which to begin reflection is with how science itself actually operates.

The argument developed here is not a transcendental argument in the usual epistemic sense, concerned with the conditions of knowledge or the justification of belief. Rather, it operates at a prior level, concerning the conditions under which there can be anything like a world available to thought, articulation, and dispute at all. The issue is therefore not simply that the world is intelligible to us but that there can be anything like meaning—any structured expression capable of being true or false—through which such intelligibility is articulated. The possibility of even the most minimal act of assertion, denial, or disagreement presupposes a world in which relations, distinctions, and forms are sufficiently determinate to sustain meaning. In this sense, intelligibility is not inferred from experience but recognized as constitutive of there being a world in which anything can be said, including its denial.

At the center of scientific practice lies two working commitments: that reality is intelligible in a specific way accessible via experiment and/or other methods, and that it is so constituted that minds such as ours can stand in various epistemic relations to it—in such a way that it can be rationally articulated, mathematically expressed, and normatively evaluated by explanatory standards such as coherence, unification, and simplicity. Intelligibility in this sense does not refer merely to human cognitive capacity but to the responsiveness of the world itself to conceptual order and rational description. To take one example among a plethora, consider the opening words of physicist Anthony Zee's book *Top Ten Ideas of Physics*. Quoting Albert Einstein as saying that "[t]he most incomprehensible thing about the world is that it is comprehensible," Zee (2025, 1) goes on to write "that the world is comprehensible is what motivates physicists. In a lawless universe behaving with neither rhyme nor reason, physics would be impossible."

It is important at this point to distinguish the present proposal from familiar critiques of intentionality and agency that treat purposive description as a merely instrumental projection. The argument that will be advanced here does not rest on claims about psychological attribution or folk conceptions of agency. It concerns instead the structural conditions of *any* explanation. Scientific explanation, like any other form of explanation, presupposes norm-governed intelligibility—standards of coherence, constraint, and explanatory adequacy—that is not exhausted by the use of intentional language.

It is worth pausing in the light of this to consider the capacity of language itself to sustain rationally governed reference and intentionality, since at least one powerful intuition about the natural world with which science deals presupposes that linguistic statements can be answerable to that world in a nonarbitrary way, that is, that they can succeed or fail in representing reality, and that disagreement is more than a clash of internal, conceptual, or cultural

conventions. Even accounts that treat world-pictures as domain-relative or conceptually constructed must still answer a prior question: What kind of reality is capable of sustaining stable, shareable, and norm-governed representational practices at all? Language could not reliably refer to, describe, or explain the world unless the world were already the kind of reality that can be meaningfully addressed. In this sense, intelligibility is not merely expressed through language; it is a condition of the possibility of linguistic intentionality itself.

Physics provides a particularly clear case through which the intelligibility of scientific practice can be observed, even though analogous patterns appear—differently configured—across other scientific disciplines. Some of the most decisive advances in modern physics have been guided not primarily by new experimental data but by judgments about intelligibility. Maxwell's unification of electricity and magnetism and Einstein's formulation of general relativity were driven by demands for mathematical coherence, unification, and conceptual consistency. In both cases, theoretical progress depended upon appeals to explanatory depth and structural unity—criteria that functioned as normative constraints on what could count as an acceptable description of reality.

These examples illustrate that scientific practice presupposes more than empirical adequacy alone. It presupposes that the world is intelligible in a strong sense: capable of sustaining rational articulation, mathematical structure, and explanatory constraint. Without such intelligibility there would be no stable scientific descriptions of the kind science requires, no coherent explanatory norms, and no meaningful basis for dialogue between scientific and theological accounts of reality. The question of intelligibility is therefore not an optional philosophical supplement to the science– religion debate. It concerns the very conditions under which scientific and theological questions can be coherently asked and answered, or otherwise. Science does not generate this intelligibility; it operates within it.

The issue, therefore, is not whether scientists project meaning onto nature but whether explanation itself is possible without presupposing an intelligible order that constrains what counts as understanding at all. The claim is not that intelligibility is a condition of our knowledge of the world but that it is a condition of there being a world in which anything can be asserted, denied, or investigated as meaningful at all (Rahner 1978).[2]

How does this shift in perspective alter the way concrete science–religion debates are framed in practice? Cosmological fine-tuning provides a particularly clear case. Standard discussions ask why certain physical constants fall within narrow life-permitting ranges, appealing to chance, necessity, multiverse selection, or design. Yet all such approaches already presuppose a deeper condition: that reality admits a mathematically expressible space of possibilities in which parameters can vary and be meaningfully compared. From this perspective, the more fundamental question is not only why particular constants are fine-tuned,

but why reality is the kind of world in which fine-tuning is a coherent category at all. It also raises specific questions of interest; why, for example, should there be a world in which there are modal physical possibilities that can issue in finely governed constants? Why, for example, should there be a world in which physical parameters range over a space of modal possibilities capable of yielding finely governed constants rather than a reality in which such values are fixed or brute. This is as much a theological question as a scientific one. Certainly a topic for the science–religion conversation.

The argument here does not resolve whether fine-tuning should be understood in naturalistic or theological terms. Rather, it draws attention to a prior explanatory question shared by all such accounts: why reality is structured in such a way that fine-tuning constitutes a meaningful explanatory problem in the first place. In this sense, the argument does not bypass fine-tuning debates but rather pressures them from below: it raises the question of whether accounts of chance, necessity, or design are adequate unless they also address the intelligible modal framework within which fine-tuning is even a meaningful explanatory category.

Similar considerations arise within the life sciences, where explanation routinely relies on normative and purposive descriptions that resist reduction to purely mechanical causation. Accounts of homeostasis, functional organization, and regulatory stability describe organisms as maintaining viability through coordinated processes that distinguish success from failure. Such explanations do not merely list causal sequences; they presuppose standards of proper functioning and goal-directed organization. The point is not to import external design into biology but to note that explanatory success here already relies on normative and modal structure. Similar questions to those observed in the earlier fine-tuning example might be excavated from the intelligibility of biological life.[3]

Taken together, these cases suggest that intelligibility is not an accidental accompaniment to scientific explanation but an intrinsic structural feature of anything that is to count as a coherently accessible world. The very idea of scientific practice, among other knowledge-seeking endeavors, is saturated in it. The aim of this article is to make that presupposition explicit and to explore how recognizing intelligibility as ontologically significant can reshape conceptual spaces in which science–religion debates are conducted. The next section develops this claim by examining the normative character of scientific explanation itself.

Scientific Explanation and Normativity

Scientific explanation is often characterized as the identification of causal mechanisms operating under lawlike regularities. On this familiar picture, to explain a phenomenon is to subsume it under general laws, specify the processes

responsible for its occurrence, or locate it within a broader causal network. While this characterization captures an important dimension of scientific practice, it remains incomplete. Scientific explanation is irreducibly normative.

In actual scientific reasoning, explanations are evaluated as better or worse, deeper or shallower, unified or fragmented. Competing theories may be empirically equivalent while differing substantially in their explanatory virtues. Scientists routinely prefer explanations that exhibit simplicity rather than excessive complication, coherence rather than patchwork adjustment, unification rather than disjointed enumeration, and depth rather than surface correlation. These preferences are not optional aesthetic embellishments added after empirical adequacy has been secured. They function as criteria for what counts as explanation at all.

This normativity is evident across the sciences, despite significant variation in method and evidential practice. Cosmology relies on large-scale theoretical coherence and indirect observational constraints; evolutionary biology combines historical inference with population-level modelling; experimental physics depends upon controlled intervention and replication. There is no single scientific method governing all inquiry. What unites these diverse practices is not methodological uniformity but a shared dependence on intelligibility. Scientific inquiry proceeds in the expectation that phenomena will exhibit structured relations that can be articulated, assessed, and compared as explanations.

Importantly, these evaluative standards cannot be reduced to empirical findings. No experiment demonstrates that simplicity is preferable to complexity or that unified explanations are superior to disunited ones. Nor can such standards be derived straightforwardly from predictive success alone. A model may yield accurate predictions while remaining explanatorily unsatisfying — overfitted, ad hoc, or lacking unifying insight. Scientific judgment therefore operates within a space of reasons as well as a space of causes. Explanation involves not only describing what happens but understanding why it happens in a way that renders the phenomenon intelligible.

It may be objected that explanatory norms are merely human inventions— useful conventions developed to manage complex data rather than reflections of anything about reality itself. On this view, norms of simplicity or coherence function pragmatically rather than ontologically: they guide inquiry without disclosing anything about the structure of the world.

This response, however, fails to account for what it is for a norm to function as a norm. An invented rule that failed systematically to track explanatory success would not acquire authority simply by being adopted. Norms guide judgment only insofar as they answer to standards that transcend individual or collective preference. Treating normativity as mere convention therefore undermines the very distinction between better and worse explanation that scientific practice presupposes.

More fundamentally, if the authority of explanatory norms derives solely from human endorsement, a regress emerges. One must appeal to further norms governing which endorsements count as authoritative, and so on. Unless normativity "grounds out" in something independent of stipulation, the idea of norm-guided inquiry collapses into arbitrariness. To count something as a norm is already to acknowledge a standard that is not reducible to the act of counting it as such.

Scientific normativity therefore cannot be fully internal to the mind. Its authority depends upon the fact that these norms successfully track features of the world—features by virtue of which some explanations genuinely disclose how things are, while others do not. This does not imply that norms are infallible or immune to revision. Scientific history is replete with discarded standards and revised ideals. But revision itself presupposes a distinction between better and worse norms, a distinction that cannot be sustained without reference to reality itself.

The persistence and indispensability of explanatory norms thus point beyond methodology to ontology. If scientific explanation genuinely succeeds in revealing the structure of the world, then the norms governing explanation cannot be wholly detached from the structure of what is explained. Coherence, unity, proportionality, and explanatory depth must correspond—however imperfectly— to features of reality that make intelligibility possible in the first place.

This conclusion does not impose a single metaphysical framework upon science, nor does it deny the historical contingency of scientific practice. It recognizes instead that scientific explanation presupposes an ordered reality capable of being understood. The question that follows is not yet theological but metaphysical: What must reality be like for norms of explanation to have the authority they demonstrably possess within scientific practice? Addressing that question is the task of the sections that follow.

Intelligibility and the Framing of the Science–Religion Debate

Much contemporary discussion of the relationship between science and religion is organized around a set of familiar models: conflict, independence, dialogue, complementarity, integration, or more recent "complexity" approaches. These frameworks differ significantly in motivation and conclusion, yet they share a common methodological assumption. Scientific explanation is treated as delivering a determinate and intelligible account of the physical world, and the task is then to determine how theological claims might be related to that account—whether by accommodation, reinterpretation, supplementation, or principled separation. Even where such typologies function mainly as foils or teaching heuristics, they still reflect a widespread tendency to treat scientific intelligibility as a settled starting point.

This shared starting point is often not thematized explicitly within science–religion discussions. Even approaches designed to resist scientism typically accept the intelligibility of the scientific picture as given rather than address the conditions under which such intelligibility is possible. Science is often assumed to disclose a world already structured for explanation, law-governed description, and rational assessment. The debate, accordingly, turns on how religion may be positioned with respect to this picture: whether it offers a competing explanation, a complementary perspective, a non-overlapping domain of meaning, or it is pointed out that a broader metaphysical horizon is logically required within which scientific accounts may be situated.

From this perspective, it may seem puzzling to insist that the science–religion debate is tacitly organized around an ontology of the scientific "given." After all, many contemporary models explicitly affirm both the reality of the physical world as described by science and the reality of the divine. They do not deny God; they simply deny that God is required to explain or ground scientific ontology. The task, as they see it, is not to justify science metaphysically but to show that scientific explanation and theological belief are mutually coherent.

The present argument does not deny the legitimacy of this aim. Nor does it suggest that such models are conceptually confused or historically naive. The concern is subtler. Even where theological reality is affirmed in principle, the intelligibility presupposed by scientific explanation is typically treated as ontologically unproblematic. The world's susceptibility to lawlike description, mathematical articulation, and rational evaluation is assumed rather than examined. Theology is then invited to take its place alongside an already intelligible picture of reality rather than be understood as a response to the deeper conditions that make such a picture possible at all.

This assumption shapes the space within which the debate is conducted. When scientific intelligibility is treated as brute or self-explanatory, theological reflection is inevitably positioned as secondary—whether as an interpretive gloss, an existential supplement, or a metaphysical add-on. Even models that emphasize dialogue or integration tend to presuppose that the order disclosed by science requires no further ontological account. The question becomes how theology can be made compatible with science rather than whether the intelligible order science presupposes is itself metaphysically complete.

What the present argument challenges is not the legitimacy of existing models but the point at which they begin. It asks whether debates about divine action, causality, or naturalism already presuppose an answer to a deeper question: What must reality be like for scientific explanation to be possible in the first place? To raise this question is not to deny the reality of the physical world, nor to dispute the success of scientific inquiry. It is to note that scientific explanation operates within a framework of intelligibility that is not itself generated by scientific methods.

This reframing is particularly important in light of historical work that has emphasized the contingency and plurality of both "science" and "religion." Scholars such as Peter Harrison have shown that many modern disputes arise from treating these categories as timeless and monolithic rather than as historically situated practices with diverse aims and methods. Recognizing this plurality strengthens rather than weakens the present argument. If there is no single scientific method, then what unifies scientific inquiry cannot be methodological uniformity. It must instead lie at a deeper level: in the shared expectation that reality is ordered, intelligible, and responsive to rational investigation.

At this point, an objection naturally arises. Is the claim that the world is intelligible not simply another way of expressing the traditional theological view that God created an ordered world? If so, does the present argument add anything of substance to long-standing discussions in the science–religion literature, or does it merely redescribe familiar commitments in philosophical language?

This objection is understandable, but it misconstrues the direction of the argument. Traditional theological accounts of creation typically begin with divine agency and proceed to the world. The present argument proceeds in the opposite direction. It begins with scientific practice as it actually operates—with its reliance on explanatory norms, evaluative judgment, and intelligible structure— and asks what must be true of reality for such practice to be possible at all. Theology, where it enters, does so not as a premise but as a possible response to the world's intelligibility.

The distinction matters. To say that the world is intelligible because God created it is a theological claim. To say that scientific explanation presupposes intelligibility is a philosophical observation about scientific practice. The present argument does not collapse the former into the latter. It argues instead that once intelligibility is recognized as ontologically significant, the metaphysical space within which theology might operate is altered. Theology no longer appears as an external addition to an otherwise complete scientific picture but as one possible way of interpreting a feature of reality that science itself presupposes but does not explain.

This reframing does not settle disputes about divine action, teleology, or naturalism. Nor does it render existing models obsolete. What it does is clarify what those debates already assume. They presuppose a world that is structured for understanding, evaluation, and explanation. By making that presupposition explicit, the present argument shifts attention from the negotiation of boundaries between science and religion to the deeper ontological conditions that make such negotiation intelligible in the first place. In doing so, it suggests that the science–religion debate is not exhausted by questions of compatibility or conflict. It is also a debate—often unacknowledged—about the nature of intelligibility itself. Whether that intelligibility is ultimately self-explanatory, brute, or reflective of a

deeper order remains an open question. But it is a question that must be faced if the debate is to engage the foundations of scientific explanation rather than merely its consequences.

Intelligibility, Explanation, and the Limits of Ontological Closure

At this point, the argument has established two claims that are modest in scope but significant in implication. First, scientific explanation is irreducibly normative: it operates under standards of coherence, simplicity, unity, and explanatory adequacy that cannot themselves be derived from empirical investigation alone. Second, these norms are not merely subjective preferences or pragmatic conventions but are operative in the very intelligibility of the world that scientific inquiry encounters. What remains to be clarified is what follows from these claims—and, just as importantly, what does not.

A common response at this stage is to suggest that nothing metaphysically substantive has yet been shown. Scientific explanation, it may be conceded, presupposes intelligibility; but why should this be regarded as anything more than a brute feature of the universe? Perhaps the world simply happens to be intelligible, and scientific practice exploits this fact without requiring any deeper account. On this view, intelligibility marks the endpoint of explanation rather than a phenomenon in need of further understanding.

This response is initially attractive precisely because of its apparent restraint. It refuses speculative excess and avoids theological overreach. Yet it comes at a philosophical cost that is easily overlooked. To treat intelligibility as brute is not merely to decline further explanation; it is to assert that one of the most pervasive and structurally significant features of reality—the fact that it can be understood at all—admits of no account beyond sheer happenstance.

The difficulty here is not that brute facts are incoherent. Any explanatory scheme must eventually come to rest somewhere. The difficulty is that intelligibility is not a local or incidental feature of the world. It is a global condition of inquiry. Scientific explanation does not occasionally presuppose intelligibility; it presupposes it everywhere and always. To declare intelligibility exempt from explanation is therefore not to accept a modest limit but to draw a boundary around the very possibility of explanation itself.

This becomes clearer when we recall what intelligibility involves. Scientific understanding depends upon the existence of stable patterns, lawlike regularities, modal relations, and mathematically expressible constraints that support counterfactual reasoning and theoretical unification. These are not superficial features layered atop a more basic reality; they are what make the distinction between explanation and mere description possible at all. A world lacking such structure would not be one in which science merely fails—it would be one in which inquiry, prediction, and rational assessment could not even begin.

Importantly, acknowledging this does not require positing a single unified "scientific method" or imposing uniform standards across diverse disciplines. Cosmology, evolutionary biology, and the historical sciences differ significantly in their evidential bases and inferential strategies. What unites them is not methodology but ontological expectation: the expectation that reality is ordered in ways that invite understanding. Scientific practice proceeds on the assumption that phenomena are not arbitrary but constrained by relations that can be discovered, articulated, and evaluated as better or worse explanations.

At this point, an evolutionary response is often invoked. Human cognitive capacities, it may be argued, have been shaped by natural selection to detect patterns conducive to survival. The apparent fit between mind and world is therefore unsurprising: organisms that failed to respond effectively to regularities in their environment did not persist. On this account, intelligibility is not a feature of the world itself but a by-product of adaptive cognition.

This explanation, however, addresses a different question. It may help to explain why creatures like us expect order, but it does not explain why the world exhibits order of the kind that sustains theoretical understanding rather than merely practical navigation. Survival requires sensitivity to regularities sufficient for action; it does not require sensitivity to deep mathematical structure, unifying laws, or explanatory elegance. The success of abstract theoretical science—particularly in domains far removed from ordinary human environments—exceeds what evolutionary utility alone can plausibly account for.

More importantly, evolutionary explanations presuppose the very intelligibility they are invoked to explain. Natural selection operates only against a background of stable regularities, lawlike behavior, and reproducible relations. To appeal to evolution as an explanation for our cognitive access to order is therefore already to assume that the world is ordered in ways that make such explanations possible. The appeal is not viciously circular, but it is explanatorily incomplete. It relocates the problem without resolving it.

The deeper issue, then, is not whether intelligibility can be accommodated within a naturalistic framework but whether it can be rendered ontologically self-explanatory. Scientific explanation excels at describing how entities behave within the world. What it does not do—and is not designed to do—is account for the structured order that makes such description possible in the first place. To insist that intelligibility requires no explanation is therefore not a conclusion delivered by science but a metaphysical stipulation imposed upon it.

This brings into view the notion of ontological closure. A metaphysically closed account aims to explain all features of reality in terms of resources internal to a given explanatory framework. The argument developed here suggests that scientific explanation, for all its power, does not achieve such

closure. It presupposes an intelligible order that it does not itself generate, justify, or exhaust. This is not a defect in science but a reflection of its scope.

Recognizing this point does not diminish the authority of scientific explanation. On the contrary, it clarifies why scientific explanation has the authority it does. Science succeeds because the world is the kind of thing that can be understood, not because understanding is imposed upon it from without. To acknowledge this is already to move beyond a narrowly physicalist ontology, even if no theological conclusions have yet been drawn.

At the same time, it is important to resist a premature slide into apologetics. The claim that intelligibility cannot be absorbed into a closed naturalistic ontology does not entail that theology provides the correct account of reality. What it establishes is a conceptual openness: a recognition that the intelligible order presupposed by scientific explanation is not metaphysically neutral. It calls for interpretation rather than dismissal.

Seen in this light, the familiar debates of science and religion appear in a different register. Questions about divine action, teleology, or creation are not attempts to insert theology into a completed scientific picture. Rather, they arise against the background of a world whose very describability already exceeds what scientific explanation can account for on its own terms. The issue is not whether science needs theology to function—it manifestly does not—but whether the intelligible order science presupposes is itself sufficient as an ultimate account of reality.

This reframing sets the stage for the next step of the argument. If intelligibility is neither a projection of the mind nor a brute feature of an otherwise indifferent world, then it must be understood as a real aspect of the world's constitution. Reality must be the kind of thing that can be known, not merely encountered. What remains to be asked is how such intelligibility is best understood—and whether it invites, without compelling, a teleological or intentional interpretation of the order that scientific inquiry discloses.

Intelligibility, Artefacts, and the Invitation to Teleology

If intelligibility is a real feature of the world rather than a projection of human cognition or a brute fact, then a further question naturally arises: What kind of reality is this? Importantly, this question does not yet concern theology in any doctrinal sense. It concerns the form of explanation appropriate to a world whose order is not merely observed but intelligible through and through.

One way of clarifying this issue is by appeal to the notion of an artefact. Artefacts are not distinguished from natural objects by their material composition but by the way their structure is organized. An artefact is intelligible as such because its features cohere under constraint: its parts are proportioned, ordered, and related in ways that make sense in light of an activity of making. What marks out an artefact is not that it violates physical laws but that its form is best understood in relation to purpose rather than mere aggregation.

This analogy must be handled carefully. To describe the world as artefact-like is not to claim that it is literally an artefact, nor to infer a maker by direct analogy. The point is epistemic rather than theological. Artefacts provide a familiar case in which intelligibility, normativity, and explanation converge without reduction. They show us what it is like for something to be intelligible because of how it is structured rather than merely describable after the fact.

This point is reinforced by considering forms of biological construction that resist a sharp conceptual division between nature and artefact. Structures such as beaver dams, spider webs, or the communicative dances of bees are neither externally imposed artefacts nor merely accidental byproducts of physical processes. They are instances of organized construction that emerge from within biological systems themselves, oriented toward functional ends such as shelter, stability, or information transfer. Such cases illustrate that intelligible organization need not originate in external design in order to be genuinely purposive or norm-governed. Rather, they point to a world in which biological agents are able to respond to, exploit, and contribute to intelligible structure because reality itself is hospitable to such organization. The relevance of these examples lies not in blurring the distinction between artefact and nature but in showing that the conditions for intelligible construction are already operative within natural systems.

Consider the often-cited example of prehistoric cave paintings, such as those at Lascaux. These markings were immediately recognized as the product of intentional activity, despite their antiquity and the absence of any knowledge about their makers. Nothing about the paintings forces the conclusion of intentional authorship by deductive necessity. Yet the suggestion that they arose through blind physical processes alone is not a serious contender. Their intelligibility—the way their form hangs together as expressive, constrained, and purposive—invites a particular kind of explanation.

The significance of this example lies not in its theological implications but in the structure of recognition it exhibits. Recognition of intentional organization does not proceed by identifying a gap in causal explanation, nor by calculating improbabilities. It arises from the way form, coherence, and constraint jointly present themselves as meaningful. The explanation offered does not compete with a physical account of pigments, surfaces, or processes of deposition; it operates at a different explanatory level altogether.

This distinction is crucial for understanding how teleological interpretation may arise without competing with scientific explanation. Teleological accounts do not describe how events occur; they address why structures take the form they do. They concern orientation, organization, and purposiveness rather than efficient causation. To recognize a teleological dimension is therefore not to displace scientific explanation but to situate it within a broader account of intelligible order.

Much of the science–religion literature implicitly assumes that theological interpretation must compete with scientific explanation, either by supplementing it where it falls short or by offering an alternative causal account. On this assumption, the debate is framed in terms of intervention, concurrence, or causal overlap. The artefact analogy suggests a different register entirely. Scientific explanations describe how phenomena arise within an ordered world; teleological explanations concern the kind of order that world exhibits in the first place.

Seen in this light, the claim that intelligibility is an ontological feature of reality does not amount to a covert reassertion of traditional creationist doctrine. It does not say, "God must exist because science cannot explain X." Rather, it says that the very success of scientific explanation presupposes a world whose order is not exhausted by causal description. That presupposition neither proves nor entails divine intentionality, but it renders such intentionality conceptually coherent rather than extraneous.

This point bears directly on familiar models within the science–religion debate. Approaches such as conflict, non-overlapping magisteria, or various forms of complementarity all assume— often tacitly—that science delivers a complete account of the world's basic intelligibility, to which theology must then be related. The present argument challenges not the legitimacy of these models as classificatory tools but the assumption that the scientific picture is ontologically self-sufficient.

If intelligibility itself requires metaphysical articulation, then theology does not enter the discussion as an external supplement. Instead, it appears as one possible way—among others—of making sense of a world whose order is already laden with normativity, meaning, and orientation toward understanding. The invitation to teleology arises not from ignorance but from insight.

At this point an objection is likely. Is this not simply a restatement of the traditional claim that God created an ordered world, now expressed in the language of intelligibility and explanation? If so, what has really been gained?

The answer lies in the direction of the argument. Traditional theological claims about creation often begin with God and proceed to the world. The present argument begins with the world as encountered in scientific practice and asks what must be true of reality for that encounter to be possible. The movement is not from doctrine to data but from intelligibility to metaphysics.

Theology, where it enters, does so as a response to the world's structure rather than as an imposed framework.

This distinction matters. It shows why recognizing intelligibility as ontologically significant does not collapse into apologetics. The claim is not that the world must have been created by a divine mind but that the world's intelligible order is more naturally at home within a metaphysical picture that allows for intentionality, purpose, or mindedness at the level of being itself.

Whether one takes that step is a further question—one that lies beyond the scope of scientific explanation, but not beyond rational reflection.

In this sense, the artefact analogy does not close the argument; it opens it. It marks a transition from the analysis of explanation to the exploration of metaphysical possibility. What follows is not a deduction but an invitation: to reconsider how the achievements of science sit within a broader account of reality, and to ask whether the intelligibility they presuppose is best understood as accidental, brute, or expressive of a deeper order.

Conclusion: Intelligibility and the Reframing of a Familiar Debate

The argument of this article has been intentionally indirect. Rather than intervening in particular disputes within the science–religion literature—e.g., concerning divine action, causal closure, or the limits of naturalism—it has sought to clarify the metaphysical background against which such disputes arise. The central claim has been that scientific explanation presupposes an intelligible order that is not itself generated or exhausted by scientific method, and that recognizing this presupposition alters how the relation between science and religion is best understood.

Scientific inquiry succeeds not merely because it uncovers causal regularities but because it operates within a framework of intelligibility that supports explanation, evaluation, and understanding. Norms of coherence, simplicity, unity, and explanatory depth are not optional embellishments added to empirical adequacy; they are constitutive of what it is for something to count as an explanation at all. These norms in turn depend upon the world being ordered in ways that make rational articulation possible. To acknowledge this is not to diminish science but to take its achievements seriously enough to reflect on their conditions of possibility.

Seen from this perspective, many familiar debates in the science–religion discourse appear to begin too late. Questions about whether divine action can occur within a causally closed system or whether theology can be rendered compatible with scientific explanation already presuppose that the physical world is intelligible in a complete and self-contained way. Theology is then invited to find its place alongside an explanatory framework whose intelligibility is treated as unproblematic. What the present argument has sought to show is that this intelligibility itself calls for metaphysical articulation.

This reframing does not invalidate existing models of the science–religion relationship, nor does it render their questions obsolete. Rather, it situates them within a deeper context. Debates about fine-tuning, biological teleology, or divine action are not merely disputes over competing explanations of particular phenomena; they are responses—often implicit—to a world whose order is already norm-governed, structured, and amenable to understanding. By drawing attention to this background, the present argument clarifies what such debates already assume, even when they do not explicitly acknowledge it.

Importantly, this clarification does not amount to a covert defense of theology against science, nor does it entail a rejection of naturalistic explanation. The claim is not that scientific inquiry requires theological supplementation in order to function. Science plainly does not. The claim is rather that the intelligible order within which science operates is not itself explained by scientific description alone. To treat that order as brute or self-explanatory is a metaphysical choice, not a conclusion delivered by scientific practice.

Fore fronting this point opens a conceptual space without dictating how it must be filled. Theism is not inferred from intelligibility by logical necessity, but it possesses resources for interpreting intelligibility as an intrinsic feature of reality rather than an unexplained residue. Naturalism, by contrast, can accommodate intelligibility only by treating it as primitive, emergent, or pragmatically imposed, and thus faces a question of explanatory adequacy. The argument advanced here does not adjudicate between these positions, but it clarifies what is at stake in doing so.

In this sense, the enduring value of the science–religion dialogue may lie not merely in coordinating different descriptions of the same reality but in attending to the deeper conditions that make any such descriptions possible at all. The argument advanced here is not that science and theology offer complementary "lenses" on a world whose intelligibility is already secure—as in familiar illustrations that distinguish physical explanation from intentional description (for example, John Lennox's oft-cited analogy of making a cup of tea)—but that both presuppose an intelligible order that neither can finally explain on its own terms. To take intelligibility seriously, therefore, is not simply to affirm plural perspectives but to allow that the very possibility of explanation, meaning, and rational disagreement rests upon a metaphysical background that precedes the familiar division between scientific and theological accounts.

Notes

[1] Kant, I. (1998 [1781/1787]) *Critique of Pure Reason*. Cambridge: Cambridge University Press; Stern, R. (2000) *Transcendental Arguments and Scepticism*. Oxford: Oxford University Press. The present argument differs from such approaches in that it does not begin from the conditions of knowledge or experience, but from the conditions under which there can be anything like a world available to meaningful articulation and dispute at all.

[2] For related developments, see also Richard Schaeffler (1992). The present proposal does not attempt a transcendental grounding of theological doctrine but rather addresses the more basic question of the conditions under which both scientific and theological claims are intelligible as claims.

[3] For recent discussions of biological teleology that resist both reductive mechanism and appeals to external design, see Michael A. Flannery (2020), and Mikael Leidenhag (2021). Both authors argue that contemporary biological explanation legitimately employs notions of functional organization, regulation, and purposiveness without invoking interventionist design. The present argument is not concerned with adjudicating these accounts but with the deeper intelligibility conditions that make such teleological descriptions meaningful and nonarbitrary in the first place. For an influential naturalistic attempt to reconstruct purposive organization in dynamical and energetic terms, see Terrence W. Deacon (2012). New questions of course might be opened concerning the level of intelligibility and the reductive and external design debate.

Competing Interests

The author declares that they have no competing interests.

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Exploring the Potential for Strengthening Faith–Science Dialogue: Design and Implementation of Deliberations with Anglican Bishops

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Engagement between science and society to address complex issues is a priority. In 2022, a gathering of 650 Anglican bishops supported a call for greater dialogue with science. This research reports on the implementation of a deliberation tool that supports bishops in responding to this call. A transdisciplinary approach engaged bishops as co-researchers in deliberation, drawing on appreciative inquiry. Thirty-six bishops from Africa, Oceania, and the Caribbean participated in three-day regional deliberations in 2023/24. Textual data were collected via participant and scribe notes. The deliberations enabled bishops to consider perspectives on science and science–faith interactions. Existing interactions were recognized, with most relating to human and planetary justice. Bishops identified the need for inclusion of local and Indigenous knowledge in science–faith dialogue; challenges of trust and inclusivity; and the value of institutional relationships and peer-to-peer deliberation. The process encouraged deep consideration of interactions, leading to actionable recommendations. These findings offer insights for furthering dialogue between science and key societal stakeholders.

Introduction

The past century has witnessed rapid change associated with scientific and technological advances. Although benefits have emerged, social adaptation has been insufficient to keep pace with the complexity of change, likely contributing to the erosion of social cohesion (Alemayehu Tegegn 2024). Challenges such as the climate crisis, social justice, and the application of emerging technologies are wicked problems, characterized by incomplete and sometimes contradictory information embedded within complex systems that engage diverse stakeholders (Lawrence et al. 2022). Addressing such challenges requires input beyond science. However, as reflected in the Sustainable Development Goals, implementation remains difficult (United Nations Department of Economic and Social Affairs 2025). Decisions regarding the application of science within society are embedded in social, Indigenous, cultural, ecological, and political systems (Fernández-Llamazares et al. 2021; Jenkins and Chapple 2011). Fostering greater dialogue between scientific and non-scientific stakeholders to enable the trusted co-creation of knowledge-based actions addressing complex issues is a recognized global priority, as reflected in United Nation's 2030 Agenda's SDG 17 regarding multistakeholder partnerships (Goransson 2021) and the UNESCO/IPBES frameworks for knowledge co-production (Díaz et al. 2015; Tengö et al. 2017).

Faith-based communities are significant stakeholders involved in communicating and promoting the application of science alongside theology for social and planetary justice (Bomberg and Hague 2018; Hodgetts et al. 2014). Our work draws on the example of the Anglican Communion. This global Christian network comprises forty-two geographically organized member churches (also called Provinces) and five other national or local churches known as Extra Provincials. The Communion is a place of belonging for more than eighty-five million people across 165 countries, where provinces are organized into dioceses and parishes (Anglican Communion Office 2026). While member churches within the Communion operate autonomously, they also work together, locally and internationally, to address complex challenges. This focus on engagement in societal action was visible at the 2022 Lambeth Conference, a ten-yearly meeting of Anglican bishops to discuss church and world affairs and the decade ahead. In 2022, the Lambeth Conference was organised around ten themes called Lambeth Calls. Four of these calls—Reconciliation, Human Dignity, Environment and Sustainable Development, and Science and Faith—reflected engagement between the Communion and issues of human and planetary justice that draw on knowledge from science, society, and theology (Lambeth Conference 2022a).

This article focuses on one response to the Lambeth Call "Science and Faith," which encourages Anglicans to engage in theological dialogue with science (Lambeth Conference 2023). The Call builds on existing work across the Communion related to ethics, the application of science, and engaging with

science to progress issues associated with sustainability and social justice. For example, Anglicanism's history of environmental engagement has promoted dialogue that incorporates perspectives from faith, science, and local and Indigenous knowledge in developing sustainable actions (Anglican Communion Office 2025a, 2025b; Green Anglicans 2020, 2025).

Cultivating Connections

Decisions regarding the application of knowledge are influenced by collective and individual factors associated with sociocultural context, familiarity with diverse knowledge and epistemologies, ways of being and knowing, and values. Science and religion are cultural authorities, variably acknowledged across different contexts as sources of credible knowledge and values that guide decision-making (O'Brien and Noy 2018). Religious and scientific institutions and their leaders operate within sociocultural systems, each possessing the potential to influence the framing of science and/or religion in decision-making (Ives and Kidwell 2019). Trust in science or religion is influenced by exposure to and trust in the leaders of each knowledge system, as well as intermediaries who engage across systems (O'Brien and Noy 2018; Younger-Khan, Weidmann, and Oswald 2024). Engagement of Anglican churches in applying science alongside faith and local and Indigenous knowledge for complex decisions demonstrates a perspective that science and faith can collaborate while still recognizing differences and maintaining each system's integrity. Seen similarly in the work of entities such as the Pontifical Academy of Sciences (n.d.) and the Yale Forum on Religion and Ecology (2025), this approach fosters connections between science and religion. It is via such connections that social conversations around science evolve, moving engagement beyond information transfer and offering the potential for the co-creation of actions (Bucchi and Trench 2021). This focus on connectivity contrasts with the perspectives of science and religion as competing or conflicting philosophies that have previously dominated across various scientific and religious contexts (Catto et al. 2019; Perry and Leidenhag 2023). The active engagement of Anglicans across diverse cultural contexts in utilizing knowledge from science and faith to address complex social issues suggests that the potential to cultivate stronger connections between science and faith within the Communion may be significant.

The Lambeth Call: Science and Faith

The Anglican Communion Science Commission was established before the 2022 Lambeth Conference to promote collaboration between faith and science communities (Anglican Communion Office 2024). The draft Call and accompanying study guide were circulated for use in pre-conference online discussions (Lambeth Conference 2022a, 2022b). During the Lambeth Conference, the 650 attending bishops discussed the proposed Call in small cross-cultural groups and offered

feedback. This was incorporated into the final document, a key section of which states: "We call on all Anglicans as they participate in mission to enter into theological dialogue with science, establishing how it is understood in different regions of the Communion, recognizing within it God-given resources for the life of faith and offering the wisdom of Anglican theological method (from Scripture, reason and tradition) to its work especially to the ethics of its use and unequal impacts across the world" (Lambeth Conference 2023, 21).

Dialogue: Exploring Frames of Reference

Dialogue is a culturally embedded relational process wherein meaning is explored through listening and speaking, enabling the potential for collective thinking to transpire, including considering and incorporating diverse perspectives into actions (Escobar 2011; Kirsch 2021). Interpretation of the nature and purpose of dialogue between theology and science has varied throughout history (Perry and Leidenhag 2023). While notions of conflict and integration have been narratives within this history, more recent thinking promotes dialogue for reciprocal interactions (Mortensen 2002). This perspective recognizes that a common pursuit of human flourishing can be advanced by engaging in dialogue across knowledge systems while maintaining the integrity of each system (O'Malley 2021).

The established practice in many parts of the Anglican Church of engagement between science, faith, and local and Indigenous knowledges to co-design transdisciplinary actions suggests that the purpose of the Science and Faith Call is not to initiate something new but to build on a culture of existing interaction. Therefore, Appreciative Inquiry, a process that seeks to facilitate development by focusing dialogue-based inquiry on a system's strengths, possibilities, and successes (Grieten et al. 2018) is useful in this context. This approach encourages a positive perspective on development choices, thereby increasing the likelihood of experimentation with "what can be," leading to the co-construction of positively framed options for action (Stavros, Godwin, and Cooperrider 2015).

Exploration of "what is occurring" is more challenging than it may appear. Existing understandings and practices reflect deeply embedded frames of reference that are often taken for granted. Frames of reference reflect worldviews based on assumptions and expectations involving values, beliefs, and concepts (Dirkx, Mezirow, and Cranton 2006). These form over time through experience and the development of understanding. They are influenced by assumptions about what is and what can be known, and the role of evidence in problem-solving (Mezirow 2011). Science and faith are complex systems of knowledge embedded in societies and, depending on positionality, into the lives of individuals and communities, sometimes as "taken for granted" frames of reference. For dialogue between faith and science to be productive,

participants need to consider what they understand science and faith to be, alongside how these knowledge systems may interact with each other and with contextually relevant local, traditional, and Indigenous knowledge. Mezirow's theory of Transformative Learning proposes that for humans to consider and potentially engage differing viewpoints, they must identify and unpack existing frames of reference to appreciate and consider other perspectives (Mezirow 2011). Through discourse and the sharing of narratives, transformative learning experiences challenge "taken for granted" frames of reference that may be associated with social and cultural norms (Kroth and Cranton 2014b). Often, this process is prompted by a disorienting dilemma, an experience that jolts or challenges thinking, enabling individuals or groups to identify deeply held frames of reference alongside differing perspectives (Kroth and Cranton 2014a).

Dialogue offers an entry point for transformative thinking and learning, particularly when the sharing of narratives supports exploration of deeply embedded and alternative frames of reference (Figure 1). In considering how to approach the development of deeper dialogue between faith and science, we proposed that actors from each knowledge system need opportunities to dialogue within their own system before entering into dialogue between systems.

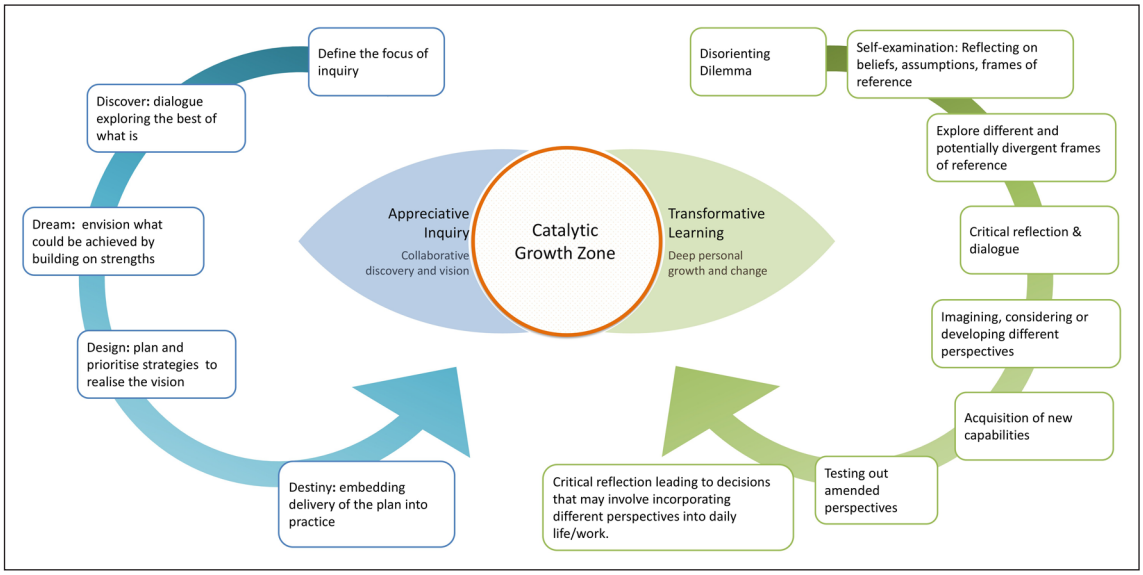


Figure 1: Stages of Appreciative Inquiry and Transformative Learning interacting to catalyze growth.

Strengthening Engagement: Leading Change Starts with Understanding Current Contexts

Within the Anglican Church, bishops will lead actions to progress the Science and Faith Call. Therefore, it is vital that they are provided with opportunities to consider the Call, explore perspectives on science and its interactions with faith, and determine culturally and contextually appropriate strategies to strengthen engagement between faith and science.

The Anglican Thought Leadership in Science Project (ATLAS) was established to facilitate opportunities for bishops to consider the Science and Faith Call and develop contextually relevant recommendations for progressing this Call. We propose that action-oriented deliberation, involving trusted leaders from faith and science, could contribute to strengthening the potential for interactions between understandings from faith and science to meaningfully progress complex societal challenges and promote human flourishing. However, before this can be tested, we propose that bishops and scientists needed opportunities to explore perspectives on the topic separately prior to engaging together. Our study aimed to identify whether workshops within regional contexts could enable bishops to deliberate on the topic of faith–science interactions as peers, subsequently formulating recommendations about ways to strengthen dialogue between faith and science.

This article reports on the design of the ATLAS deliberation process and its implementation with groups of bishops from Africa, the West Indies, and Oceania. It describes a novel process that integrates multiple qualitative methodologies within the design and considers whether this process was effective in engaging bishops to examine the potential for strengthening dialogue between faith and science. It then presents the main themes identified from the deliberations.

Methods

This transdisciplinary study utilized an innovative participatory approach to design and implement a three-day deliberation workshop focused on exploring faith–science interactions. The design integrated strengths from appreciative inquiry (Reed 2007) and narrative inquiry methodologies (Kim 2016) with understandings from transformative learning (Taylor 2012) and principles and practices from World Café (Löhr, Weinhardt, and Sieber 2020). The resultant process was used to facilitate exploration of perspectives on faith–science interactions by Anglican bishops from Africa, the West Indies, and Oceania. The workshop design created opportunities for participants to consider their own and others' perspectives, reflect on experiences and strengths, contemplate potential, and, via deliberation, reach considered recommendations regarding strengthening dialogue between faith and science.

Consent to Participate

The study was approved by the University of Auckland Human Participants Ethics Committee Ref#2633. All participants provided informed consent (online or written).

Context and Participants

Transdisciplinary research engages academic and nonacademic partners representing multiple areas of expertise in a community of practice to cocreate

scientifically valid, socially relevant, and actionable research (Schmidt et al. 2020). The team comprised individuals with expertise in Anglican and scientific leadership, theology, and natural and social sciences from Africa, Oceania, the West Indies, and the United Kingdom. The coordinating bishop(s) for each workshop extended invitations across their regions. Invitations included costs associated with air travel (where required), meals, and accommodation. A preference for geographic diversity was encouraged. A participant count ranging from nine to twenty was aimed for, thereby facilitating the formation of no fewer than three groups of three and no more than four groups of five. Lead times between invitations and workshops were three months in Africa, seven months in Oceania, and twelve months in the West Indies.

Design: Pilot Testing

A condensed pilot workshop was conducted in April 2023 with clergy from the Diocese of Auckland, New Zealand, to evaluate the proposed deliberation content and format. Eighteen clergy, representing diversity in ministry experience, age, gender, and ethnicity, participated. The five-hour program tested condensed versions of the first four workshop sessions, examined the data collection model, explored interest in the Call's concepts, and sought feedback on content and process. Data collection included individual reflections recorded on sticky notes, group-developed headline themes, and notes taken by scribes at each table. Key learnings informed the design of the three-day workshops that were contextually adapted for use in Africa, Oceania, and the West Indies.

Deliberation Process

The three-day in-person workshops were held in sites that enabled communal living, promoting relationship building and engagement. Participants received an introduction and program overview in advance, including informed consent information. For Oceania and the West Indies, this included an interactive website accessible to bishops and facilitators. These websites contained session information, provided a repository for data images, and created a space for questions and post-workshop discussions. The West Indies website was accompanied by a hard-copy workbook.

Two experienced facilitators, one of whom was local, guided each workshop, maintaining focus and timing. Bishops were organized into tables of three to six people. Each table was supported by a host whose role was to ensure the discussion remained focused and a scribe for notetaking (White 2022). Hosts and scribes were experienced in qualitative research, journalism, or the Anglican Church. In Oceania and the West Indies, all hosts and scribes were local. In Africa, an unplanned change led to four observers from the United Kingdom assuming host (n=3) and scribe (n=1) roles. Training for facilitators, hosts, and scribes included theoretical and practical considerations.

Initiated with a gathering event on the evening of day zero, workshops comprised ten sessions spread across the following three days, with a rest period built into the afternoon of day two (Figure 2).

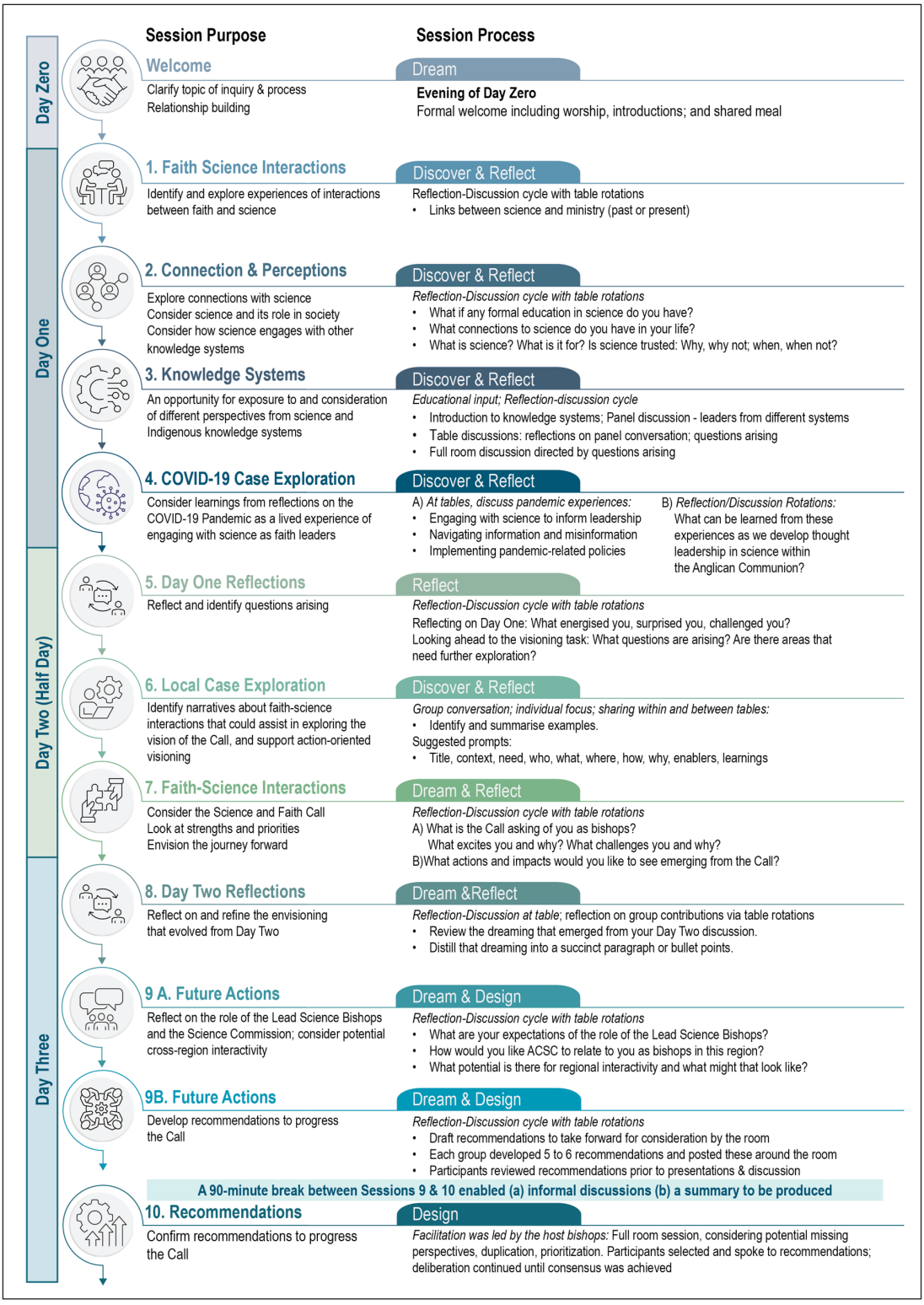


Figure 2: Overview of the deliberation process.

The first six sessions were designed to examine existing experiences and perceptions. Sessions one and two explored experiences of interactions between faith and science, followed by connections with science and perceptions of science's role in society. These sessions were intentionally minimally scripted, exploring existing frames of reference before any educational input about science.

Typical of deliberation design, session three was structured as "educational input." This offered participants the opportunity to consider the concept of knowledge systems, specifically their ontology, epistemology, and how their claims derive legitimacy. Participants also heard from scientists about their perceptions of science and its role in society. Combined, sessions one through three offered the potential to trigger disorienting dilemmas regarding perceptions about science. Pilot feedback (2023) indicated that this session should include perspectives from church and Indigenous leaders in addition to scientists. In Africa, this involved a prerecorded conversation between science leaders, followed by a discussion with church leaders. In Oceania and the West Indies, a panel discussion with leaders from science, church, and Indigenous communities explored the nature of different knowledge systems and their roles in society. Day one concluded with bishops sharing experiences as church leaders during COVID-19, reflecting on engagement with science via a common case example (session four).

Day two began with reflections to identify topics requiring further discussion (session five), followed by the sharing of in-depth exemplars of current faith–science interactions (session six) to conclude the exploration of "what is." The transition from "reflect/discover" to the "dream" phase occurred through an exercise that identified strengths and priorities and envisioned pathways forward (session seven). A half-day rest followed, allowing for personal or informal reflection and conversation.

Day three continued the "dream and design" phase of appreciative inquiry. Initial reflections (session eight) focused on reviewing the envisioning from session seven. Sessions nine and ten focused on developing and refining recommendations to advance the Call.

A structured cycle of reflection-discussion-reflection was used to frame the table-based deliberations and rotations (Figure 3). Sessions commenced with personal reflections on the focus question, recorded on individually coded green sticky notes. Notes were contributed to idea boards (large sheets of paper) on each table. Hosts then facilitated discussions, initiating these via the note-based contributions. After approximately fifteen minutes, the facilitator prompted tables to identify headlines and record these on the idea boards using marker-pens color-coded by group. Approximately five minutes later, groups were instructed to return to personal reflections using individually coded pink sticky notes. Yellow-colored coded notes were available for participants

to record thoughts or questions arising at any time. Following the initial reflection-discussion-reflection cycle, groups rotated, leaving the host and scribe in place. On arrival at a new table, groups reviewed the idea board, and the host initiated a discussion on how this compared to the incoming group's thinking. Groups considered and commented on or added to the existing headlines. Following three rotations, groups returned to their original table to reflect on the perspectives added by other groups to their original thinking and make final adjustments to their boards. The cyclical process of rotations fosters an environment conducive to participant contributions and promotes critical reflection on diverse perspectives (Löhr, Weinhardt, and Sieber 2020). It also aligns with several modes of theological reflection familiar to bishops (Graham 2022).

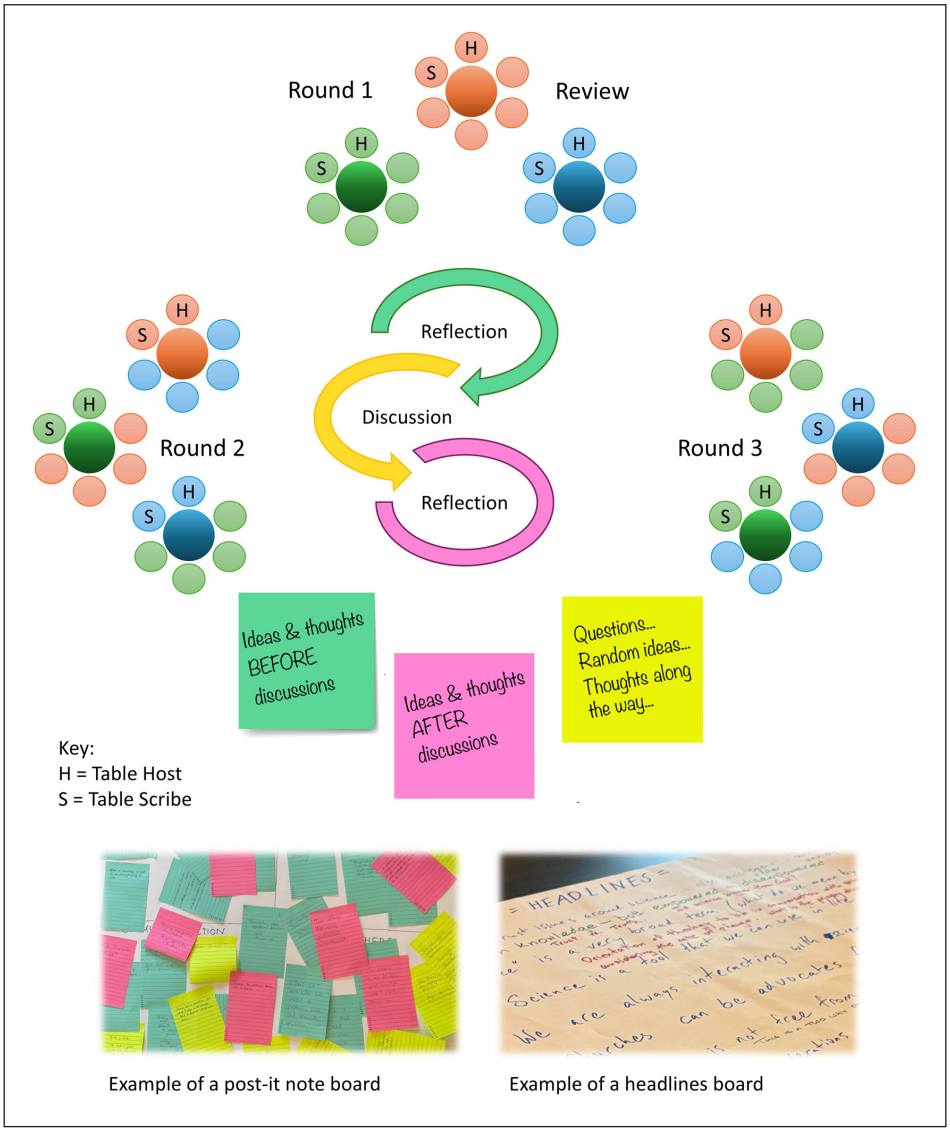


Figure 3: Cycle of reflection, discussion, and review with table rotations, adapted from Brown and Issacs (2005).

Data Collection

Data collection methods included:

- individually coded colored sticky notes collecting pre-(green) and post-(pink) discussion reflections and comments (yellow)
- group-coded idea boards with headlines/themes
- scribe notes from table and whole-room discussions
- additional sources such as meeting notes, facilitator notes, program plans, and reflections or clarifications contributed by participants prior, within, or after the workshops.

Analysis

Idea boards were photographed after each session. Participant notes were reviewed and transcribed, with clarification sought where necessary. Scribe notes were reviewed and confirmed. Template analysis (King and Brooks 2018) was employed to probe the data. This is a flexible style of thematic analysis that utilizes a hierarchical coding template to organize and interpret extensive textual data. Template analysis was chosen as it supports the use of a priori themes to develop an initial coding template, allowing participant-generated themes to be recognized alongside themes informed by the study's research questions and questions that framed the deliberation sessions. After a familiarization and preliminary coding stage by groups of researchers from each geographic region, the initial template was developed on a subset of the overall data. This was iteratively applied to additional data and further modified as required. The final template with higher-order (broad) and lower-order (specific) codes was then used to review and code the full dataset. Within template analysis, there remains the flexibility to modify codes as the analysis proceeds. NVivo 14 was used to support the thematic analysis process by enabling the systematic coding of data, the development of a coding template, and the visualization of patterns across the dataset. The potential for theme conceptualization to be influenced by researcher positionality, including relationship to place and the cultural context of workshops and narratives, is significant (Holmes 2020; Jadallah 2025). Recognizing this, data from each workshop were reviewed and analyzed by groups, including region-specific team members, during the initial and subsequent coding processes. Further, an independent researcher who did not participate in the workshops reviewed and analyzed all data, and a second independent researcher compared the analyses across the groups. Finally, the theme summaries were taken to representative groups of participating bishops for collective sense-making to review themes and reflect on the trustworthiness of the data analysis.

Findings

Participant Characteristics

Thirty-seven bishops from nine provinces and thirty-four dioceses accepted invitations (Figure 4). Of these, one from each of Melanesia and Tanzania

accepted invitations but were unable to attend. An alternative representative attended from Tanzania. Most participating bishops were male, reflecting the gender imbalance of these roles globally. All had undergraduate and most had postgraduate qualifications in theology and/or ministry with ten or more years of leadership experience. From Oceania, four bishops held undergraduate, and a further three postgraduate, science qualifications and related work experience.

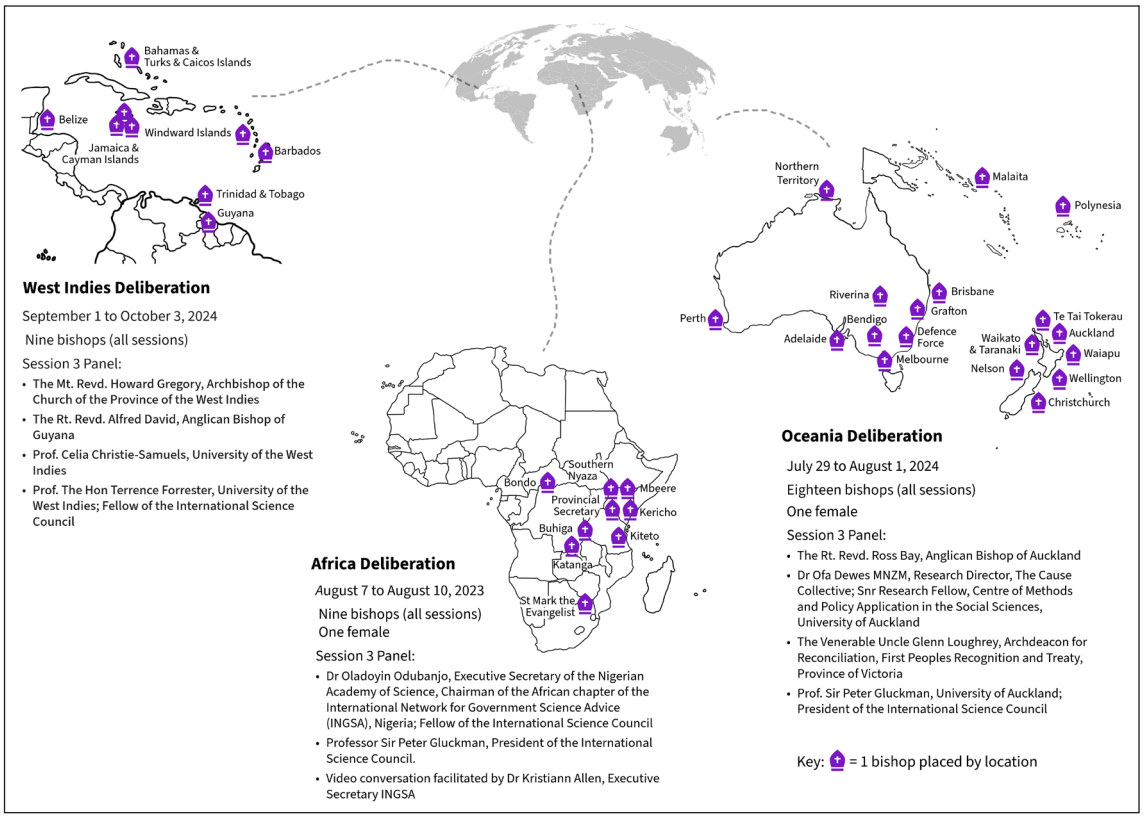


Figure 4: ATLAS deliberation workshops by location showing attendee distribution across each region.

In Africa, two additional groups participated, comprising scientists (n=4) and theologians or clergy (n=5). These participants were clustered as separate groups but interacted with bishops via table rotations and whole-room discussions. Based on recommendations from the 2023 pilot testing and observations during the workshop in Africa, data from these groups have not been utilized in this article. During pilot testing, it was observed that where clergy had postgraduate science training or where scientists joined a table discussion, the flow of conversations altered. Input from nonscience-trained participants reduced, along with the diversity of perspectives and openness to express uncertainty. The 2023 pilot-testing review team noted the importance of bishops being able to deliberate as peers. The exploration of prior experience with science in session two was identified as important for enabling table hosts to manage the potential impacts of a diversity of science-related experience observed during pilot testing. These observations and recommendations

were discussed in regional planning meetings and during table-host training. The recommendation for bishops to deliberate as peers was confirmed by the planning teams in the West Indies and Oceania and identified as important by participating bishops. "What I appreciated most was that we could meet just as bishops to talk about this" (West Indies). "Just having bishops at the table created a safe space for exploration of topics and issues" (Oceania).

Major Themes Emerging from the Deliberations

Six themes emerged across the deliberations examining faith–science interactions and considering recommendations for strengthening dialogue: (1) recognition of existing interactions between faith and science in the context of Anglican churches; (2) the role of engagement between church and scientific communities in addressing complex challenges; (3) the importance of respecting and integrating perspectives from Indigenous, traditional, and local knowledge systems alongside faith and science; (4) the importance of building trust between science and faith; (5) the need for ongoing dialogue to strengthen relationships between church and scientific communities; (6) the importance of fostering holistic and ethically grounded relationships between faith and science that are inclusive of marginalized voices. All quotes reported in the findings represent the voice of participating bishops. As we are reporting on ideas emerging from collective deliberation, we have associated each quote with a region rather than an individual.

Theme 1: Existing Faith–Science Interactions

It is important that overall findings are contextualized within participants lived experiences of faith–science interactions. These were explored in sessions one, four, and six. While variable within and across regions, all bishops identified examples of faith–science interactions pertinent to their ministry. These demonstrated the integration of scientific evidence or perspectives into preaching, pastoral care, leadership, and social action within ministry, with many illustrating contributions to science communication. "The bottom line is that [during the pandemic] the Church and Church leaders were science communicators" (Africa).

Figure 4 provides an overview of reported interactions. Many bishops reflected that these were more extensive than they may have previously realized. Many extend beyond faith and science to include engagement with local, traditional, and Indigenous knowledge, and most link to complex societal issues. The normative nature of such interactions was highlighted by reflections such as this one from a bishop in Oceania on the role of science in society: "[W]e swim in science-background—different worldviews playing in together." However, it was also noted that while science strongly influences societal decision-making, conscious recognition of that influence may vary

and be contextually mediated within the church. In all three regions, there was recognition that for some people, the relationship between faith and science can be challenging. However, it was also noted that the application of reason has always been a strong component in the way Anglicans form their faith in relation to the world. Given the depth and volume of evidence reported from sessions one, four, and six, these data will be explored in detail in further publications.

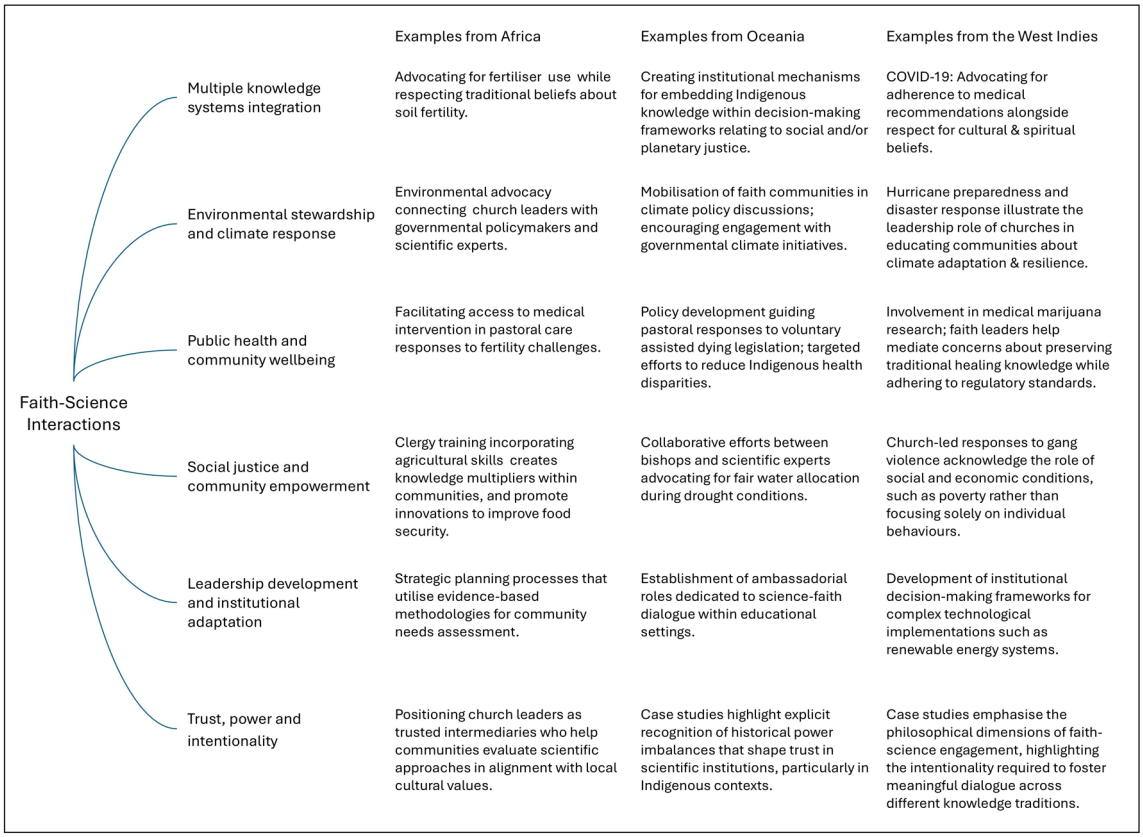


Figure 5: Overview of themes under which existing faith–science interactions were reported during session six, Local Case Explorations.

Theme 2: Faith–Science Interactions and Complex Challenges

Bishops discussed the idea that despite the differences between faith and science, both seek to understand the world and promote human flourishing. They identified motivational connections with elements within the Marks of Mission of the Anglican Communion, such as responding to human need, transforming unjust societal structures, and striving to safeguard the integrity of creation (Anglican Communion Office 2025c). These drivers were reflected in the reported examples of interactions between faith and science. While the range of examples was extensive, most connected to complex challenges linked to social and planetary justice and human flourishing, often with an emphasis on ethics.

Bishops identified that the Anglican Church frequently takes on the role of intermediary in relation to the application of science in complex issues or challenges. COVID-19 was a good example of this, where church leaders found themselves acting as science communicators. "During the pandemic, we were educating about COVID-19 and encouraging the observation of protocols as a way to promote health and safety" (West Indies).

A bishop from Oceania pointed out that developing understanding of a particular challenge from the perspective of science as well as faith was valuable when encouraging community engagement. "Understanding the benefits of why we need to do the research [is important]. The better we can communicate it, and our community leaders can advocate and transfer knowledge to communities."

Bishops also discussed times when this role of intermediary was linked to challenging the use of science where the potential for negative consequences existed for local communities. Interestingly, in all three regions, the application of genetically modified seed crops was used to exemplify this.

Theme 3: Valuing All Knowledge Systems

A recurring theme that accompanied discussions of complex societal challenges was the importance of respecting and integrating perspectives from Indigenous, traditional, and local knowledge systems alongside those from faith and science. This was evident in examples of existing faith–science interactions across the regions. Some examples from Oceania not only integrated Indigenous, traditional, and local knowledge in actions but also advocated for this at structural levels.

Bishops across all regions stressed that meaningful dialogue must consider the cultural, political, and historical contexts in which knowledge is both produced and applied. Understanding these broader influences, they argued, is essential for developing more holistic and inclusive approaches to complex global challenges. "Any dialogue between faith and science will take place within a cultural and political context and therefore must also include the voice of Indigenous and other knowledge systems in order to have effective outcomes" (Oceania).

Bishops acknowledged that Indigenous knowledge, deeply rooted in local ecosystems and cultural traditions, offers valuable insights that can complement contemporary scientific approaches. African bishops highlighted this point with a striking example, underscoring that traditional practices emerging from observational evidence can have strong parallels to scientific evidence. "Indigenous knowledge is also important—science enhances Indigenous knowledge. There are days when people don't fish to give the sea a rest. It's a 'day of rest'–it's also science" (Africa).

The reflection of a bishop from Africa that "Indigenous epistemology integrates faith, science, and traditional knowledge" reinforces the interconnected nature of these different ways of knowing and the importance

of this interaction. "Understanding the interplay between faith, science, and traditional/community knowledge is fundamental for designing Anglican thought leadership in science projects that are culturally sensitive, contextually relevant, and capable of fostering positive change in African communities" (Africa). This was reiterated in recommendations emerging from the West Indies and Oceania that emphasized the importance of developing educational resources that explore the relationship between faith, science, Indigenous, local, and traditional knowledge systems.

Many bishops emphasized that these different knowledge systems or ways of knowing should not be viewed as hierarchical but instead recognized as complementary and mutually enriching. Bishops from the West Indies encouraged this collaborative approach, calling for efforts to "bring all knowledge systems (Indigenous, science, faith) into the same space and into creative interaction with each other." This was reflected in their final recommendations: "Foster dialogue with stakeholders, especially scientists and Indigenous leaders, to enhance appreciation of the role of Indigenous, local, and traditional knowledge systems alongside faith and science for the enhancement of life and the common good" (Recommendation 8, West Indies).

Theme 4: Trust and Communication

The need to build trusted relationships between the church and scientific communities was seen as a key requirement for effective collaboration, particularly in communities where historical experiences such as those related to the introduction of genetically modified seed crops have led to skepticism toward the motivations of some scientific institutions.

Bishops acknowledged that trust is shaped by a complex mix of cultural perceptions, world views, and past experiences (particularly those associated with slavery and colonization), all of which influence how scientific endeavors are received. Discussions emphasized that trust is fostered through active engagement, clear and contextually relevant communication, and respectful listening, acknowledging both differences and shared goals. As bishops from the West Indies expressed, "Challenge: Greater appreciation and understanding of the value of science and faith. Will the dialogue include truth-telling? Will there be reconciliation or greater understanding and more appreciation between the two?" Their comments underscored the importance of honest engagement that does not shy away from historical tensions.

Bishops from Africa pointed out that "[s]ome faith communities do not fully trust science; how would they be made to understand that science complements their ministry and thus needs to work in harmony?" They also acknowledged that "[i]gnorance and down-playing traditional knowledge among local communities hinders trust of science," reinforcing the need for respectful engagement across diverse knowledge systems. The need to understand contextual complexities

when engaging communities was seen as a priority. "Understanding the dynamics between faith, science, and traditional knowledge enables Anglican thought leaders to communicate their ideas and initiatives in ways that resonate with the local population" (Africa).

Bishops in Oceania reflected that across their region, the openness of churches to engagement with science appears to be associated with communities where there is high societal trust in science. They reflected that "[t]rust is critical for such discussions; need time to build trust" and recommended that in communities where advances in science had led to negative or unintended consequences, intentional actions to enable transparency and build trust are required.

Theme 5: Dialogue and Relationship Building

Identification of the importance of ongoing dialogue to strengthen relationships and build trust between church and scientific communities was common to all three deliberations. Bishops identified that when dialogue created the potential to explore differences and synergies, this opened up opportunities for collective actions. They reflected that for dialogue to be effective, it must move beyond silos and create opportunities for meaningful engagement. As bishops from the West Indies stated, "Faith and science must each allow the other to cross over into the other's territory to create a richer and broader discussion." Many saw this kind of cross-fertilization as key to fostering deeper conversations that respect different ways of knowing while still seeking meaning. One bishop from Oceania cautioned, however, "I think we need to be careful that the church doesn't only talk to Christian scientists but we have a genuine dialogue with those outside of the church, otherwise we are just talking to ourselves." Bishops from Africa echoed the importance of this approach, noting that "[t]his understanding can help bridge potential gaps in comprehension and create a more meaningful dialogue around science and faith." Their comments reinforced the idea that developing a shared understanding of different perspectives is critical for productive dialogue and, eventually, progressive collective action.

Reflecting on lessons from COVID-19, bishops emphasized the importance of having long-term institutional relationships rather than relying on personal connections. This is reflected in Recommendation 2A from Oceania: "Address the opportunities and challenges associated with dialogue arising from individual contacts and thus develop sustainable institutional relationships."

The idea of structured networks was also raised frequently. Bishops from Africa suggested the establishment of regional panels of experts to help build up interactions between faith and science. This sat alongside a recommendation for resourcing that could "equip church leaders with the knowledge and tools necessary to discuss and promote faith *and* science" (Recommendation 6, Africa).

Bishops across all three regions recommended that connections be multigenerational, seeing this as key to ensuring partnerships could evolve over time, withstand leadership changes, and remain effective in responding to new challenges. The need for wide-reaching resources supporting the exploration of interactions between knowledge systems to foster dialogue and relationship building was evident. In addition to confirmation of the need for multigenerational reach, bishops emphasized the need for reach to include "parishes and grass-roots ministry, schools, theological colleges, and academic institutions, inclusive of but not limited to sciences and humanities" (Oceania). The emphasis of this resourcing was focused on supporting the exploration of the nature of different knowledge systems to foster "dialogue that promotes engagement across knowledge systems" (West Indies). Bishops in Oceania noted that this should involve "encouraging robust epistemological awareness that supports development of understanding of the nature of science and other ways of knowing" (Oceania).

Theme 6: Inclusivity

Beyond the sociocultural, political, and geographic diversity within and between the three regions engaged in this study sits a collective understanding of the impacts of colonization histories (past and present) on the communities in which the participating bishops live and work. This was reflected on multiple occasions during the deliberations, where the need for the application of decolonial constructs in advancing work associated with the Call was emphasized. "Beware of the ways in which things like the Call can look like another form of colonization, e.g., in the supremacy of frameworks. Language can convey an invitation to participate/collaborate or an imposition of certain ways of thinking/framing things. Genuine co-design, not colonization is important" (Oceania).

Associated with this was an acknowledgment of the importance of fostering holistic and ethically grounded relationships between faith and science that are inclusive of marginalized voices. Bishops stressed that leadership should reflect the lived experiences of those most affected by global challenges and that codesign with communities in which actions are intended is essential.

Additionally, discussions associated with inclusivity identified the need to engage marginalized and easily forgotten voices within society, multigenerational perspectives, viewpoints that cross language divides, and perspectives from faith traditions beyond Anglicanism and Christianity.

Discussion

We have examined the themes emerging from deliberations by bishops in Africa, Oceania, and the West Indies, exploring the potential for strengthening dialogue between faith and science.

Thirty-six bishops engaged in the deliberation workshops, not as research subjects but as collaborative research partners with the power to shape, interpret, and act upon the knowledge generated through the deliberative processes (Cunningham and Muyomba-Tamale 2022). The framing of participants as research partners recognizes expertise and enables the coproduction of knowledge (Smith and McGannon 2024). This contributes towards addressing power imbalances in research, recognizes the need to address the colonization of knowledge production, and aligns with the commitment of participatory research to emancipatory knowledge-seeking (Baker et al. 2009; Tuhiwai Smith 2021). The process of critically examining beliefs and assumptions and the societal structures that influence them is recognized in transformative learning theory as essential to initiate openness to exploring alternative perspectives (Kroth and Cranton 2014a), which is a key component of deliberation and dialogue.

Deliberation is a method of listening, talking, and considering differing perspectives. It is characterized by mutual respect and the rational consideration of different viewpoints in the development of decisions regarding complex issues (White 2022). The findings suggest that the structure of the ATLAS deliberations promoted the initial three phases of appreciative inquiry: discovery of what is, dreaming about what could be, and designing a potential way forward. Appreciative inquiry is a narrative methodology that promotes sharing and reflection. The sharing of exemplars and perspectives in all three regions indicates that, akin to experiences documented by Allison Tucker (2024) where the interweaving of appreciative inquiry and narrative inquiry uncovered rich narratives with educators, sharing narratives structured within the stages of appreciative inquiry and facilitated by the World Café methodology promoted deliberation.

The initiation of the discovery phase (sessions one and two) prior to input from scientists about perspectives on science and its role in society (session three) reflects common deliberation design strategies (White 2022). In all regions, this discovery process uncovered varied experiences and promoted extensive discussion. Independent of region, the contexts for most of these experiences, and later in the deliberation, the drivers behind recommendations, were associated with complex societal issues linked to social and planetary justice and human flourishing. This is unsurprising given the known history of this type of work in Anglicanism and aligns with literature reporting wider interactions between faith and science, often exemplified by initiatives involving environmental or sustainability-focused actions (Bomberg and Hague 2018; Tatay-Nieto 2020).

The concept of faith-based actors as intermediaries in the process of science communication and engagement within communities is illustrated throughout the bishops' discussions, exemplars, and proposed actions. Intermediaries are

actors within systems who can alter perspectives and contribute to shaping change by acting in a "go-between" role (Landrum 2017). The deliberations demonstrated that bishops understand themselves to have the opportunity to act as intermediaries in the development of greater trust by church communities in the insights of science. This is not bishops acting as science communicators. Rather, through the development of faith–science relationships, bishops are able to create greater openness to the learnings that can be gained from both knowledge systems (Landrum 2017). This role of faith leaders in fostering trust and openness is documented in environmental actions across multiple faith-based settings (Moyer and Brandenbarg 2021; Mucunguzi, Adrine, and Ogola 2022) but is also noted as potentially underutilized in some contexts (Tobin et al. 2023).

Understanding the drivers that promote church leaders to engage as intermediaries in this way clarifies this concept. For example, many of the workshop discussions referenced safeguarding the integrity of creation (Anglican Communion Office 2025c) as a driver of engagement between faith and science. Knowledge from science is received into the church community and considered within the analysis of a theological framework. Where a science–theology synergy is identified, the church can convey scientific knowledge through a theological lens in both informational and motivational ways. As information, scientific knowledge can contribute to a broadening of understanding of God and God's world. As motivation, scientific knowledge can help church leaders inspire believers to take action, thereby increasing participation in the mission of God. Taking the example of climate change, which was identified across all three deliberation workshops (see Figure 5), we examine this concept. Scientific knowledge about the warming of the atmosphere, increases in the emission of greenhouse gases, and the rise in sea levels create cause to reflect on theologies of creation and sin, and, in particular, the goodness of God's creative work and the impact of human activity on it. The safeguarding of the integrity of creation is part of an Anglican understanding of mission (Anglican Communion Office 2025c). Scientific evidence informing the action required to mitigate negative impacts on creation can motivate people to more effectively contribute towards engaging with and using science.

Trust in science appeared to be high among the participating bishops, potentially revealing self-selection bias. Attitudes towards science and religion are shaped by experience, both individual and societal. In common with international evidence (Chan 2018), the bishops discussed awareness of significant variance in levels of trust in science within the communities in which they worked. Within the deliberations, negative impacts of the application of science-based technologies such as genetically modified crops were associated with communities where trust in science is low. This aligns with evidence that attitudes towards science are associated with perceptions of the ability of

science to contribute positively to the world. Bishops discussed their experience supporting communities in efforts to protect against potentially detrimental applications of technologies and promoting the application of technologies that could have positive impacts, such as vaccines. These reflections suggest that within such communities, trust associated with faith leaders can be used to leverage trust in explorations of science, again demonstrating the role of faith leaders as intermediaries. It has been proposed that trust in religion may be more relational, whereas trust in science is based on products and capabilities of science itself rather than relationships with science (Cacciatore et al. 2018; Chan 2018). However, it is also apparent that trust in science is associated with perceptions of the trustworthiness (Wintterlin et al. 2022) and motivation of scientists (Benson-Greenwald et al. 2023), suggesting there is an element of relationality involved. Where faith leaders have a role in engaging communities in science, this may be contributing towards bridging the exposure to science gap and potentially building trust in science where this is lacking. The deliberations also revealed that church leaders often champion ethics and morality in societal conversations around the application of science. Vukašin Gligorić et al. (2024) found generally high levels of trust in science and scientists in the United States, highlighting that perceptions of competence and morality were the most significant factors influencing public trust in scientists, with morality being particularly influential. Given that contributions related to ethics and morality are often led by church leaders, this suggests that increased visibility of engagement between faith and science could be beneficial in addressing issues of societal trust in science related to morality.

Colonization was a common theme across all workshops. While geographically and culturally diverse, the regions of Africa, Oceania, and the West Indies share histories of British colonization through which the Anglican Church emerged, serving as both a vehicle for social advancement and a tool for colonial control. In all regions, these histories continue to shape social and economic inequities that negatively impact Indigenous peoples and descendants of enslaved peoples. Colonizing academic practices are an ongoing part of these histories, whereby the dominance of Western knowledge and research methodologies perpetuate unequal power dynamics that have undervalued or ignored knowledge evolving from colonized peoples and nations (Jadallah 2025). The workshops revealed a theme of suspicion of Western scientific methods and their potential to be a further tool of colonization, even if unconsciously or unintentionally. This should be taken seriously and shape the process by which the ongoing faith–science engagement is promoted in such regions.

Collectively, the evidence from across the three deliberations suggests that the structure of the workshops created an opportunity for bishops to explore existing frames of reference regarding science, reflect on their current engagement with science, and consider whether and how this may

be strengthened. The motivational driver was linked to contributing to actions associated with complex societal issues. Recognition that this required approaches that engaged perspectives from multiple knowledge systems in a contextual manner was very clear among participating Anglican bishops. The proposition that dialogue between faith and science may contribute to driving societally acceptable actions in response to complex issues is consistent with the perspectives of global entities such as the United Nations and the International Science Council. These entities advocate for approaches to complex issues that are informed by Post-Normal Science (PNS) and Transdisciplinary Research (TDR) (Bandari et al. 2024; Lawrence et al. 2022). These holistic approaches acknowledge contextual positionality, recognize the interplay between facts and values, and comprehend the necessity of incorporating perspectives from multiple knowledge systems in developing actions (TDR) or informing high-stakes decisions (PNS) concerning complex issues (Lawrence et al. 2022; Saltelli 2023). The exploration of progressions arising from regional recommendations and the examination of outcomes from deliberations on the theme of faith–science interactions for scientists and for combined groups including leaders from science and faith should be pursued. Additionally, it is important to consider questions related to comparisons across diverse cultural and faith contexts, as well as the enablers and barriers to interactions that foster synergies, while respecting differences across knowledge systems.

We have reported on the perceptions of the participating bishops. However, there were other actors present, namely scientists and Indigenous leaders, albeit in lesser numbers, who contributed to session three, where an opportunity was created for bishops to hear perspectives from this group. The focus of the scientists in this session was primarily on addressing the questions of what science is and is not, the limits of science, and the mutual recognition that people can live with multiple knowledge systems and that respect across knowledge systems is essential for them to have optimal value for society. The commitment of these scientists, particularly those who were neither religious nor Anglican, demonstrated that these potentially sensitive conversations can be held without tension or rancor. Examination of the perspectives of the session three participants has the potential to inform the design of deliberations involving leaders from across science and faith communities.

Limitations

Issues regarding the diversity of participants created the most significant limitation in this research. While a breadth of geographic spread among participants was achieved, self-selection bias may have influenced the outcomes of these deliberations in Oceania and Africa. In the West Indies and Aotearoa New Zealand, where there are fewer bishops, a greater proportion of potential participants attended, thus reducing self-selection bias. In contrast, in larger

regions such as Australia and Africa, it is more likely there was a degree of self-selection bias towards those with an interest in faith–science interactions. Further, in Aotearoa New Zealand, Melanesia, Polynesia, and parts of Africa, limitations associated with the availability to travel impacted the diversity of participants. The limited representation of women and voices from minority groups within the regions was reflected on by the bishops and noted as a limitation that could be addressed as they progress towards the next steps. The inability to use local hosts and scribes in Africa, resultant from an unplanned change, is noted as a limitation.

Conclusions

To our knowledge, this is the first study that has explored perspectives of Anglican bishops regarding the role of faith–science interactions via a process of deliberation that recognized the bishops as research partners. The findings reinforce the importance of codesign in the development of transdisciplinary interactions. The opportunity for deliberation enabled bishops to engage deeply with the Call on Science and Faith within their own contexts. Emerging from this was recognition of the multiple ways in which interactions between faith and science already exist. These were more extensive than perhaps bishops may have previously realized. This provides an important base for the development of action to strengthen these relationships. Potential impediments to interactions between faith and science were identified, relating to a suspicion of the dominance of the scientific method. The potential for bishops to offer leadership in facilitating actions that promote openness and trust in processes that explore insights from science and faith is noted as significant. The importance of drawing on varied knowledge systems, including those of Indigenous and local knowledge, should not be underestimated. The common desired outcome of human flourishing can offer a positive basis for building greater trust between faith and science. The deliberation model designed specifically for this study and applied in three diverse contexts facilitated bishops to deliberate as peers in discussions about faith–science interactions. This process allowed them to identify opportunities for strengthening dialogue between faith and science in ways that could enhance human and planetary wellbeing. Thus, the model has demonstrated potential that could be contextually adapted for wider application.

Competing Interests

The authors declare that they have no competing interests.

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Quantum Fundamentalism or Emergence? A Reply to Harris

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Mark Harris has developed a new research program at the intersection of theology and quantum physics, centered on two coordinated commitments: quantum fundamentalism, the claim that quantum mechanics has a unique standing within the sciences, and Christological fundamentalism, the claim that the divine Logos is the source and ground of the created order. I make the case that Harris's program, while rejecting naïve versions of reductionism, is still structurally reductive. I then develop an alternative framework based on emergence, which is intrinsically non-reductive. A theology of science based on emergence would proceed in a distinctive manner compared to fundamentalism.

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Mark Harris (2023, 2024, 2025) has launched a new research program at the intersection of theology, philosophy of science, and quantum physics. Its organizing idea has two coordinated commitments. The first is quantum fundamentalism: quantum mechanics has a unique standing within the sciences. It reaches across chemistry, biology, and every part of physics, and no alternative framework does the same. The second is Christological fundamentalism: the divine Logos is the source and ground of the rationality, intelligibility, and structure of the created order. Harris's (2025, 159) thesis is that these are not merely compatible but are internally related: "[Q]uantum fundamentalism is a form of, and is made possible by, Christological fundamentalism."

Harris takes care to distinguish quantum fundamentalism from the kind of crude reductionism that would collapse biology into chemistry and chemistry into particle physics. Drawing on Alyssa Ney, he defines "fundamental" in terms of explanatory maximality rather than any bottom-up hierarchy of constituents. He also aims to move the theology of quantum mechanics beyond its long fixation on the Copenhagen interpretation, one he regards as unfortunate given its anti-realist leanings. These are moves I wish to endorse. The question is whether the broader program can be sustained.

The program faces two tensions in its current form, one internal and one external. The internal tension is that Harris's program, despite its explicit rejection of reductionism, retains reductionist themes at three points: its appeal to in-principle quantum description, the causal priority entailed by its linkage of the two fundamentalisms, and its narrowing of Ney's comparative criterion to a single theory within physics. The external tension is that contemporary physics supports a kind of emergence that is not merely epistemic—what I call moderate metaphysical emergence (MME)—and this form of emergence conflicts with quantum fundamentalism. On that alternative picture, the quantum level is not the privileged point of contact between physics and the created order.

The argument proceeds as follows. The first section presents Harris's account, and the second section explains Ney's definition of fundamentality, on which Harris relies. The third section develops the internal critique. The fourth sets out MME and the physics that supports it. The fifth section returns to Harris to show why MME and quantum fundamentalism pull in different directions. The final section closes with remarks on what this means for theology of science.

Quantum Fundamentalism

Let's say more about the two types of fundamentalism. Harris (2025, sec. 4) affirms the Christological variety in an unqualified way: the divine Logos (Christ) is the fundamental ontological ground of the natural world and the source of its rationality, intelligibility, and structure. He believes that our ability to do science is rooted in the rational order of nature, which comes from the Logos.

The notion of quantum fundamentalism was suggested by Henrik Zinkernagel (2016, 1): "Everything in the universe (if not the universe as a whole) is fundamentally of a quantum nature and ultimately describable in quantum-mechanical terms." While Zinkernagel's terminology is suggestive, his description invites a reductionist reading, which Harris wants to avoid. Looking for an alternative, Harris instead adopts Ney's (2019, 33) account, which defines fundamentality in terms of explanatory maximality: a theory is fundamental if it is "a common source of (causal and constitutive) explanations that possess the greatest degree of scope, accuracy, and precision of all theories that have so far been formulated." Her proposal is explored more fully in the second section of this article. For now, the key point is that quantum fundamentalism can be defined in such a way that it avoids reductionism.

While Ney herself does not say that quantum mechanics is fundamental, Harris notes that the theory has ramifications for the sciences well beyond particle physics. Quantum mechanics is relevant to other parts of physics (e.g., inflationary cosmology), chemistry (e.g., the Pauli exclusion principle), and biology (e.g., photosynthesis). No other theoretical framework is as far-reaching or as adaptable, and no other framework is as able to unite the diverse landscape of the sciences (Harris 2024, 600). Quantum mechanics therefore counts as fundamental on Ney's criteria.

It is important to note what Harris's quantum fundamentalism is not. As mentioned earlier, it is not a kind of reductionism, which some readers might assume (Harris 2024, 599). The reductionist takes nature to be stratified into many levels, with the most fundamental being the smallest scale of matter—quantum fields or, more speculatively, strings. The rest of nature is built on this foundation. For a "full-blooded" reductionist like Sabine Hossenfelder, whom Harris cites (2024, 599–600), everything that science studies is determined by the laws that describe fundamental physics. For Hossenfelder (2022, 85–87), "fundamental" means that which cannot be derived from or reduced to anything else.

Mentioning his own work in condensed matter physics, Harris (2024, 600) argues that the reductionist hierarchy is unwarranted. Fortunately, quantum fundamentalism does not require a bottom-up hierarchy, nor does one need to hold that all of science boils down to subatomic particle physics. Ney (2019, 29–30) agrees that contemporary models "generally eschew the assumption that the sciences carve out a neat partition of entities into levels," and "few any longer subscribe to the building block model." Explanatory maximality allows for a "more horizontal (or at least less stratified) view of the sciences" (Harris 2024, 600), in which the quantum framework is operative across the sciences without any single scale serving as the derivational base for all the others. Harris does not entirely avoid the more vertical language of levels and scales.[1] But his focus is on the pervasiveness of quantum mechanics across different scales of

physical description, not on any one set of entities as the ontological foundation for all others.

If one accepts Christological fundamentalism, then quantum fundamentalism is implicitly reliant upon it (Harris 2025, sec. 7), and this has consequences for how the theologian approaches the philosophical issues that beset quantum mechanics. Harris takes up the measurement problem, for example. Theologians, he argues, have been far too enamored with the Copenhagen interpretation, which is anti-realist at heart, "as it emphasises the observer's role in constructing reality" (Harris 2025, 157).[2] The label in fact covers a range of views, some of which would count as realist in Harris's terms (Howard 2004).[3] But Harris is correct that theological reflection has focused too narrowly. The realist alternatives (the "many worlds" interpretation, Bohmian pilot-wave theory, and spontaneous collapse theories such as GRW[4]) are better candidates, and Harris argues that Christological fundamentalism favors them. Theology on his account therefore has something to contribute to quantum foundations.

The main issue here is whether Harris is able to fully escape the grasp of reductionism, as he seeks to do. Reduction as both a methodological and an ontological principle is common in science, tacitly guiding—or infecting, depending on one's view—one's thinking. The same is true for philosophy of science and often theology of science, even though theologians explicitly reject reductionism. As an alternative to fundamentalism, I suggest that theologians consider emergence as the central organizing principle of natural theology. What sort of emergence is discussed in the fourth section of this article.

What Is Fundamental?

Ney's definition of "fundamental" is unique, and she rejects two other candidates along the way. First, no theory is constitutively complete (Ney 2019, 29). Naïve materialist theories once claimed to be complete in this way, e.g., everything is made of atoms. That sort of "building block" model is no longer viable. There is no one simple explanation for how "derivative entities" across the sciences depend on their constituents.

Second, no theory is causally complete. If one were, it would potentially provide a causal explanation for every given event. But even our best theories in physics only apply within "a limited regime for special kinds of systems" (Ney 2019, 31). Consider the Standard Model, which is a relativistic quantum field theory. Many of its most important applications involve effective field theories, describing phenomena at a given energy scale without requiring detailed knowledge of what happens at higher energies (where higher energy corresponds to smaller scales). This provides physics at lower energies (larger scales) with a tractable set of fields and interaction terms, even if the underlying high-energy theory is unknown or too complex to use directly. No effective field theory is "complete" in that each only works within a particular energy range.

Ney rejects causal and constitutive completeness in favor of maximality. One theory is more fundamental than another when it causally or constitutively explains more than its rival. Her fundamentality is intrinsically comparative. No theory is fundamental in and of itself. In addition, fundamentality is always relative to a given domain. The Bardeen-Cooper-Schrieffer (BCS) theory is fundamental for superconductivity. The theory of evolution is fundamental for heredity (Ney 2019, 34). One might even say that physics is fundamental, if compared to other whole disciplines: chemistry, biology, etc. Physics is fundamental for the range of all physical phenomena compared to other sciences.

With Ney's account in view, we can return to Harris. He adopts explanatory maximality precisely to avoid reductionism. The question is whether it does the work he needs it to do.

The Ghost of Reductionism

Harris rejects Hossenfelder's (2022, 82–83) naïve form of reductionism, in which micro-physics is thought to be constitutively complete:

> A lot of people seem to think it is merely a philosophical stance that the behavior of a composite object (for example, you) is determined by the behavior of its constituents—that is, subatomic particles . . . But reductionism—according to which the behavior of an object can be deduced from ("reduced to," as the philosophers would say) the properties, behavior, and interactions of the object's constituents—is not a philosophy. It's one of the best-established facts about nature.

To reject reductionism is to reject science, in Hossenfelder's view. Clearly, that is not Harris's position. Nonetheless, reductionist themes are hard to avoid altogether. Several slip into his account along the way.

Three strands are worth tracing: his appeal to in-principle descriptions, the causal priority that his linkage of the two fundamentalisms appears to entail, and the narrowing of Ney's comparative criterion to a single theory within physics. Each might be written off on its own. Together, they reproduce the shape of the picture Harris means to leave behind.

Reduction "in Principle"

The first indication Harris's (2025, 156) quantum fundamentalism has not fully escaped the influence of reductionism is in the language he uses to characterize it:

> [E]xacting experimental tests invariably confirm the quantum picture; it has never (yet) been proven wrong. As a result, many physicists believe physical reality to be fundamentally quantum, a viewpoint that has come to

> be known as "quantum fundamentalism." Here, everything in the universe is thoroughly quantum, and in principle everything can be described scientifically in such terms.

The key phrase here is "in principle." It is commonly asserted that all events can be described in principle in terms of fundamental physics. In other words, if we had complete knowledge of quantum mechanics, the Standard Model of particle physics, and the ways in which all true scientific theories are related to one another, we could discern that every physical event is ultimately quantum mechanical.

While such claims are not difficult to find, they are typically made by reductionists.[5] The redescription of biological and chemical events in terms of physics alone is one way of characterizing just what reduction amounts to. The prevalence of the "in-principle" qualifier is due to the fact that such proposed reductions are "rarely, if ever, accompanied by a suggestion as to how this might be done" (Batterman 2021, 10). The appeal to in-principle descriptions of higher-level phenomena in base-level terms is a promissory note that a full reduction will be completed sometime in the future. Having waited decades for such promises to be fulfilled, one should be skeptical. As Mark Wilson (2017, 21) warns, when we see "the phrase 'in principle,' . . . it's generally a signal that important issues have been lightly brushed aside."

Harris's claim about the in-principle completeness of quantum descriptions is one of several places where his fundamentalism is at odds with Ney's. One reason many philosophers of science reject the explanatory completeness of any given theory is that it has proven to be impossible to describe higher-level theories purely in terms of physics. It is the failure of reduction that prompts weaker ties between the disciplines, like that proposed in Ney's fundamentalism. She does not need the "in-principle" qualifier. The unreconstructed reductionist does.

This particular residue of reductionism might simply be a poor choice of words. The next two examples are not.

Causal Priority

Reductionism also begins to creep back in when Harris connects his two types of fundamentalism. He asks, "What was God thinking when he created the quantum world?" His answer is that God was thinking of his Son (Harris 2025, 164). Harris (2025, 164) claims that "Christ is also the source and the ground of all matter, of all particles and fields." Christological fundamentalism does not seem to be merely about explanatory maximality and breadth. The Logos is the "source and ground" of all particles and fields. What does that mean?

Ney's fundamentalism provides two options. A fundamental theory gives "a common source of (causal and constitutive) explanations" (Ney 2019, 33).

Constitutive explanations show how the properties of a whole are determined by the properties of its parts. For example, the properties of a given fluid can be explained in terms of its chemical makeup. That cannot be the way in which the Logos is fundamental. The Logos is not what particles and fields are made of.

What about causality? Causal explanations give us the processes by which an event occurs. Ney cites galaxy formation and cell splitting as examples. Causal explanation seems like a better candidate for Christological fundamentalism. The Logos is the "source and ground" of matter in the sense that particles and fields are, at least in part, brought about by the Logos. Creation is causal.

As we have seen, ontological reductionism privileges one level of physical description as the basic one within nature. Everything else is somehow built up from those basic parts. Harris rejects this. Micro-physics is not privileged in this way. His linkage of quantum and Christological fundamentalism, however, reinstates this structure by a different route. If "quantum fundamentalism is a form of, and is made possible by, Christological fundamentalism" (Harris 2025, 159), then quantum mechanics would seem to have an analogous causal priority in nature. No other theory is fundamental in this sense. The convergence of these two fundamentalisms makes the quantum domain the exclusive ontological substrate for the Logos's generative operations. Quantum mechanics is the privileged point of contact for Christological natural philosophy rather than merely one place among many at which the Logos is present and active. The Logos is the ontological terminus; the quantum level is the privileged point of scientific contact with that terminus. The metaphysical topography—one level as hub, the rest as derivative—is preserved.

This is what I mean by tacit reductionism. Harris does not endorse the reductionist claim that higher-level phenomena can be deduced from quantum-mechanical descriptions. What his linkage of the two fundamentalisms does commit him to, it seems, is a weaker but still reductionist-shaped thesis: the quantum level is the point at which the created order is anchored to its creative ground. That alone is enough to reinstate the level privilege that anti-reductionists have sought to dismantle.

The Narrowing Question

Ney's examples of fundamentality are comparative: physics is fundamental relative to chemistry and biology; BCS theory is fundamental for superconductivity relative to rival accounts of that domain. Claims of fundamentality are always indexed to a comparison class. What, then, is the comparison class for the claim that quantum mechanics is fundamental? Ney's own answer is that physics is fundamental relative to the other sciences. She does not single out a particular theory within physics. This is part of how her framework avoids reductionism.

Harris's commitment is a claim of a different kind. It privileges one theory within physics over thermodynamics, fluid dynamics, condensed matter, and the rest. Whatever its independent merits, this is an intradisciplinary ranking, and Ney's argument for explanatory maximality neither requires nor delivers it. Singling out the quantum domain reintroduces the vertical hierarchy her framework was designed to set aside. On my reading, Harris and Ney share a vocabulary but defend different theses, and the appeal to Ney does not carry the weight Harris asks of it.

The three subsections of this section can now be read together. In-principle completeness, causal priority, and the narrowing of fundamentality to a single intradisciplinary theory jointly reconstitute the picture reductionists have long defended. This is not the naïve reductionism of Hossenfelder's pyramid, which Harris rightly rejects. But it is, on my reading, recognizably reductionist in structure: ontological priority for one theory, while everything else has a lesser status.

This is the "ghost" Harris's program harbors: reductionist structure without the reductionist label.

In the next section, I offer an alternative approach that challenges the primacy of quantum theory even within physics itself.

Emergence

Types

Harris's (2024, 600) own field of condensed matter physics deals with "emergent phenomena." What does that mean?[6]

As a first approximation, emergence is the denial of reduction. But since "reduction" is itself ambiguous, it is not always clear what its negation amounts to. Most physicists have in mind what philosophers of physics call "weak emergence" (Koperski 2025, sec. 7.2). It starts with the observation that phenomena at higher levels are qualitatively different from those at lower levels.[7] In Philip Anderson's (1972) apt description, "more is different." Water is wet, but water molecules are not. My coffee mug is red, but the atoms it is composed of are not. Beyond that, weak emergence includes an epistemic gap: emergent properties resist reduction, cannot be predicted from exhaustive knowledge of the base level alone, and exhibit novelty. These three criteria are primarily epistemological. They describe limits on our ability to derive or predict upper-level behavior, not limits on what the base level actually determines. Weak emergence is therefore fully compatible with ontological reduction. The base level may in fact be "running the show," as it were. We just cannot see how.

Strong emergence, in contrast, begins with the same criteria but then adds a metaphysical one: the novelty at higher levels is real, not merely apparent from our epistemic vantage point (Koperski 2025, sec. 7.3). Genuinely new causal powers come into being, ones not found in, nor derivable from, the base level.

The most common example is consciousness and the causal efficacy of mental states. This requires an account of downward causation, where mental states lead to, for example, the motion of the matter composing one's hands.

Critics note that consciousness itself remains unexplained, and an appeal to strong emergence does not remove the mystery. Without more examples, it is not clear how this type of emergence fits with current science, and so most physicists and philosophers of science remain skeptical.

When Harris refers to emergence, it is almost certainly weak emergence he has in mind. It is not surprising, then, that he barely mentions it. Weak emergence tells us very little about physical reality. It is fully compatible with ontological reduction, the claim that higher-level entities are nothing but compositions of lower-level ones, with their properties completely determined by those of their constituents, even if we do not know the details about how that happens. This is why weak emergence is now widely accepted. One can be just as reductionist as Hossenfelder and still affirm weak emergence.

But weak emergence is too weak given what we know in science. We have reason to believe that higher-level properties are real and have a degree of autonomy but are still dependent on the lower level from which they emerge (unlike strong emergence, which has a limited and somewhat mysterious connection to base). Meso- and macro-properties are real features of the natural world, not convenient fictions or pragmatic shortcuts (Batterman 2021, 110–11). They are "objectively present in nature, quite independently of whether we recognize their exploitable advantages or not" (Wilson 2021, 193). I call this intermediate position—neither strong nor weak—MME. Why think there is such a thing?

Universality

While many of the best examples of MME are biological, reductionists tend to dismiss those out of hand. Fortunately, MME manifests itself in physics as well. Consider the phenomenon known as universality. Phase transitions are found in systems with entirely different microstructures: gases, magnets, and superconductors all exhibit the same mathematical relations near their critical points (Batterman 2019, 27–30). These systems are completely different at the micro-level. They are composed of different kinds of particles interacting in different ways, and yet their macroscopic behavior is identical. This means that the micro-level properties, including the quantum properties, of these systems are not what explains their *shared* behavior. The explanation for the pattern must lie elsewhere.

Consider a simple analogy from Hilary Putnam (1975, 295–96). A wooden block contains a one-inch round hole. A round peg fits into the round hole; a square peg does not. Why not? The material composition of the block does not explain the difference. Had it been steel, plastic, or granite, one

would get the same result. Even if one could somehow derive the peg's inability to fit from knowledge of its molecular structure, such a derivation would not explain why systems with completely different microstructures all behave the same way. The explanation lies in the macroscopic geometry, the shapes and relative dimensions of the openings. The molecular-level details are simply irrelevant.

In physics, identifying which properties matter in this way is less straightforward, but the lesson is often the same.[8] In many cases, what happens at the micro-level is irrelevant vis-à-vis macro-behavior. The causally relevant, emergent properties are found elsewhere.

Engineering Applications

Multiscale modeling makes the same point from a different direction (Koperski 2025, sec. 8.4). Consider a steel bar under stress. At the micro-level, steel consists of molecular lattices. At the macro-level, it is a continuous material that bends and compresses according to Hooke's law. Between these extremes lie several mesolevels (ferrite, cementite, pearlite), each with its own distinct properties and dominant behavior. The behavior of macroscopic steel cannot be derived from the molecular lattice alone. The mathematical representations at different scales are "tyrannical": each scale's differential equations dictate a structure for matter at all lower scales that is mathematically inconsistent with what is known about other scales (Batterman 2013). Multiscale modeling resolves these inconsistencies by incorporating information from each level. It is a "middle-out" approach rather than a bottom-up one (Batterman 2021, chap. 6; Wilson 2017, chap. 5). These mesolevel properties are not dispensable. They get the physical ontology right in ways that neither continuum mechanics nor atomic physics is able to do.

The best case for MME might be made from biology (Love 2021, sec. 7.2). Feedback loops regulate blood sugar, body temperature, blood pressure, and more (Ellis 2016, 160). In the life sciences, this sort of negative feedback is known as homeostasis. In each case, changes in higher-level properties—those at the level of a system or organ—trigger an action with subsequent effects on lower scales. What is causally relevant in homeostasis is biological properties, not the microphysical properties the reductionist takes to be the only real ones. There are many examples of causally relevant, higher-level environmental conditions throughout the natural sciences (Bishop, Silberstein, and Pexton 2022). Such examples are, unfortunately, dismissed by hardcore reductionists. All such cases, they claim, can be reduced to matters of physics in principle. Again, that is a reductionist move.

Multiscale modeling and universality point to the irreducibility and causal relevance of properties far beyond the Standard Model. Biological mechanisms provide more of the same. They are all "metaphysically" emergent insofar as they are real, indispensable, and irreducible.

Many Fundamentals

According to Ney, fundamentality is determined by way of comparison. It picks out whichever theory does the most explanatory work within a given domain. The conclusion that follows from the previous section, on Ney's own criterion, is not that the quantum framework is the privileged base for natural philosophy. It is that there are many fundamental theories.

MME tells us how the explanatory work is distributed. Universality and multiscale modeling show that the explanations governing fluid phase transitions, the elastic response of metals, the homeostatic mechanisms of biological systems, and many other phenomena run through mesoscale properties. Microphysical properties are often irrelevant. Those details are washed out, leaving mesoscale properties as the relevant difference makers. When one applies Ney's criterion to the domain of phase transitions, quantum mechanics fails to qualify as the theory possessing the greatest degree of scope, accuracy, and precision. It is the theory of order parameters and correlation lengths that universality classes pick out. In Ney's sense, that theory is fundamental for phase transitions. The same point holds for the continuum-and-mesoscale theories that govern the elastic regime of steel, and for the biological mechanisms that govern homeostasis. Each is fundamental for the domain over which its explanations dominate.

The result is a plurality. There are many fundamental theories, each operating at its own scale, each satisfying Ney's criterion for its proper comparison class. This is what her criterion yields in light of the evidence for MME.

Three responses are available. Harris could reject Ney's criterion and adopt some narrower account of fundamentality. He would essentially be treating Ney like Zinkernagel: they provide suggestive terminology that ultimately must be replaced. He could reject MME, but doing so without falling back into reductionism is a difficult needle to thread. Or he could revise quantum fundamentalism itself, dropping the claim that quantum mechanics is uniquely fundamental and accepting that the created order has a genuinely many-leveled explanatory structure.

The tension between MME and quantum fundamentalism matters for theology of science because the two pictures disagree about whether one theory in physics is uniquely fundamental across all domains. MME, paired with Ney's criterion, denies that any one theory plays that role across the board. The resulting pluralism suggests a theology of science that recognizes the irreducibility and causal relevance of mesoscale properties as genuine features of the created order rather than as artifacts of a promised, in-principle reduction. That is a different starting point from fundamentalism. The difference is structural rather than merely one of emphasis.

Conclusion

This article is not a refutation of Harris's two fundamentalisms. It has argued that the current articulation retains a reductionist structure, and that MME,

taken together with Ney's own criterion, supports a pluralist alternative on which there are many fundamental theories at many scales. The alternative is not merely emergentist about properties; it is pluralist about fundamentality itself. Given the difficulty of this terrain and the early stages of these two programs, I would hope for work to continue on both fronts.

That said, the approach one brings to natural philosophy carries over into theology of science. MME and fundamentalism offer different perspectives on what God "had in mind" when it comes to creation. I suggest that only in one has the ghost of reductionism been fully exorcised.

Acknowledgments

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Notes

[1] He describes quantum mechanics as working "all the way up" and refers to condensed matter physics as operating "at a much higher level than that of subatomic particles" (Harris 2024, 597, 600).

[2] For a recent refutation of the standard reading of Niels Bohr, see Hans Halvorson (2026).

[3] As Werner Heisenberg (1958, 55) puts it, "Certainly quantum theory does not contain genuine subjective features, it does not introduce the mind of the physicist as a part of the atomic event."

[4] The common abbreviation for Ghirardi-Rimini-Weber.

[5] To cite two among scores of examples, see David Papineau (2009, 54) and Hossenfelder (2019, 90).

[6] The answer is difficult, he says (private correspondence), because condensed matter physics lacks a unified theory, like the Standard Model. Practitioners use quantum mechanics, thermodynamics, and other frameworks "in an ad hoc/pragmatist kind of way," depending on the problem.

[7] The notion of "levels" here is largely a placeholder for scales, of which there are several, principally those dealing with size and energy.

[8] This sort of identification is what renormalization group (RG) analysis does. The RG is a rigorous mathematical procedure that transforms the representation of a system, eliminating irrelevant microscopic details while preserving the dominant features that control macroscopic behavior. Through this process, systems with entirely different microstructures are shown to flow to the same fixed point in an abstract mathematical space, where the fixed point is that configuration of the system's parameters at which further RG transformations produce no change, representing behavior that is stable across scales (Koperski 2025, 162–63). The systems that flow to the same fixed point belong to the same universality class: a collection of physically diverse systems that share identical large-scale behavior because the same mesoscale parameters dominate their dynamics. The micro-level details—the specific quantum properties of the constituent particles—are washed out by the RG transformation. What remains are mesoscale properties: density fluctuations, symmetries, correlation lengths, and other features defined at intermediate scales between the atomic and the macroscopic (Morrison 2012, 143).

Competing Interests

The author declares that they have no competing interests.

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Open Library of Humanities

Religion and Ecology, Integral Ecology, and Scientific Ecology: Shared Worldviews, Constructive Cooperation, or Divergence?

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Media applications of the term "ecology" have become increasingly cultural and conflated with "environment(al)." Analysis of the *World Religions and Ecology* series, edited by Mary Evelyn Tucker and John Grim, found engagement with ecological issues but limited participation by ecologists. Adopting Ken Wilber's objections to philosophical naturalism, the humanities-based integral ecology of Sam Mickey, Sean Kelly, and Adam Robbert critiques scientific ecology's materialistic models and crypto-reductionism. It classifies restoration ecology as Exterior-Individual-It, which is inconsistent with the communitarian and spiritual aspects of restoration practice. Focused on social ethics, the *Laudato Si'*-based integral ecology of Dennis O'Hara, Matthew Eaton, and Michael Eaton seeks intentional engagement with science and criticizes political attacks on climate change research while asserting that science and technology must develop a greater awareness of their human implications. Religious appropriation of ecology affects the scale and foci of environmental problem analysis. Religious scholarship could benefit from in-depth explorations of scientific ecological conceptualizations of scale, disturbance, systems, risk assessment, and health.

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Introduction

This inquiry arises from the observation that fields such as religion-and-ecology do not cover the same diversity of natural phenomena and environmental topics as scientific ecology and related disciplines, such as conservation biology and restoration ecology. I have identified possible sources of the perceived dissonance, such as religious research focusing on issues with press coverage (Bratton 2012, 2014). The purpose of this article is to investigate how religion-and-ecology, and integral ecology, perceive ecological science and whether they incorporate current scientific foci, findings, language, and environmental concerns. Following a brief overview of the origins of the term "ecology" and its diversification in meaning, the article reviews major trends in ecological science during the twentieth century. Although other means of gleaning an understanding of natural history are valid and useful, for this article, ecological science encompasses scholarly research, societies, and publications. It then investigates the participation of PhD-level ecological scientists and the applications of environmental science in the series *Religions of the World and Ecology* published by Harvard University Press and edited by Mary Evelyn Tucker and John Grim beginning in the 1990s, with the final volume published in 2004. It then compares two more recent multi-author volumes on integral ecology, Sam Mickey, Sean Kelly, and Adam Robbert (2017a), based on integral studies as influenced by Ken Wilber, and Dennis O'Hara, Matthew Eaton, and Michael Eaton (2020), based on *Laudato Si'*, and explores how they portray and engage ecological science.

Foundations and Trends in Scientific Ecology

While science often adopts vernacular vocabulary, the origin of the word ecology reflects the nineteenth-century naturalists' preference for classical languages. The zoologist, artist, and monist Ernest Haeckel coined the German word *Ökologie* from the Greek noun *oikos,* originally meaning a household or a shared economy. An enthusiastic Darwinian, Haeckel did humanity and the natural order, as was typical of his generation of biologists. Humans crowned the evolutionary tree. Aside from publishing descriptive accounts of animal interactions with their environments, Haeckel was philosophically active as a founder of the Monist Society. Of interest to art historians, the combination of realism with abstract organic patterns in his biological illustrations contributed to the transition from nineteenth-century art to twentieth-century modernism (Voss 2023).

Initially, scientific ecology favored observational descriptive reports over experimental studies and focused on natural processes visible at human spatial and temporal scales. The models were deterministic and idealistic. In the early twentieth century, for example, the American Fredrick Clements developed a theory of plant succession following disturbance, where predictable species assemblages replaced one another until a burned or plowed site reached a relatively stable

climax. Responding to climatic zones and soil types, ecological communities had observable boundaries termed ecotones and functioned much like superorganisms. Natural processes like plant succession had predictable outcomes, terminating in ideal or maximally productive states, such as old-growth forests. At mid-century, Henry Gleason and Robert H. Whittaker challenged Clements's conceptualization and documented the individualistic responses of plant species to environmental gradients, such as elevation and moisture. In 1942, Raymond Lindeman's investigation of the trophic-dynamic aspects of ecology framed ecosystems in terms of energy transfer and nutrient cycling. In 1953, Eugene Odum published a best-selling university-level text centered on ecosystems. Odum pursued a holistic approach, constrained scientific reductionism, and conceptualized natural environments as composed of interacting biotic communities. Ecology gradually displaced subjective classifications and ideals based on cultural norms and teleological interpretations of evolution (Golley 1993).

From the 1960s into the 2000s, scientific ecology placed an ever-greater emphasis on experimentation and comparisons among systems with significant variables controlled. Leading laboratories increasingly applied statistics and developed predictive mathematical models, while new instrumentation enabled detailed study of molecular processes, particularly in chemical cycling, pollutant detection, and population genetics. These trends contributed to an expansion of spatial scales from microcosms and sandbox experiments to global models. Today's research extends beyond the seasonal and human lifespans, from the microsecond to deep time. New ecological specializations have emerged, such as disease ecology, landscape ecology, paleoecology, and global carbon modeling. Ecologists have analyzed hierarchies, flows, pathways, linkages, and intra- and interspecific relationships. Tracking biotic responses to natural and anthropogenic disturbances, they have found that many species are adapted to periodic burning, windfall, or flooding; thus, disturbances are often necessary to maintain ecosystem productivity and biodiversity. Natural and human disturbances interact, and many ecological communities long thought to represent the "climax," or "old growth" states, had histories of cultural burning. Disturbances at a locale produce multiple potential outcomes, and a single site can support multiple stable states. Abandoning older concepts of strongly bounded systems and processes, S. T. A. Pickett and Peter Sherwood White's (1985) edited collection of ideas concerning disturbance and succession is far more postmodern than Clements's linear, single-factor model.

The range of scales has been critical to concepts such as Gaia, which combines microbial ecology with atmospheric chemistry and physics. Ecologists have challenged the notion of harmony in nature and the concepts of "virgin" ecosystems and untouched wilderness. They have intentionally avoided idealistic interpretations and dichotomies resulting from culturally rooted categorizations, as these lead to incorrect assumptions about the structure and origins of ecological

communities. While becoming more holistic and systems-oriented, ecology has also become more experimental and deployed additional reductionistic chemical, molecular, and mathematical techniques. Applied ecology and conservation biology have striven to correct past and ongoing natural resource disasters, resulting from biased or insufficient scientific examination.

The Diversification of the Term Ecology

Since the mid-twentieth century, applications of the term ecology have multiplied, and increasingly incorporated social and economic implications not considered by Haeckel. Euro-American popular culture has adopted ecology as a descriptor for healthy human relationships with other species. The term has merged with environment(al). A commercial product that does not pollute or harm the environment is "ecologically friendly." One can purchase eco-soaps, eco-sandals, and eco-engines. In April 2025, this author conducted a search of shareware images available in Microsoft and Bing photo and illustration stock collections available for use with software such as Word and Powerpoint to determine how software designers supporting widely available writing or publication programs interpreted the terms ecology and environment(al). Frequent themes included sustainable technologies, such as photovoltaic cells and wind turbines. Rather than providing diverse images of living organisms at various scales, the collections favored compositions displaying a green planet in human hands or humans standing on a globe covered in vegetation. Popular usage thereby has promoted a "one Earth," "mother Earth," or "shared planet" theme, emphasizing the universality of life.

On September 25, 2025, an additional search of Microsoft images for "ecology" produced fifty selections, nine of which had unified-Earth themes; twenty-five (50 percent) of which concerned sustainable energy, particularly wind turbines and photovoltaic arrays; seven of which displayed sustainable products such as recyclable materials or electric automobiles; and six of which showed agricultural or garden landscapes. Of the nine images incorporating humans, five included children. Only two of the fifty photos were of living microcosms—a spider web and mushrooms in a moss mat, and there were no images of pollinators, predators, or other organisms with keystone ecological roles. Most of the outdoor photos displayed charming scenery, including wind turbines standing in fields of golden grain or crowning dramatic ridge tops. A search for "environmental" produced a much larger inventory. In the first 100 images, there were three unified-Earth selections, twenty-five close-ups of plants and eleven of animals, thirteen photos of oceans or lakes, then of forests, and seven of mountains. There were images of pollinators, predators, and endangered species, including such charismatic taxa as bees, hummingbirds, cranes, pandas, tigers, elephants, and gorillas. Ironically, from a scientific perspective, wind turbines and photovoltaics were absent. The Microsoft stock

largely reversed the scientific implications of the terms, equating ecology with sustainability while emphasizing the experiential, biotic, and lived-in aspects of environment(al). Although there is no easy way to check, the contents of the environmental inventory suggested political vetting. Only one photo of a crushed plastic bottle on a beach appeared in the first fifty images, and none captured petroleum spills or wastewater effluents. Photo libraries intended primarily for professional designers, such as Getty, recognize the duality of ecology and query whether the designer is seeking natural history or environmentally oriented images. These results verify the flexibility and merger of the terms ecology and environment(al) in popular usage, as well as the extent of media manipulation of their conceptual foundations.

The *World Religions and Ecology* Series, Edited by Mary Evelyn Tucker and John Grim

Religious responses to the negative impacts of industrialization, agriculture, and resource extraction, such as Christian stewardship, preceded the emergence of the environmental movement in the 1960s. After World War II, Christians, as the most prevalent voices in Euro-American universities, continued to dominate Western scholarly responses, such as the rise of ecotheology (Bratton 1983). Yet comparative and social-science-based religious environmental scholarship was becoming increasingly prevalent (Hargrove 1986). Although not the first to refer to religion-and-ecology, Mary Evelyn Tucker and John Grim founded and guided the project that provided the greatest boost to the emerging academic field. Former graduate students of the comparative religions scholar and Roman Catholic priest Thomas Berry, they organized a series of grant-funded meetings, each of which generated a volume focused on a faith tradition, published by the prestigious Harvard University Press. The selection of religions mirrored Western scholarly preferences for identifying "world religions" as those with a corpus of theological, philosophical, or spiritual texts or those associated with world powers, including Japan, China, and India (see Figure 1). Thus, the project dedicated a volume to Shinto, a Japanese religion (published by a Japanese press), and to Jainism, considered foundational to the evolution of Asian religions. Adherents of Jainism comprise 0.4 percent of the population of its natal region, India, or about five to six million people (Starr 2021). In 2020, 28 million people in sub-Saharan Africa alone, most of whom were traditionalists, identified with religions other than the "world religions" (Hackett et al. 2025), yet all Indigenous religions were amalgamated into a single volume (Grim 2001). Interestingly, the series did not systematically cover new religious movements, emerging religions, or modern alternative religions as categories. Nonetheless, the breadth, international representation, and scholarly quality of the project established religion-and-ecology as an essential subfield of comparative religions, environmental studies, and environmental humanities.

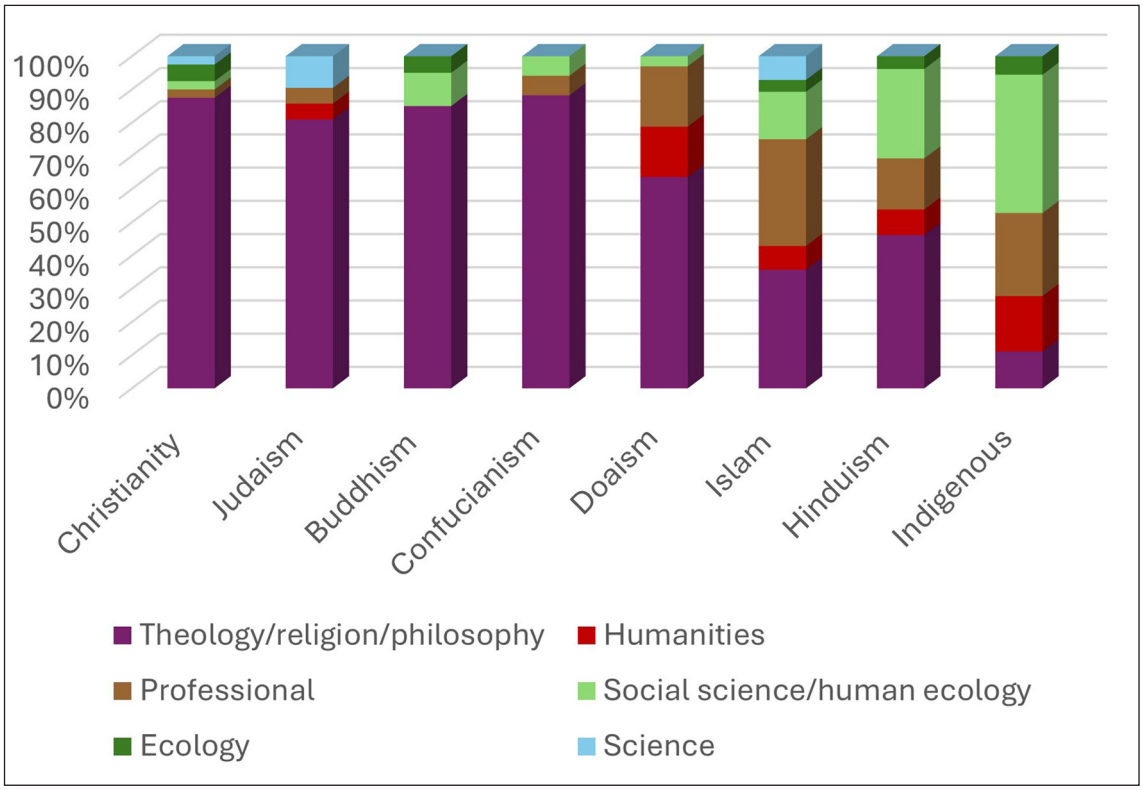


Figure 1: Fields of the authors and editors, Harvard University Press Series *Religions of the World and Ecology*. The graph partitions the educational and research backgrounds of the authors and editors from selected volumes in the series on ecology and religion edited by Mary Evelyn Tucker and John Grim. The comparison demonstrates the limited presence of scientists and the differentiation among the religions concerning the inclusion of the social sciences and the professions. The categories are all sciences (other than ecology), ecological science, social sciences and human ecology, the professions (including law, medicine, architecture), humanities such as languages and literature, and a combined category for theology, religious studies, ethics, and philosophy. The volumes are Hessel and Ruether (2000), Tirosh-Samuelson (2002), Tucker and Williams (1997), Tucker and Berthrong (1998), Girardot et al. (2001), Folz et al. (2003), Key-Chapple and Tucker (2000), and Grim (2001).

Considering the flexibility of the term ecology, a question arises about the goals of religion-and-ecology: Does it intentionally and insightfully incorporate ecological science? A helpful exercise is to analyze the academic training and roles of the editors and authors of the Harvard series. To this end, an ecological scientist is defined as having a PhD or research-based terminal degree in an ecological field and having published scholarly articles or books in scientific ecology or natural history. This analysis also identifies PhD-level scholars from other sciences, including other subfields of biology and a category titled "social science/human ecology," incorporating anthropology, sociology, and political

science. Due to academic overlaps between fields such as religion, theology, philosophy, and ethics, terminal degrees in these areas were combined into the "religion" category, while scholars in fields such as languages and fine arts fell into a combined "humanities" category. Individuals with a graduate degree or established as practitioners in applied fields, such as law, medicine, education, and urban planning, including expertise in acupuncture and feng shui, constituted a combined "professions" category. This classification prioritizes science when an individual holds two or more terminal degrees.

Figure 1 displays this classification for selected volumes and indicates that scientific ecology is weakly represented, with some volumes having no ecologists at all. Among the volumes on Christianity, Judaism, and Buddhism—three traditions covered in most comparative religions educational programs—only three contributors meet the ecologist's criteria: Stephanie Kaza, Calvin DeWitt, and Susan Bratton. Only one other scientist, physicist Ian Barbour, contributed to the Christian volume. Further, the ecologists did not necessarily contribute scientifically based commentaries (Tucker and Williams 1997; Hessel and Ruether 2000; Tirosh-Samuelson 2002). Bratton (2000), for example, responded to a contribution on prophecy, as requested by the editors, and discussed the potential for Christian eco-deacons. Other scientists with interdisciplinary interests, such as the conservation biologists Michael Soule (Buddhist) and David Ehrenfeld (Jewish), were potentially available but did not participate.

Among the unexpected findings, some editorial teams drew more chapters from the professions than others. The Islamic volume rightly recognizes the importance of professions such as architecture to environmental management (Folz et al. 2003). The volumes on regional religions, including Daoism and Indigenous religions, also had greater representation of the professions (Girardot et al. 2001; Grim 2001). The highest percentage of social science and human ecology representation concerned Indigenous religions, yet Hinduism also had greater representation from social science, particularly anthropology, than Christianity or Judaism (Key-Chapple and Tucker 2000). Reflecting Western academic history, an analysis of the religious specialties indicated that the contributors to the volumes on Christianity and Judaism were more likely to be specifically trained in theology, religious philosophy, or religious ethics, or serving in a theology department. Contributors to the volumes on Asian or Indigenous religions were more likely to be associated with religious studies or comparative religions programs. Although recent movements, such as eco-feminism, appeared in multiple contexts, and Rosemary Radford Ruether co-edited the Christian volume, the scientific roots of the Gaia hypothesis received sparse attention. There was little engagement with economics or law, despite their importance to environmental justice and international development. Nonetheless, Tucker and Grim were sensitive to the importance of having scholars from non-Western and Indigenous faith traditions serve as editors and

senior authors. These contributors were, on average, more concerned about sustainable development and environmental policy formation.

A second way to examine the authors' engagement with scientific ecology is to investigate their coverage of different scientific topics. In reading the indices of the volumes, ecological terms such as nutrient cycling, succession, zoonoses, and carbon sequestration are largely absent. Major ecological environmental foci, including atmospheric change and biodiversity loss, appear throughout the series. However, the chapters offer little to no discussion of more specific scientific subjects, including those that pose serious ethical questions, such as endocrine disruptors, habitat fragmentation, and ocean acidification. The volumes focus on broad-scale ecosystem classifications, agriculture, and vertebrate fauna. For example, Evan Eisenberg (2002) provides an insightful overview of the historical impacts of agriculture and deforestation on Israel, including soil salinization and nutrient loss. However, despite internationally recognized Israeli scholarship on the restoration of degraded lands and water conservation and the many Jewish-heritage scientists conducting marine, aquatic, or atmospheric research (including Lynn Margulis of Gaia systems theory), the volume on Judaism offers only a few pages on climate change and contemporary water management. Thanks to the Indigenous and anthropological authors, Grim (2001) covers the widest variety of biomes in the series, repeatedly addresses biocultural diversity, uses terms such as endemic and exotic, and mentions multiple species (primarily megafauna and economically important plants). However, while covering climate change, fires in tropical forests, and nuclear waste, it does not delve into a full range of global processes critical to Indigenous cultural survival, such as sea-level rise and the long-distance transport of pollutants via marine food chains.

A significant number of contributors to the *World Religions and Ecology* series have interdisciplinary backgrounds or dual degrees, and another investigator may have categorized them differently. However, crediting every bachelor's degree in biology would not greatly increase the scientific presence or properly identify individuals with credentials as ecological professionals or researchers. The inclusion of scientific ecology was sporadic at best, and, with a few exceptions, limited to the overview level. The paucity of other environmental sciences, such as toxicology and atmospheric chemistry, further limited dialogue with scientific ecology. This suggests that religious scholars have appropriated the term ecology and the implication of a more profound understanding of biotic diversity and natural processes it conveys, or that they have adopted the popular rather than the scientific definition.

Integral Ecology's Origins

Before addressing the question of whether this appropriation is problematic, it is helpful to explore an additional interdisciplinary term that emerged about the same time as the Tucker and Grim project but has more recently gained

traction as a distinct theological or philosophical approach: internal ecology. The definitions and practices of integral ecology vary relative to the religious backgrounds of its advocates. The Christian conceptualization is anchored in the thought of late twentieth-century Catholic theologians, particularly Thomas Berry and Leonardo Boff, as articulated in *Laudato Si'* under the guidance of Pope Francis. Boff originally used the language of "holism" and "holistic ecology." Tucker et al. (2019, 147) credit Berry with first using the term integral ecology in 1995. Roman Catholic theologians and community leaders have widely adopted integral ecology as a concept that merges Catholic spirituality and social ethics with environmental problem-solving. A second cadre is more closely related to the assemblage of alternative religious pathways arising from Western explorations of Asian religions and contemplative spirituality. For example, Ken Wilber (2011, 2017), one of the most cited leaders of "integral studies," proposes elevating humanity to a second-tier cosmic consciousness. His program has elements of New Age cosmology, including a linear and deterministic hierarchy of spiritual states identified by colors, a division of human scholarship into four quadrants, and claims that integral transformative practice can prevent the impending demise of humanity. Focusing on human consciousness, Wilber (1995) adopts the idea of an "integral-perspectival mind" from Jean Gebser's (1985) *The Ever-Present Origin,* initially published in German in 1953 (*Ursprung und Gegenwart*). Wilber (2011, 2017) aligns "integral transformation" with the applied academic fields of politics, governance, medicine, business, education, and, of course, integral ecology. Yet a third cadre of progressive scholars, predominantly from the humanities rather than a denominational framework, has also adopted integral ecology as a basis for freeing diverse cultural constructions of nature from the constraints of the materialism and reductionism that support ongoing environmental degradation. Including philosophers and religious scholars, such as Michael Zimmerman and Sam Mickey, these integral ecologists often cite Wilber and adopt his models.

Figure 2 compares the academic backgrounds of the editors and contributors to a Roman Catholic-focused collection of essays by O'Hara et al. (2020), *Integral Ecology for a More Sustainable World: Dialogues with Laudato Si'*, and those in *The Variety of Integral Ecologies: Nature, Culture, and Knowledge in the Planetary Era* by Mickey et al. (2017a), which is anchored in humanities scholarship. The profile of O'Hara et al. (2020) is very similar to that of the Harvard volume on Christianity, with theology and religious ethics strongly dominant. Although several contributors have secondary credentials in fields such as business, health, and agroecology, only one scientist authored a chapter—Brother Guy Consolmagno, a physicist who has served as director of the Vatican Observatory. He addresses critiques, going back to the Galileo debacle, that the church and the pope should not be engaged in science. The works in Mickey et al. (2017a) are primarily a combination of philosophical and religious studies and social science, with no scientists serving as authors.

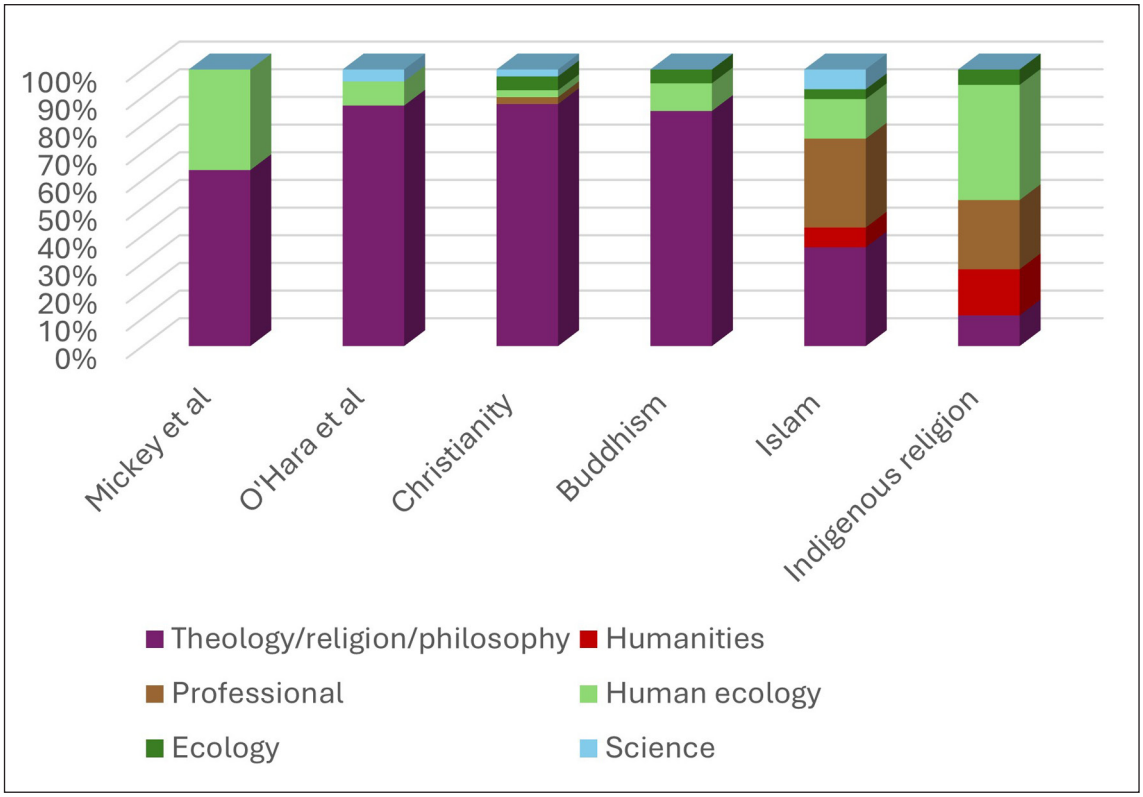


Figure 2: Fields of the authors and editors, two *Integral Ecology* volumes compared to the Harvard Series. The graph partitions the educational and research backgrounds of the authors and editors from two volumes on integral ecology and selected volumes in the series on ecology and religion edited by Mary Evelyn Tucker and John Grim. The comparison demonstrates the integral ecology volumes incorporate no contributions by scientific ecologists. The author background of the integral ecology volume by Roman Catholic contributors (O'Hara et al. 2020) is similar to that of the Harvard series volume on Christianity (Hessel and Ruether 2000). The categories are all sciences (other than ecology), ecological science, social sciences and human ecology, the professions (including law, medicine, and architecture), humanities such as languages and literature, and a combined category for theology, religious studies, ethics, and philosophy. The volumes are Mickey et al. (2017), O'Hara et al. (2020), Hessel and Ruether (2000), Tucker and Williams (1997), Folz et al. (2003), and Grim (2001).

Integral Ecology's Evaluation of Scientific Ecology, Ken Wilber, and Mickey et al. (2017a)

Before investigating Mickey et al. (2017a) in more detail, a review of Wilber's tenets is helpful in distinguishing Mickey et al.'s conceptualization of integral ecology from that of Pope Francis. Wilber is immediately problematic, as his discussions of science are brief, dated, and bereft of contemporary scientific theory. In *A Theory of Everything* (Wilber 2011, x–xi), for example, he incorporates a two-page description of string theory from physics without exploring other

scientific cosmological models. Primarily informed by concepts of social and psychological development, Wilber's use of the term "evolution" is not in the sense an evolutionary biologist would use it. As Lisa Sideris (2018) summarizes: "An important feature of both [Michael] Zimmerman's and Wilber's theories is the idea of hierarchical stages of cultural evolution, and tiers of consciousness, that are understood to have universal relevance and applicability for human history. Wilber and many who follow him hold that most people have not attained these higher stages of consciousness." Wilber's evolutionary cosmic consciousness shares features of social Darwinism, such as an ever-ascendant humanity, and elements of apocalyptic prophecy that most life science researchers diligently avoid.

Acknowledging his revision of the Great Chain of Being, Wilber (2011, 66) presents a nested hierarchy encompassing the universe and human existence in levels, where the physiosphere is below the biosphere, which is below the noosphere incorporating human consciousness and the apex theosphere. For Wilber (2011, 98), the noosphere "transcends and includes the biosphere. The biosphere is a crucial component of the noosphere, but not vice versa." He argues that "eco-philosophers, who abhor hierarchies that place humans on top of the evolutionary scale . . . value the biosphere above particular organisms, such as man," implying those who focus on the biosphere fall short of second-tier consciousness, which requires a concern for all humanity (Wilber 2011, 38). As Sideris (2018) concludes: "Integral ecology in a Wilberian vein adopts a multi-perspectival, comprehensive approach to reality that is indebted to a framework devised by Wilber called the AQAL (all-quadrant, all-level). The AQAL model acts as a metatheory that assumes there are (at least) four irreducible perspectives, or quadrants, that must be addressed in order to understand and deal with environmental problems: objective, interobjective, subjective, and intersubjective perspectives." Wilber (2011, 98) extends his critique of "ecotheorists" who treat nature or the biosphere as the ultimate reality to identify the biosphere as "only *half* the story." The biosphere is "only a small slice of the Bigger Pie . . . that includes the biosphere, noosphere, and theosphere," and de facto all four of Wilber's quadrants. From a scientific ecological perspective, the biosphere is not a cosmic model. The term is used to convey the interconnectivity of Earth's living organisms and ecosystems. Wilber changes its definition, demotes it, and makes it subject to controversial religious principles. While Wilber (2000, 470–71) rarely comments on specific environmental issues, he critiques the "Eco-camp" for its abuse of reason and attempt to embrace nature rather than accomplish "transcendence from the biosphere to the noosphere." He is equally dismissive of systems theory from all fields for its "subtle reductionism" and "limited worldview," and for being an "exterior approach" (Wilber 2000, 117–47).

Wilber's (2011, 8–11) passion for nested hierarchies presents a barrier to developing environmental strategies incorporating a diversity of religious

perspectives, because he hierarchically arranges spirituality as memes, beginning with the first-tier stages of survival sense (beige), evolving to kin spirits (purple), followed by power gods (red), truth force (blue), strive drive (orange), human bond (green), flex flow (yellow), and the two superior stages distinguishing second-tier thinking—whole view (turquoise) and integral-holonic (coral). Magical or animistic religions are purple, while tribal religions with heroic narratives and mythic spirits are red. Religions based on an omnipotent other and emphasizing the law are blue, landing the Abrahamic faiths in the middle of the first tier. Although Wilber (2011, 2017) places the theosphere at the apex of his nested hierarchy, he provides almost no information on what defines or characterizes it. Interestingly, Wilber (2000, 521) prophetically announces "the coming of the Over-Soul that is the World Soul" but does not discuss it, while extensively describing the marriage of spirit and soul (Wilber 2011). As understanding the theosphere is actualized via personal transformation, his theos emerges as a form of fill-in-the blank god.

Meanwhile, Wilber's models denigrate Indigenous religions as spiritually primitive and treat Roman Catholicism as the archaic blue meme. Wilber (2011) is particularly intent on superseding "boomeritis" and identifies the boomers committed to social justice and cultural pluralism as the green meme. They are nearing, but three stages below, the ethical ideal. He observes that cultural and religious pluralisms accept inadequate worldviews; thus, his spiritual consciousness should replace these faulty forms of egalitarianism. Interestingly, Wilber's definition of boomeritis could cast Boff and Pope Francis and their emphasis on care for the poor as archetypes of the green meme. Wilber's repeated justification for demoting science, the civil rights movement, environmentalism, and premodern religions is that they have not been effective at solving all humanity's problems. He thus sets an impossible standard and offers an abstract, even magical, key to attaining it. Sideris (2018) observes that Zimmerman has criticized "the pope's failure to think along lines of cosmic evolutionary (hierarchical) development," thereby deeming *Laudato Si'* and Francis's version of integral ecology inadequate. Clearly, integral ecology is not one school of thought. Wilber is not well-versed in scientific ecology, nor is he an environmental writer, considering his infrequent and superficial attention to specific environmental issues.

Mickey et al. (2017b, 1) open their introductory chapter with the premise that defining ecology in biotic terms is insufficient and that scientific ecology does not provide adequate knowledge or interdisciplinarity to understand the "Earth community." Notably, they begin at the global scale, asserting:

> Ecology is typically defined as the study of relationships between organisms and their environments. Although this definition is correct, it does not tell the whole story. More specifically, it does not account for what can be described as integral ecologies—a variety of emerging approaches to ecology that cross

> disciplinary boundaries in efforts to deeply understand and creatively respond to complex matters, meanings, and mysteries of relationships that constitute the whole of the Earth community.

Mickey et al. (2017b, 1–2) then treat ecological science as relatively complete and dismiss the need for scientific updates. They claim sweeping authority in announcing: "The aim of this book is not to present a comprehensive account of ecology (much of which has already been written), but to introduce and explore the diversity of integral ecologies . . . Learning about integral ecologies cultivates a comprehensive understanding of ecology, which facilitates collaboration and communication amid a full spectrum of ecologies."

A notable feature of Mickey et al. (2017a) is that the editors and some contributors articulate a suspicion of ecological science and portray it as culturally isolated, narrowly focused, or socially biased. Interestingly, Mickey et al. (2017b) utilize two founders of ecology, Ernest Haeckel and Eugene Odum, as archetypes of scientific ecological thinkers. Their critique treats Haeckel as locked in mechanistic and materialistic models—a complaint that can be directed at science in general. Mickey et al. (2017b, 3) posit that "while Haeckel's ecology enlarged the scope of biology, it was only able to account for ecological phenomena mechanistically (i.e., as 'the necessary results of mechanical causes'), excluding as 'unscientific' any accounts of a divine plan or transcendent agency in the natural world." Citing Carolyn Merchant (2007, 178), Mickey et al. (2017b, 4) then decry Haeckel's monism for its basis in mechanistic explanations and for attributing varieties of moral and religious consciousness to the same mechanistic processes. They reject his pantheism, radical for its time, for related faults, in concluding: "Although Haeckel includes inquiries into divinity and consciousness in his ecology, he includes them in a way that fails to honor the depth and mystery of such topics . . . His pantheism is a mechanistic materialism." Mickey et al. (2017b) rightly condemn Haeckel's contributions to social Darwinism and, after his death, Nazi ideology's exploitation of his ideas. However, they offer no evidence that social Darwinism and its justification of racism are continuing failures of contemporary scientific ecology.

In turning to Odum, who had retired by the 1980s, Mickey et al. (2017b, 5) backdate scientific ecology's leadership by half a century. They again invoke the limitations of science in general when they observe that "Odum's integrative approach to ecology supports efforts to overcome reductionism and work toward the mutual benefit of science and society. However, his ecology still contains aspects of the reductionism it claims to avoid. He does not address the spiritual or religious dimensions of ecology at all, nor does he include the humanities within his holistic thinking" (Mickey et al. 2017b, 5). Citing Donato Bergandi (2000, 16), Mikey et al. (2017b, 5) suggest that "one could describe Odum's 'holistic' ecology' as 'cryptoreductionistic' or as 'reductionistic holism.'" Mickey

et al. (2017b, 5) further propose that "Odum's integrative ecology would have been more holistic if it included perspectives from the humanities, including disciplines such as cultural anthropology, religious studies, philosophy, literary theory and poetics, the latter two fields bringing together the humanities with the fine arts." However, Odum acknowledges that his own ecological thinking was strongly influenced by his sociologist father, Howard Washington Odum, a professor at the University of North Carolina, from whom he also acquired a commitment to social justice (Craige 2001, 114). Further, Odum was an early advocate for Aldo Leopold's land ethics, personally presented on the topic, and was interested in whether ecosystem science could provide further insights applicable to environmental ethics (Craige 2001, 107–14). During Odum's tenure, the Institute of Ecology he founded at the University of Georgia included faculty from the humanities and aesthetic fields and served as a platform for guest humanities speakers, such as Holmes Ralston and Merchant. Eugene Odum's spouse, Martha Ann Huff Odum, who majored in design at the University of Illinois and expressed her love of wilderness and nature through painting, helped to instill art in the Institute of Ecology's scholarly culture. The institute building was designed with display space and hosted art shows with receptions and lectures (Craige 2001, 19–20).

Rather than give Odum credit as a founder of the field of environmental studies who labored to legitimize environmental policy and ethics courses in curricula and provide ecological science textbooks suitable for baccalaureate students from nonscience fields, Mickey et al. (2017b) cast him as a "lab rat" in disguise. This points to two issues. The first is that the invocation of strongly compartmentalized models of the relationships among academic fields, such as those of Wilber, does not accommodate the scholarly contributions of highly interdisciplinary scientists, such as Odum, Leopold, and Rachel Carson, or the integrative nature of their explorations, such as system ecologist and mathematical modeler H. H. Shugart's (2014) *Foundations of the Earth: Global Ecological Change and the Book of Job*. Mickey et al. (2017b) adopt a stereotype of scientific ecologists as confined by materialism (the "It"), and thereby disinterested in the aesthetic, spiritual, or communitarian. The second issue is that integral ecology and scientific ecology differ in their concepts of holism and do not have the same scope or standards for validating their models. Scientific ecology is about living, and thereby material systems and the tangible and observable processes that generate and maintain them. The environmental and ecological sciences incorporate reductionist studies—such as LD_{50} experiments, mapping mercury or DDE in sediments, and quantifying carbon sequestration by plant species—that both inform constructive environmental action as they stand and contribute to the development of systems models. Their validity rests in their replicability, accuracy, and precision and whether repeated application proves their predictions about how biotic systems behave. In contrast, Wilber

claims holism by placing a theosphere atop a cosmic hierarchy, yet does not fully describe or characterize *theos*. Mickey et al. (2017a) forward the artificially bounded AQAL model.

Mickey et al.'s (2017b, 10) integral ecology tracks its lineage to theologians, particularly Thomas Berry and Leonardo Boff, whom they favorably compare with German Romantics like Johann Wolfgang von Goethe, as they all "viewed natural phenomena in terms of a natural process that cannot be captured by mechanistic explanations." However, Mickey et al. (2017b) do not center their conceptualization around Boff's focus on the poor and disenfranchised. They frequently cite integral theorist Wilber's (1995) *Sex, Ecology, Spirituality: The Spirit of Evolution* as a model for countering the weaknesses of contemporary philosophical naturalism and the environmentally damaging, mechanistic, materialist worldview they believe it forwards. Sean Kelly's (2017, 189) chapter, "Five Principles of Integral Ecology," credits ecological science for contributing "to a more holistic, and in this sense, more integral understanding of the natural world." However, Kelly expresses concern about academic specialization and fragmentation and depicts the sciences, including ecology, as more guilty of these sins than the humanities. Kelly (2017, 202) claims that while "Standard Gaia theory and Earth system science already represent significant challenges to the dominant trend in late modern science toward increasing specialization and disciplinary fragmentation. The sciences of ecology, for their part, are generally following the dominant trend." Kelly (2017) provides no historical evidence, however, to support either statement or the implied comparison. Informed by Basarab Nicolescu (2002), Kelly (2017, 202) concludes: "It is worth remembering that the disciplinary mind of modern science—which as we have seen, extends to standard ecology as well." From a scientific ecologist's perspective, environmental concerns have fueled the consolidation of several ecological subfields and spurred ecological applications of molecular genetics, analytical chemistry, and quantitative stochastic modeling. Attempting to solve wicked environmental problems has favored specialization but also encouraged transdisciplinary research projects.

Kelly (2017, 208) articulates the integral ecologists' worry that ecology as a branch of modern science "was schooled within the wider cultural process of what sociologist Max Weber called the 'disenchantment (*Entzauberung*) of the world.'" Kelly presents re(enchantment) as a transformative process and establishes it as one of the five principles that define integral ecology, along with evolutionary, planetary, transdisciplinary, and engaged. From an environmental problem-solving perspective, these are qualities, values, or even communitarian virtues that can be applied across any relevant academic field. Concerned about disenchantment and the scientific limitations of what ecology explores, Mickey et al. (2017a, 12) invoke a Wilber (1995)-inspired integral ecology that "overcomes dualisms of objectivity/subjectivity and matter/spirit." This ideally conceptualizes "nature and

culture as mutually constitutive, not mutually exclusive" (Mickey et al. 2017a, 12). As Esbjörn-Hargens and Zimmerman (2011, 276) propose, this helps to "avoid a nature-versus-culture stance." To this end, they classify scientific ecology with the "It" portion rather than the "We." Sean Esbjörn and Michael Zimmerman (2017) organize ecologies and their parallel academic fields, providing four categories from Wilber's AQAL model: Exterior-Individual-It versus Interior-Individual-I; and Exterior-Collective-Its versus Interior-Collective-We. In their scheme, Exterior-Individual-It is the terrain of behaviors, including such disparate fields as chemical ecology, physiological ecology, cognitive ecology, restoration ecology, environmental psychology, molecular ecology, theoretical "pure" ecology, and ecological modeling. This category mixes applied research with theoretical and purely conceptual modeling, and analytic and heavily instrumented studies with research that is primarily descriptive or experiential. From the perspective of scientific ecology, the AQAL model is binary, defined by absolute boundaries, and non-integrative.

The Maturing Conversations Prompted by *Laudato Si'*

The integral ecology of O'Hara et al. (2020) is far more concrete in its approach to social ethics and infuses more environmental economics, policy, and science into its analyses than that of Wilber or Mickey et al. (2017a). Two chapters engage climate change, one examines nuclear energy, and four explore the technocratic paradigm. Matthew Whelan (2020, 100), who has worked in field as an agroecologist, presents "an agroecological reading of *Laudato Si'*," where he constructively draws on work of scientific ecologists, such as John Vandermeer, and argues that agroecology should replace industrial agriculture, because a distinguishing characteristic of industrial agriculture is "its failure to defer to and to learn from the wisdom of the earthly and natural order given by God." Expressing the Catholic integral ecologists' concern that economic and political interests can suppress science, Stephen B. Scharper (2020, 50) comments that: "Climate change science has emerged in the last three decades as one of the most vexed and contentious areas of contemporary scientific endeavor. From the muzzling of environmental scientists and the closing of ecological research centers in Canada to the censorship of leading climate researchers in the United States, such as NASA climate scientist James Hansen, politics has tinctured, tethered, and at times eclipsed scientific data on one of the most crucial issues of our times." Overall, the integral approach of O'Hara et al. (2020) seeks a participatory balance, where the environmental sciences work constructively with Catholic social ethics to overcome the problems generated by the ideals of unlimited economic growth and consumerism, and scientists understand that "science and technology must develop with an awareness of its ethical and human implications" (Consolmagno 2020, 191). Just as Pope Francis consulted scientists in drafting *Laudato Si'*, O'Hara et al. (2020) acknowledge the necessity and value of tapping ecological knowledge

and wisdom. However, a concern evident in several chapters and shared with Wilber is that scientific ecologists pursue preservationist goals that protect the biota at the expense of humans.

Appropriation of the Term "Ecology"

Appropriation is a complex topic because the term "ecology" is applied in different ways. On the one hand, as religion often guides political and social responses to environmental change and degradation, using ecology as a banner or call to action is well-meaning and invites civic engagement. The public understands ecology as the pursuit of healthy living systems and sustainable economies. On the other hand, the word ecology suggests a knowledge and appreciation of the Earth's biotic communities, which may or may not be present in the practice of religion-and-ecology. The selection of authors and editors for the Harvard series and the integral ecologists' association of scientific ecology with the inadequacies of contemporary natural philosophy are not just responses to trends in popular ecology but contribute to the detachment of the term ecology from its scientific roots. Although several authors in the Harvard series incorporate life science in their chapters, the series favors universal scales and splicing ecology with sustainability. While *Laudato Si'* has a more intentional program for fostering constructive participation with scientific ecology, its application of integral ecology is primarily cultural.

Wilber appropriates ecology, evolution, and Teilhard de Chardin's noosphere in constructing and legitimating his cosmological models. The appropriation of scientific language is also evident in the coinage of new terms related to ecology and religion and affects the field's approaches to spatial and temporal scales. For example, Thomas Berry's emerging "Ecozoic" age borrows from the geological identification of the planet's great evolutionary eras, such as the Paleozoic and Mesozoic. The original geological divisions are "zoic" as they are based on radical changes in fossil assemblages of animal remains. In contrast, Berry's Ecozoic compresses the time frame and places it on a human scale, which ignores the massive geophysical and biological changes that initiated the Paleozoic. Further, from a scientific perspective, all eras (sometimes called ages) are equally ecological. As "ologies," the words ecology and geology claim a superior understanding of Earth systems and thereby assert scholarly authority. Tucker identifies Berry as a geologian—a hybrid between a geologist and a theologian. Although borrowing the authority of science to create banners and goals for religious environmental activism is neither unethical nor ineffective, it can result in dissonance with scientific language and understanding. It becomes concerning if it disconnects or displaces ecology and other sciences rather than draws on their knowledge and wisdom, or causes scientists to dismiss religious ideas as inconsistent with scientific models.

Among the three perspectives investigated, Tucker and Grim's project is respectful of ecological science, yet it did not explore contemporary ecological

theory or delve into its ideas of environmental systems change in space and time. Wilber and Mickey et al. (2017a) portray ecology as flawed due to materialism and reductionism. While Kelly's (2017) identification of integral ecology as evolutionary bolsters its claim of authority, his application of the term evolution relative to scientific usage is indefinite. Mickey et al.'s (2017b) arguments that scientific ecology fails in holism, interdisciplinarity, and social accountability allow humanities scholars to claim high ground in academic leadership. Unfortunately, the assumption that much of what scientific ecology has to offer is already available inhibits exploration of current applied ecological research and a host of concerns centered on living systems. O'Hara et al. (2020) are the most intentional in synthesizing environmental science with social ethics and reflect *Laudato Si's* effort to consult scientists. Nonetheless, the trajectory overall has been to increasingly treat ecology as a general cultural understanding of nature rather than the practice of science or natural history per se.

The academic trends bring up an additional question: Can religion harm or fuel disregard for scientific ecology? A thought-provoking feature of Mickey et al.'s (2017a) precepts is the degree to which they share conservative religionists' distrust of contemporary science, including ecology, and their apprehension that ecological science ignores, supersedes, or disempowers the divine and enchanted. Both Mickey et al. (2017a) and religious conservatives portray life and physical science as unresponsive to sociocultural contexts and are wary of science's potential to support undemocratic and oppressive social hierarchies. Some (not all) Christian Evangelicals may reject scientific findings as superseding divine authority, especially when the science predicts environmental degradation or disasters (Veldman 2019). As Naomi Oreskes and Erik Conway (2010) have documented, industrial lobbyists have fueled Christian conservative suspicions that contemporary science is untrustworthy and that scientists are secular, self-motivated, and materialistic, thereby encouraging climate change skepticism. By supporting environmental causes, the integral ecologists certainly diverge from Christian conservatives. However, in reference to controversial applications of integral ecology, such as Michael Zimmerman (2009), Sideris (2018) expresses the concern that, in adopting ecomodernism, with its technological solutions and free markets, and apparently Wilber, to question whether the scientific consensus on climate is sufficiently inclusive of alternative and skeptical perspectives." For religious conservatives and Neo-liberals contesting environmental research, the purpose is often a rejection of science's support for governmental regulation of business and industry. The contributors to Mickey et al. (2017a), in contrast, are more concerned that science can treat nature as mere material and reduce the diversity and richness of cultural and spiritual expression.

Marking a division among the schools of integral ecology, O'Hara et al. (2020) meld ecological science into their problem analyses and understand economically driven climate change denial as divisive. Additionally, *Laudato*

Si' places a much greater emphasis on the centrality of service and resisting economic sins in mitigating environmental degradation than Wilber's stages of cosmic consciousness model does. Scharper (2020) argues that *Laudato Si'*s calls for "compassionate science." Scientific objectification is not a deficiency. Yet, integral science arises from caring and compassionate goals, relationships, and applications. The flexibility of the term ecology camouflages the differences in cosmology, eschatology, and spiritual practice among integral ecologists.

Interdisciplinarity and Validating Models—the Case of Restoration Ecology

An additional means of examining the relationship between religion-and-ecology, integral ecologies, and scientific ecology is to determine if the religious and philosophical models are true, robust, and sufficient, and whether religion is weighing and absorbing concepts from contemporary scientific ecology, and vice versa. A division from the scientific ecologist's perspective is religion and ecology's tendency to universalize, elevate, or compress scales and underestimate the importance of microscales and phenomena such as patchiness in natural systems. While the "one-planet" or cosmic approach is friendly to considering relationships between anthropogenic and natural disturbances, the elevated scale precludes cultivating a nuanced understanding of how to plan for wildfires, storms, and atmospheric change-induced weather alterations. Damning the mechanistic approach devalues mathematical modeling and the instrumentation utilized for DNA sequencing and tracing chemical pollutants. In contrast, I have identified religious ecodimensionality as an essential characteristic of many effective religiously based strategies for environmental management, including their applications to resource-harvesting technologies, thereby integrating a scientific conceptualization of scales and cycles (Bratton 2018). For example, Indigenous fisheries management often conveys traditional ecological knowledge (TEK) via religious ritual, art, and narratives, thereby adapting harvest times and amounts to reproductive cycles, migrations, and population fluctuations.

All the contributing fields have, in one way or another, worked to eliminate simplistic dualisms. Yet, for the Wilber-informed integral ecologists, bifurcation of academic fields into those based on I/We or It implies that the We fields are the superior platform for action. The proposed classification is only useful if it accurately characterizes ecology and its subfields. A test is to examine an applied subfield, in this case restoration ecology with its social and civic components, to determine if its classification as Exterior-Individual-It is plausible and useful, and whether the scientists and professionals practicing ecological restoration dismiss the spiritual and aesthetic in favor of the mechanistic and material. In addition, ecological restoration innately engages careful applications of scale and combinations of anthropogenic and natural disturbances.

The science educator William Jordan III (2003, 2) has defined ecological restoration as "the attempt, sometimes spectacularly successful, sometimes less so, to make nature whole—that is, to deploy the technologies of agriculture, informed by history and the sciences of ecology and conservation biology—to return a landscape, whether a tract of land in Illinois, a mountain slope in Colorado or a coral reef in the Philippines, to some clearly defined historic ecological condition." In this conceptualization, human management may not just be necessary but healthy and positive for both the biota and the human community. Jordan has also proposed that restoration involves performance and potentially ritual. Regarding prescribed fire in native prairie restoration in the American Midwest, Jordan (1994) observes that "[t]he burns are really the quintessential or emblematic act of prairie restoration. They have even become a rite of spring, eagerly anticipated by the growing number of 'prairie people' involved in restoration efforts in the Midwest, and are often surrounded by a festive, joyful, atmosphere." Agreeing with poet and literary scholar Fredrick Turner (1988), Jordan (1994) "the need for prairie fire dramatizes *its* dependence on *us*, and so liberates us from our position as naturalists or observers of the community into a role of real citizenship." Gretel van Wieren (2008) points out that in the practice of restoration, "humans are in important ways restored to land," and the reconnection is effective "in a spiritual-moral sense." She concludes that "restoration performs sacred work and serves as a form of public witness; and it can engender spiritual-moral experiences within participants." These models treat well-planned and well-executed ecological restoration as an actualization of "We" rather than "I" or the more distant and material "It" in terms of the human community, the ecological community, and their integration. Fields such as restoration ecology and conservation biology incorporate culture and its components in their very definition.

In "A Night Burn on the Prairie: Ecological Restoration as Performance, Ritual, and Ceremony," Jordan et al. (2026) argue that scientifically informed restoration practice can still emerge as an intricately organized cultural construction and a spiritual or religious experience. Spirituality, in turn, fosters enthusiasm, caretaking, and love of nature. They ask if the burns are performance, ritual, or ceremony, whether the fire, flora, and fauna are actors or celebrants. Assuming the practice of ecological restoration incorporates the Exterior and the Interior, Jordan et al. (2026) concur with van Wieren (2008) that restoration is an emerging form of public spiritual practice and thus a component of civil religion. Van Wieren (2013) documents the sisters of Holy Wisdom Benedictine Monastery in Wisconsin's participation in native prairie and woodland restoration as a form of sacramentality. Benedictine spirituality rests in the routine and mundane as framed by sacred time. The hours mark intervals for labor, study, contemplation, worship services, shared meals, and recreation. The community becomes "more aware of God's presence in

ordinary activities and in the larger world" (van Wieren 2013, 153). Restoration counts as strenuous work, including such physically or attention-demanding chores as seed collecting, pulling weeds, tilling, and transplanting. The sisters utilize the restored sites as educational venues for schoolchildren, and they have installed pleasant nature trails that serve as welcoming locales for absorbing the wonder of creation, engaging in prayer, and renewing the inner spirit (van Wieren 2013, 153–54).

The innovative Benedictines are practicing a form of integral ecology in their synthesis of science, engaged knowledge, addressing human community needs, caring for creation, nurturing spiritual practice, and welcoming the divine. However, their project was underway prior to the dissemination of *Laudato Si'*. Van Wieren (2013, 168) mentions in a footnote that "[e]arly on, Thomas Berry claimed a bioregional social philosophy as integral to an earth-based spirituality and ethic," but does not directly identify the Holy Wisdom project as integral. In this case, the venerable Benedictine concepts of the sacred nature of the biota (the material), time, and work have served the community in good stead. Additionally, examining how science and religion reached this juncture of flexible compatibility credits the ecologists with initiating the foundational restoration experiments, providing regional educational programs, and assisting private landowners, schools, and non-profits in getting involved. Holy Wisdom Monastery is near the University of Wisconsin-Madison Arboretum, which has a decades-long record of conserving representative examples of native plant communities, testing methods for conducting ecological restoration programs, developing conduits for communication among professionals, and prioritizing imaginative educational outreach. Prior to his retirement, William Jordan III was the arboretum's publications and outreach manager. Critical to this constructive outcome are scientific respect for religion, cultural diversity, and organizations with non-scientific missions, and religious respect for the needs of the greater community and the labors of the ecologists and scientific professionals. Although educational programs that promote healthy communication more often originate with scientific stakeholders, nourishing receptive cultures and civic frameworks is necessary to ensure the viability and duration of ecological restoration's endeavors. The management structure is inherently "We" and participatory. The normative "It" of scientific publication does not encompass the complex "We" of the wellsprings of ecological scientific imagination and process. Citing a study by Sara Pike (2023), Jordan et al. (2026) identify alternative and post-industrial religious engagement in ecological restoration as "a means of building relationships."

In inquiring whether religion can damage or suppress science, the question should also be posed: Can ecological science harm religions? Inadequate scientific modeling and invalid results have bolstered regulatory practices such as banning Indigenous cultural burning, which is part of a complex

of ceremonies and rituals. For example, misguided forestry planning has contributed to the decline of longleaf pine (*Pinus palustris*) and its unique floral communities by suppressing frequent low-intensity cultural fires (McGuire et al. 2023). Conversely, ecological restoration can serve as a means of recovering religious traditions, healing the land, and forwarding sovereignty for Native Americans, such as the Lumbee and Waccamaw Sioux, who incorporate the longleaf and sacred fire in their religious symbolism, rituals, and cosmologies. Cooperation with scientifically informed state agencies and conservation organizations, such as the Nature Conservancy, can accelerate ecosystem and cultural restoration (NC Botanical Garden 2024; Jordan et al. 2026). Kelly's (2017) five principles, including re-enchantment, are compatible with the social initiatives that restore longleaf and renew its interdependencies with human cultures. Both scientific restoration ecology's and religion-and-ecology's growing concordance with TEK as a historic means of retaining, dispersing, and processing inventories of biota and observations of biotic processes and relationships with the physical environment refine applications of scale and managed disturbance to site-specific planning (Nelson and Shilling 2018).

Discussion

In widespread usage, the meaning of ecology has diversified and become more culturally oriented. The scientific definition of ecology is, in comparison, relatively stable and remains biologically anchored. Religion-and-ecology, as well as integral ecology, primarily invoke ecology as a cultural phenomenon or value. Given this vocabulary tangle, religious scholars should identify scientific ecology as such when drawing on its models and knowledge. They should also consider how their audiences understand ecology and which form of religion-and-ecology they are investigating or advocating. Researchers should distinguish among popular themes, biased stereotypes, and vetted science. In addition, the applications of religion-and-ecology should strategically consider how best to further engage scientific ecologists, human ecologists, and environmental professionals with religious communities. Religious appropriation of ecology affects the scale and foci of environmental problem analysis. This can be beneficial when it enhances the understanding of social factors but a liability when it compresses scales, constrains research designs, devalues the biota, or dismisses complex phenomena, such as climate change.

Models such as Wilber's AQAL are so general and top-down that the inclusion of almost any religious activity in environmental problem-solving can be considered integral. For example, Sean Esbjörn-Hargens and Zimmerman (2011) provide case histories to validate the effectiveness of integral ecology. However, they include environmental conflicts in which integral ecology was neither the most influential religious contributor nor invoked by the primary

decision-makers. Darcy Riddell (2011) identifies integral ecology as contributing to the evolution of more culturally inclusive and environmentally conscious planning for British Columbia's rainforests. Riddell reports that she and other activists used Wilber's principles, including contemplative practice, to keep them focused on the campaign for forest conservation and overcome fatigue and despair—a worthy application. However, when she identifies First Nations' (Indigenous) religious contributions as consistent with the AQAL model, she then also treats them as a contribution of integral ecology. Environmental historians and policy analysts, however, credit the First Nations, rather than Wilberian integral ecology, with firmly defending their spiritual valuation of the landscape and cultural trees and championing an understanding of hydrologic change called "blue ecology." Further, government agencies and ecological professionals have been deploying contemporary planning strategies, such as adaptive management, that forward cultural values and contributions (Blackstock 2013; Takeda 2015). While Riddell's account is honest and heartfelt, to claim victory for a very Western, cosmic consciousness model, which conflicts with and displaces First Nations cosmology, is a form of appropriation that the First Nations rightly resist. Adherents of alternative religions and spiritualities have variously supported, protested, or attempted to usurp the leadership and religious values of the First Nations in resolving environmental conflicts (Coté 2010; Bratton 2021, 1–5, 23–47).

Analysis at universal and elevated scales is legitimate but insufficient to address environmental problem-solving at local and regional levels. The application of Wilber's concepts to classifying environmentally responsive sciences, such as restoration ecology, is too linear and dichotomous to fully evaluate the scientific fields' social structures and relationships with the human and nonhuman. As Benedictine sacramentality and Native American religions are anchored in lived-in landscapes and for centuries have supported thoughtful land care and the sacred essence of day-to-day work, they accommodate the scaling and interactivity of scientifically informed ecological restoration. A conscious effort by all restoration participants to draw on traditional ecological knowledge as well as university-generated scientific findings, and to cultivate the engaged knowledge generated by restoration practice, improves the viability and longevity of projects. Restoration in practice has the advantages of shared goals and bioregional frameworks, expediting consilience. However, in academic applications, the gaps in scale alone can constrict ecology-and-religion's repertoire of environmental concerns. The dismissal of scientific specializations and mechanistic research methodologies also depletes the inventory. Conversely, further religious examination of scientific ecology's investments in topics such as the fragmentation of ecological communities, human modification of disturbance regimes, species adaptation to physical environmental change, and the fate of pollutants in ecosystems will assist

in prioritizing issues for environmental action and identifying barriers to successful problem-solving.

Religion-and-ecology and integral ecology have already contributed to constructing robust and beneficial communication pathways. There are cases, such as the scientific professionals' potential for preempting TEK and Native American sovereignty, where scientists need to improve their understanding of the values and cultural contributions of religion. Conversely, devaluing scientific ecological knowledge because it's specialized, mathematical, or tracking carbon sequestration using sophisticated instrumentation is a nonstarter. Better options include encouraging shared knowledge, wisdom, contributions, and respect, as is evident in many restoration projects and in movements like blue ecology, which practice interdisciplinarity by promoting conversation and shared action among representatives of several fields or sources of expertise, including TEK (Blackstock 2013).

Wilber and the Roman Catholic integral ecologists share the perception that ecological science often sides with the biosphere against humankind. While scientific ecologists do develop protective relationships with the organisms and habitats they study, commercial and industrial anti-regulatory interests promote the stereotype of ecologists as anti-people. Further, many of the disasters caused by supposedly scientifically informed natural resources management arose from attempts to use ecological models to optimize production. The lack of ecological language and concepts, the demand for abstract holism, and the limited repertoire of ecological topics in the sources examined suggest that scholars with religious backgrounds may not be fully accessing scientific literature on specifically human topics such as environmental health and environmental risk. The experiment with Microsoft, where the "environmental" photo search produced more images of charismatic megafauna and splendid natural landscapes than of oil spills, microplastics, and wildfires, is evidence that the media selects for positive images and exciting wildlife rather than burned homes, drought-stressed farms, and Parkinson's disease patients. Ironically, much research specifically on human health or economic liabilities requires advanced skills in statistics, biochemistry, microbiology, or other "reductionist" fields to read and is less likely to appear in publications for general audiences. A possible corrective is to develop deep-dive projects or conversations to further open ecological and environmental science knowledge to religious leaders to provide new avenues for the social application of scientific findings. Pope Francis's integral ecology, for example, can provide a robust platform for shared religious and scientific ecological explorations of scale and disturbance, such as the fragmentation of vegetation in Amazonia, and applications of systems theory, such as the impacts of atmospheric change. Concerns for human welfare should prioritize ecological risk modeling and environmental health.

Competing Interests

The author declares that they have no competing interests.

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The Climate Emotions Wheel and Polycrisis Emotions: A Discussion with Special Emphasis on Religion and Science

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The troubled state of the world evokes many kinds of emotion. In this article, climate change-related emotions are discussed with the help of the Climate Emotions Wheel, a popular visualization published in 2023. Climate emotions are set in relation to "polycrisis emotions," and impacts of the polycrisis for climate emotions are explored. Special attention is given to how science and religion interact with (climate) emotions, both on their own and in interaction with each other. Climate scientists are used as a case example. Various dynamics of climate emotions are discussed, such as emotion norms and emotional complexity, and observations are made about their relationship with religion, science, and the polycrisis. Climate emotions are connected with issues related to wellbeing, environmental action, and ethics, and they are of interest to a wide range of people, including advocates, philosophers, health workers, scientists, and religious leaders. This interdisciplinary article aims to support in-depth engagement with climate and polycrisis emotions in various fields.

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Introduction: Emotions about a World in Crisis

The environmental crisis is intensifying in many ways, and a crucial part of this is anthropogenic global warming—the climate crisis (e.g., see Ripple et al. 2025). Scholars from a wide variety of disciplines are working with climate-related research. There is a growing interest towards emotions and other affective phenomena caused by the climate crisis, and climate (change) emotions research has lately developed into an interdisciplinary research field (Brosch and Sauter 2023; Pihkala 2022b). Climate emotions are interconnected with wellbeing, action tendencies, and ethical issues in a powerful but complex way (e.g., see Mosquera and Jylhä 2022; Alabak and Verduyn 2025). This makes them of interest to a wide variety of people, such as researchers, policymakers, educators, psychologists, communicators, philosophers, and religious leaders.

In the 2020s, the global situation has been characterized by multiple, interacting crises. The concept of polycrisis, coined in the 1990s by Edgar Morin and Anne-Brigette Kerne and recently popularized by Adam Tooze, has been increasingly used (Henig and Knight 2023; Rakowski et al. 2025). The polycrisis complicates discussions of climate emotions, as well as the broader topic of various eco-emotions. Emotions about the state of the world are evoked by complex phenomena related to many issues, such as militarization, disruptions in social order and politics, and migrations, all of which have connections to the climate crisis. There is not yet any widely accepted terminology for these emotions: "polycrisis emotions" is a working term used in this article, and some empirical studies have explored the topic (e.g., see Izydorczyk et al. 2025). There is a need to discuss the relationship between more particular climate emotions and the broader polycrisis emotions, along with exploration of various dynamics that are specific to climate emotions.

This article takes up that task. Dynamics of climate emotions are explored using a popular visualization, the Climate Emotions Wheel, as a focal point for discussion. The broader context of the polycrisis is discussed, but it is fully recognized that the topic needs further attention; this article aims to provide insights for future research. Special attention is given to religion, science, and the interaction between these—the field of science and religion. Scholars of religion and science have made some explorations of eco-emotions and climate emotions (e.g., see Pihkala 2018), but there is not yet much literature on the interconnections of eco-/climate emotions, religion, and science. This topic is also interesting for a broader audience, because religion, science, and their interplay can shape how people experience and evaluate emotions, including climate emotions.

The structure of the article is as follows. First, various kinds of eco-emotions and their relationships with climate emotions are briefly discussed. Then, emotion wheels and the Climate Emotions Wheel in particular are introduced. The next sections discuss religion, science, and (climate) emotions,

and climate scientists are used as a case example of how science and climate emotions can powerfully interact. The context of the polycrisis is then briefly discussed further. The latter part of the article explores various dynamics of climate emotions by using the wheel as a focal point. Observations about the polycrisis situation, science, and religion are made along the way. It is hoped that this wide-ranging discussion will benefit a broad range of people interested in climate emotions, and several themes for further research are mentioned.

Emotions about Environmental Matters and Technology

Emotions about environmental issues are nowadays most commonly called "eco-emotions" (Voşki et al. 2023). In environmental writing, there have already been depictions of such emotions for decades, for example in texts by famous American conservationist Aldo Leopold (1949) in the 1940s. But the conceptualization of a genre of eco-emotions is relatively recent. Australian environmental philosopher Glenn Albrecht (2019) created a concept for ecological grief, solastalgia, in the early 2000s, and later in the 2010s, he wrote about an array of "Earth Emotions." Others have used terms such as "environmental emotions" (Beran et al. 2025).

The objects of eco-emotions can be diverse. One fundamental trigger of eco-emotions is a local environmental change that evokes emotions because people have connections to the particular place and/or the living beings in it. Regional changes can also evoke emotions, as well as wider global environmental changes and threats. The latter phenomena are connected with psychological research about "macrosocial worries" (Wullenkord and Ojala 2023) and sociological research about how a changing world affects people (Brulle and Norgaard 2019). In the 2000s and especially since 2017, the psychological impacts of the global environmental crisis have been discussed with terminology of "eco-anxiety," "climate anxiety," and "eco-distress" (Pihkala 2024b). These terms describe complex phenomena that often include emotions but also other psychological states, such as stress, trauma, and anxiety states (Lawrance et al. 2022). Visible environmental changes and damage can cause strong emotions such as grief and anger when a beloved ecosystem is damaged (Pihkala 2024c), but invisible changes can also be psychologically significant and cause fear and anxiety because of uncertainty about how much they impact people and ecosystems (e.g., see the discussion in Marshall 2015).

The phenomenology of eco-emotions and climate emotions is thus complicated. Many factors shape people's emotions and other psychological reactions. There can be various triggers and causes for emotions. Emotions can and often do fluctuate. And people may or may not be aware of these dynamics (Crandon et al. 2022; Hoggett 2019). Various kinds of eco-emotions can interact with each other: for example, global environmental worry can cause a person to be more concerned about local environmental changes, and vice versa (Pihkala 2022a).

Technology, which is so intimately connected with science, plays a crucial role in numerous environmental changes anas well as in many efforts to protect the environment and increase sustainability. It is thus often involved in experiences of eco-emotions, including climate emotions. The phenomenology is again complex. The same issue, such as building wind turbines to increase renewable energy, can cause different kinds of emotions in different people: some are excited and hope is generated, while others are sad about the local impacts to ecosystems or angry that the turbines are placed in an unjust way in relation to ownership of the land or cultural heritage (Lundheim and Löfström 2025). Climate emotions and eco-emotions can thus be in a kind of conflict for people: in the aforementioned example, a development—the wind turbines—can simultaneously evoke both climate hope and local ecological grief.

Identities and values naturally shape people's eco-emotions and climate emotions (e.g., see Hulme 2009; Doherty et al. 2024). Strong environmental values and nature connectedness are generally related to stronger eco-emotions about local environmental changes and also affect climate emotions, but it should be noted that people with weak nature connectedness can still feel climate worry and anxiety because of the perceived threats to humans and human infrastructure (for research and discussions, see, e.g., Grénman et al. 2025; Wullenkord et al. 2024).

Climate Emotions Wheel

Emotion wheels have been used for a long time in psychology, and especially popular has been the one by psychologist Robert Plutchik (see Karimova 2017). Plutchik has been an influential emotion researcher and has advocated for categorizing eight primary emotions: anger, anticipation, joy, trust, fear, surprise, sadness, disgust. He argues that other emotions can be derived from these, but as a whole, frameworks of basic or primary or universal emotions have been debated, and there have been various versions (Scarantino 2016).

Plutchik's wheel has the aforementioned eight emotions in the middle. He also uses the image of an ice cream cone to depict relations between various intensities of emotion. Part of the scheme is to display relations between emotions by positioning them either close to each other or as opposite to each other. Emotions and counter-emotions are on opposite sides: for example, joy and sadness are opposite each other, as well as loathing and admiration. Plutchik uses physiological responses as the basis of this. Other emotion researchers and psychologists have proposed different models, and relations between emotions are a complex and continuously debated topic (e.g., see Semeraro et al. 2021).

Plutchik's wheel was one of the inspirations for the Climate Emotions Wheel, but this one does not try to include spatial dynamics such as emotions and counter-emotions. The wheel is a visualization of many of the emotions people have been observed to feel in relation to anthropogenic climate change.

A working group under the Climate Mental Health Network produced the wheel in 2023, using existing research on climate emotions as background. The work drew heavily from eco-emotion scholar Pihkala's work (esp. Pihkala 2022b). The design has four segments and under them, twenty-three emotion words in total, as seen in Figure 1.



Figure 1: The Climate Emotions Wheel. Climate Mental Health Network. Kamenetz, Pihkala and working group 2023. Published by permission.

The structure of the wheel is discussed further later in this article, but it should be noted that there are many possible ways to categorize and thematize climate emotions. There is also great variation in the amount of research and public discussion that has so far been given to different climate emotions. Some emotions mentioned in the wheel, such as worry, anxiety, grief, and guilt, have been studied in many research projects (Ojala et al. 2021; Marczak et al. 2023), while others have only recently received more attention, such as anger (e.g., see Gregersen et al. 2023). Some phenomena can be characterized as both emotions and something else, such as attitudes or virtues: hope is an example of this (e.g.,

see Pihkala 2018). And there are many climate emotions not mentioned in the wheel (Pihkala 2024a).

It is impossible to estimate the full impact of online graphics that can be freely shared, but it can be said that the Climate Emotions Wheel has been popular. It has been used by educators, communications personnel, psychologists, environmental activists, and many other groups. People from various countries have been inspired to translate the wheel, and it is currently available in thirty-one languages. As an example of prominent public use, it has been visible in Times Square, New York, as part of advertisement space donated to climate matters by a company (Climate Mental Health Network 2023).

The observed benefits of emotion wheels are many. In psychology, there is rich research data about the importance of being able to name emotions (Barrett et al. 2016). Broadly, it helps in engaging more constructively with emotions. Naming emotions activates areas of the prefrontal cortex that enable more calm decision-making. Self-awareness and self-knowledge increase, which can bring many benefits. After recognizing emotions, people can consciously apply what they have learned about that particular emotion, or seek for more information. Communication with others becomes more feasible, and people can tell others what they are feeling, if necessary. Skill with recognizing emotions in oneself can lead to better skill with recognizing other people's emotions and understanding them better. This is sometimes called affect labeling and/or emotional differentiation. The concepts of emotional granularity and emotional literacy are also connected to this (Smidt and Suvak 2015).

The Climate Emotions Wheel can be powerful in providing recognition and validation, and perhaps also witness. The existence of this kind of wheel signals public recognition of the emotional dimensions of climate change. People can feel validated by seeing the name of a climate emotion they are feeling in a published visual aid. The wheel bears witness to the wide range of climate emotions and gives them a certain right to exist by depicting them as common phenomena.

Religion, Science, and (Climate) Emotions

Study of religion and emotions is a thematic academic discipline (Corrigan 2007). Scholars and practitioners have been interested in many issues, such as emotions commonly experienced in religious practices, emotion norms and religion, and the possibility of categorizing certain particularly "religious emotions" (e.g., see Ferran 2019). It has been found that emotions are very significant in religion, but there is great variation in whether emotions are explicitly discussed in religious groups or just felt as part of spiritual life. Different religions and religious groups can emphasize different emotions as important or as a desired part of their social lives (e.g., see Roberts 2021). For example, there can be presuppositions that people will express guilt or gratitude at a given phase in a

religious ritual. Religion can also include norms about the desired intensity of emotions (Emmons 2005).

In a parallel manner, there has been research on science and emotions, exploring issues such as the role of emotions in practicing science, emotion norms in scientific communities, and various views of the relationship between science and emotion in history (e.g., see Dror et al. 2016; Scarantino and de Sousa 2018). Overall, science has a complicated history in relation to emotion. There have been powerful strands in Western science that have emphasized the importance of keeping emotions at a distance from ways of making scientific research (e.g., see Barbalet 2002). However, many researchers have pointed out that this is neither completely possible nor even desirable. Emotions are present as motivations for research; for example, scientific discoveries are often linked with profound joy (Barbalet 2002). Scholars working on sociology of science and emotions have pointed out that "extant literature indicates that emotions pervade science as a practice, profession and social institution. Emotions support the ability to perceive and observe empirical patterns and relationships, and to make specific types of knowledge claims. They are elemental facets of scientists' career evaluations and work life, and their influence on the research process informs and consequentially impacts the form and content of scientific knowledge" (Parker and Hackett 2014, 549).

Usually, scientific communities have strong implicit emotion norms that guide people not to show almost any emotion, especially "negative" ones, and I will return to this later. The interdisciplinary field of science and religion (or, religion and science) can also be analyzed in relation to emotions, but to my knowledge, there is not much research about this. Possible research questions include the role of emotions in interactions between science and religion, and emotions felt by practitioners of science and religion in their inquiries and activities. For example, gatherings of people interested in science and religion can include many emotions, such as joy meeting others interested in similar topics, envy about others who know more (this can also be "positive envy" in the form of admiration; see Lomas 2016), and warm feelings of togetherness.

Topics related to eco-emotions and climate emotions have been studied in relation to religion and to science, although these bodies of research are still quite limited in size. It is even more rare to find discussion about the three themes of eco-emotions, religion, and science, and this article at hand provides ideas for such studies.

I will introduce a few studies on religion and eco-emotions, as well as ones on science and eco-emotions. Several articles and essays discuss ecological grief (including climate grief) and religion/spirituality (e.g. Menning 2017; Malcolm 2020), as well as environmental guilt/shame and religion (e.g., see Fredericks 2014; Powell 2019). These two families of emotions, sadness and guilt, are prominent in Western religions such as Christianity and Judaism, which may

explain why they have been discussed so much in relation to environmental matters and religion. Furthermore, there have been some empirical studies about eco- and climate emotions felt by religious people. For example, Finlay Malcolm (2025) studied eco-emotions felt by environmentally active Christians in the United Kingdom, and Johannes Cairns and Panu Pihkala (2024) studied Western Engaged Buddhists' views about climate emotions. These empirical studies clearly found that the reservations in both Christianity and Buddhism about anger have affected views about climate anger. Activists had also made changes in their views because of what they learned in environmental action about the usefulness of constructive anger (see also Pihkala 2024d).

The Case Example of Climate Scientists and Climate Emotions

The case example of climate scientists and their climate emotions brings to the fore the complicated history and present situation of the relationship between science and emotion. Many climate scientists have, in recent years, criticized social norms in scientific communities that prevent them from expressing, and possibly even recognizing, their own their emotions. For example, Kimberly Nicholas (2021, 70–71) writes: "As a scientist, I was trained to be calm, rational, and objective, to focus on the facts . . . My dispassionate training has not prepared me for the increasingly frequent emotional crises of climate change."

A number of both research articles and journalistic texts emphasize the heavy mental toll on climate scientists because of their work and the social dynamics around it (e.g., see Head and Harada 2017; Pihkala 2020). These problems include certain emotion norms and disenfranchised climate grief (for the concept, see Pihkala 2024c). These topics have been discussed, for example on the pages of *Nature* (Rodrigues 2024) and *Nature Climate Change* (Schipper et al. 2024). As a counter-movement to restrictions around emotional expression and emotional competence, both climate scientists themselves and climate-aware therapists have developed methods to emotionally engage, such as group discussions and self-help texts (e.g., see Calabria et al. 2024; Haddaway and Duggan 2023; Marvel 2025). The website and project Is This How You Feel? (Duggan et al. 2021), where climate scientists write open letters about their emotions, is one public example of this.

E. L. F. Schipper and colleagues (2024, 1011) argue that if the full spectrum of emotional responses by climate scientists is not taken seriously, this is actually bad science: "The current dogma requiring climate scientists to ignore emotions, especially those typically labelled as negative, such as worry, sadness, anxiety and even anger, contradicts the very basis of science, which strives to initially take all factors of any given equation into account. Indeed, worries about the future, expressed as emotions, may also stimulate scientific curiosity and lead to success in ongoing research."

I am not aware of studies that provide in-depth analysis of how religion interacts with the climate emotions of climate scientists, but it is clear that these interactions do exist. One prominent figure to study would be the famous climate scientist and public advocate Katherine Hayhoe (2021), who speaks and writes openly about both her Christian faith and her many climate emotions. In the following section, observations about this general topic are made in relation to various emotion dynamics.

Climate Change, Emotions, and the Polycrisis

In the current situation, a number of interacting and overlapping crises evoke emotions and psychological distress in people. Naturally, the polycrisis is felt and experienced differently by different people in various socioeconomic situations and global contexts, but nobody who lives now is free from some impacts of the total crisis.

Psychological surveys have tried to find out the most pressing concerns for people, such as a study about distress in relation to climate change, the COVID-19 pandemic, and the war in Ukraine among the German population in the early 2020s. The authors make a very important point: "[S]imultaneous effects of these stressors are not yet understood, making it difficult to evaluate their relative contribution to the population burden and potential future manifestations in clinically significant psychiatric disorders" (Weierstall-Pust et al. 2022).

A question arises: Would it be important to explore and name "polycrisis emotions" and "polycrisis distress"? What emotions and combinations of emotions are particularly important for people living in various contexts amidst the polycrisis? This kind of exploration does not need to entail an attempt to name emotions and affective phenomena on behalf of others, but instead it can be descriptive and provide information for others to think about their emotions.

In my own experience, feelings of overwhelm are prominent among people in these times, as well as feelings of powerlessness. These are emotions that have featured strongly in surveys and interviews about climate emotions, but they are now often related to the polycrisis, and the climate crisis as an integral part of it. Many other emotions are evidently prominent and widespread too, such as anger about global leaders who wreak havoc and a disappointed disbelief in the downfall of democracy and ethics in global politics.

Several other dynamics around climate emotions and the polycrisis can be rather easily recognized. Climate anxiety can be about the environmental impacts of artificial intelligence and all the infrastructure and electricity it demands, and at the same time about wars that cause environmental damage and take political attention away from climate politics (for examples of this worry, see Kinney 2025; Bigger 2025). A special emotional dynamic amidst the intensifying polycrisis twists around the choice of actions. When so many crises

are urgent, where does one put one's limited resources for action? I have met climate-aware people who feel guilt because they are not able to devote as much time to climate action as before because other crises take so much attention. This is not the most traditional form of "climate guilt," but it is related to the more general topic of guilt and the climate crisis.

Exploring Climate Emotions, Religion, and Science with the Wheel

In this section, the dynamics of climate emotions and their connections with religion and science are discussed with the Climate Emotions Wheel as a focal point. This discussion also draws from my own experiences of engaging with various audiences about the wheel, including people in religion and science gatherings. Given the spatial limits of this article, the discussion will be brief, and it is hoped it provides ideas for further research and practical engagement.

Many aspects of the design of the wheel lead directly towards certain fruitful questions for discussion. In my experience, these tend to emerge spontaneously from (Western) audiences. For example, at least half the time, somebody asks about the balance between negative and positive emotions in the wheel.

Many of the selected topics are major themes in emotion research and public discussions around emotion: ways of categorizing emotions, colors and emotions, emotional complexity and mixed emotions, the relationship between language and emotion, the relationship between positive and negative emotions, emotion norms and feeling rules, and objects and triggers of emotions.

A note related to practice: when working with the wheel with various audiences, I often explicitly discuss most of these themes in an effort to increase emotional literacy amidst the polycrisis. These themes can be used consciously for psychoeducation amidst various audiences, including religion and science gatherings, religious communities, and scientific institutions.

Ways of Categorizing Emotions

There is a long discussion in psychology and emotion research about ways in which emotions should be defined and categorized (Scarantino 2016). It is not possible to delve deeply into these discussions here, but the idea of universal or basic emotions is important in relation to emotion wheels. There have been efforts in emotion wheels and graphs to name certain basic, fundamental emotions and other emotions under them. Plutchik has his version of this, but there is no commonly held agreement on basic or universal emotions. It is clear that some emotions are very universal, such as fear, joy, anger, and sadness, and these can usually be recognized via facial expressions (Barrett et al. 2016).

When preparing the Climate Emotions Wheel, there were various ideas about how to categorize climate emotions, and famous lists of basic or universal

emotions were consulted. However, climate change is a rather negative object of emotions, even while the particular objects of climate emotions may also include positive things, such as climate action for the common good. It was felt in the working group that no existing scheme of basic or universal emotions was an excellent fit for a climate emotions wheel. Thus, it was decided to use an applied structure of four segments. Three of them are as basic or universal as emotions get: fear, sadness, and anger. The fourth, a segment about more positively valenced emotions, was difficult to name. After long deliberation, it gained the somewhat vague title of "positivity." An earlier draft had "hope" in that place, but it was felt in the group that it would be problematic to characterize all the emotions in this segment as related to hope (Climate Mental Health Network 2023). There is an ongoing discussion in environmental thought and communication about the varieties of hope and their dynamics, for example in relation to action, wishful thinking, and meaningfulness (e.g., see Pihkala 2018; Kelsey 2020).

In relation to religion and science, one topic for deliberation is the question of religious emotions in relation to climate emotions and the wheel. Some emotions named in the wheel are more traditionally considered religious emotions, such as guilt, gratitude, and hope. But many common religious emotions are not named in the wheel, including some emotions that are common in the pursuit of science, such as awe and wonder (Gottlieb et al. 2018).

Colors and Emotions

Colors are evocative in relation to emotions. People may associate a given emotion with a certain color, but this is shaped by many factors, such as cultural traditions and personal preferences. Some commonly made links between emotions and colors have physical backgrounds. A person who is notably angry often has a reddened face, and red is a common symbolic color for anger, also in the Climate Emotions Wheel (for color and emotion, see Fugate and Franco 2019). In many therapies, color is used in various ways, and the wheel presents a possibility to invite people to reflect on that theme.

Overall, the Climate Emotions Wheel does not have a highly nuanced color scheme. The selection of green for the fear segment is a less common association, and sometimes raises questions. This can lead into discussions about what various colors signal and the general relationship between color and emotion.

In general, it would be interesting to explore the dynamics between color, religion, and science. How do various religions shape color symbolism, and what habits do they have of using certain colors? What is color from a scientific perspective, and how does that relate to social, cultural, and religious attitudes about color? Fascinating discussions about emotions, color, and contemporary issues such as climate change could emerge from these sets of questions.

Emotional Complexity and Mixed Emotions

It is well known that some emotional experiences include different, even opposite, elements: for example, one may feel both grateful and sad at the same time. Related to this, there are in-depth discussions in emotion research about what emotions fundamentally are and how neatly they can be separated from each other. Many scholars use the term emotional complexity to describe this topic area (Berrios 2019). The term "mixed emotions" is also well known in public discussions and may refer to various combinations: some people focus on combinations of positive and negative emotions (more about these concepts later), while others use the concept more broadly to describe any kind of assemblage of emotions (Grossmann and Ellsworth 2017). Emotion philosopher Sonja Rinofner-Kreidl (2016) has proposed the term "interlaced emotions" to describe similar dynamics in a general and rather poetic manner.

The wheel can invite people to think about various combinations of emotions and the general topic of emotional complexity. This is very relevant, since the climate crisis is such a complex phenomenon and can indeed evoke complex and multifaceted combinations of emotions. And, in relation to the other dynamics described here, the potential constructive impacts are broad and extend to general emotional literacy. Via realizing the complexity of climate emotions, people can learn more about emotional complexity in general.

It has been observed in research and therapy that people's climate emotions often fluctuate and change. There are processes of coping, adaptation, and transformation (Pihkala 2025). Climate scientists have testified in academic writing that "individual scientists—including the authors here—often cycle through feelings of both despair and hope, and/or work to actively cultivate optimism (despite despair) to ensure contributions to addressing the problem. Thus, feelings of alarmism and optimism are not necessarily fixed" (Schipper et al. 2024, 1011). Climate scientists have also testified to the mixed emotions inherent in doing their research: for example, joy of discovery can be combined with horror about the implications of the results (Haddaway and Duggan 2023, 14).

People working with religion and science are accustomed to explorations of complex phenomena, and they could contribute to insights about the complexity of climate emotions and the dynamics religion and science bring to this complexity. In the context of the polycrisis, emotional experiences are bound to be even more manifold.

The Relationship between Language and Emotion

The relationship between language and emotion has been much discussed (Pritzker et al. 2020). Words are important and useful in relation to emotions since they can provide at least some possibilities to describe emotions and talk about them with others. But philosophers of emotions have also expressed

doubt about the capacity of words to capture the extent and richness of emotional experiences. Furthermore, various languages have different sets of emotion words, and the relationship between language, culture, and emotion is important to think about.

In my experience, the Climate Emotions Wheel practically always sparks discussions about emotion labels, and I often encourage people to reflect more broadly on the relationship between language and emotion. Because the wheel has been translated into so many languages, the different freely available versions provide possibilities to compare expressions and connotations across various languages. I will use Finnish and English as examples. Some labels, such as overwhelm, are difficult to translate; for example, the Finnish equivalent, "ylitsekäyvyys," is an uncommon word. "Feeling overwhelmed" is a common climate emotion in English-speaking countries, but in Finnish, there is no common expression for this experience. However, when explained, people usually resonate with the experience. These kinds of discussions invite people to think about the relationship between language and emotion and encourage them to seek beneficial expressions for climate emotions in their own language. Using once again a Finnish example, the concept of "riittämättömyyden tunne," roughly translated as "feeling to not be enough," resonates with many people's experiences about climate change (e.g., see Coppola and Pihkala 2023).

Language is a theme closely related to religion and science dialogues, where participants have observed that it can take time to learn what others mean through their use of language; even the same term can signal different things to people from various backgrounds. Topics related to language, climate emotions, and religion and science could lead to very fruitful discussions; and, as mentioned earlier, the whole phenomena of polycrisis emotions requires new terminology and critical discussions of how to name phenomena.

The Relationship between Positive and Negative Emotions

Emotions are often described as positive or negative. There is an important critical discussion about this, because these labels can be unclear and sometimes have problematic implications, especially the downplaying of the value of negative emotions (e.g., see Solomon and Stone 2002). In what sense is an emotion "positive" or "negative"? This is linked with the concept of valence, which is sometimes understood only in relation to the pleasure or displeasure of an emotional experience. However, scholars have pointed out that valence can be evaluated with many kinds of criteria (Bellocchi and Turner 2019). Numerous psychologists and other thinkers have argued that all kinds of emotions can serve important functions, and "negative" emotions should not be despised even if there is a culture of emphasizing the positive (e.g., see Lomas 2016). Other possible terminology includes "difficult emotions" or "dark emotions" (Greenspan 2004).

As mentioned earlier, there have very often been complications in scientific communities regarding emotions and their expression. Several commentators have pointed out particular difficultly in relation to "negative" emotions (e.g., see Nicholas 2021). This is logical, given the situation: if there is a lack of skill or motivation to engage with even positive emotions, then engagement with negative emotions will be even more challenging. In relation to climate scientists, the long-standing pressure in environmental communication to display optimism is also a contributing factor to the difficulty of being with negative emotions, as scholars such as Susanne Moser (2015) have noted years ago. Recently, climate scientists themselves have testified that "negative" emotions can support them in their action and motivation: for example, "she [climate scientist Luciana Gatti] uses climate grief as a fuel to keep sounding the alarm" (Rodrigues 2024; see also Marvel 2025).

Could religion help engage with difficult emotions, since many religious practices encourage people to be with challenging affects such as guilt and sadness? For example, are climate scientists who have experience with religions and spirituality better equipped to engage with difficult climate emotions? These questions are worth pondering, and they will be discussed further in the following section. The polycrisis, with all the problems it brings, further increases the need for skills of "staying with the trouble" (Haraway 2016).

Emotion Norms and Feeling Rules

The topic of positive and negative emotions is closely connected with emotion norms and feeling rules. In a given community and culture, there are various norms related to emotions. These are related to questions such as who is supposed to feel what in a given situation, or who is allowed to display what emotion in public. Sociologists and social psychologists have studied these phenomena under the terms emotion norms and feeling rules. These norms and rules can impact both positive and negative emotions (however one defines them), but often they are very prominent in relation to negative emotions. For example, there are often cultural and gendered norms around expressing anger and sadness, and men typically are allowed more expression of anger and women more expression of sadness (Barrett et al. 2016).

Climate emotions are affected by emotion norms and feeling rules in many ways, and scholars have started to pay attention to this (e.g., see Neckel and Hasenfratz 2021; Mosquera and Jylhä 2022). These emotion norms can be gendered (for gender and emotion broadly, see Barrett et al. 2016). For example, men can find it even more difficult than women to be in touch with their climate grief because they have been socially conditioned to hide their sadness and grief in public, and the same applies for women and anger (e.g., see du Bray et al. 2019).

As mentioned, science and religion can shape emotion norms, and different groups that practice either of these, or both together, can have their own sets of emotion norms. In future research and public discussions, it would be important to explore these further. For example, it is easy to perceive that many religious leaders want to emphasize hope if they speak of climate anxiety and/or climate grief. One can ask: Is this at least partly related to an emotion norm—and theological stance—in religions in which there is pressure not to despair and pressure to mention hope? (For discussion, see Ward 2020; H. Malcolm 2020) Another example, closely related to Abrahamic religions, is guilt. Theological stances on guilt also shape stances on climate guilt (Fredericks 2021; Pihkala 2024d).

The topic of polycrisis and emotion norms is a whole new discourse that needs attention in future research and discussions. One example of the connections between this and climate emotions is that there can be norms about which aspects of the polycrisis are deemed suitable to be talked about in a certain social setting. For example, some people may prefer that military threats and their emotional impacts are discussed rather than the climate crisis and related emotions.

Objects and Triggers of Emotions

Emotions are triggered by something, and a complex interplay of internal and external factors shapes this. In emotion research, there are various models of this, and the concept of appraisal is important here: it describes, roughly speaking, how a situation is interpreted (Barrett et al. 2016). Emotions can have various kinds of objects or causes, and this is important to explore in relation to climate change and the polycrisis.

The wheel includes many emotions that may be evoked in relation to the climate crisis in its totality, such as worry and overwhelm. However, some of its emotion words are usually related to more specific objects (see also Rozen et al. 2025). For example, it is rare to feel gratitude about the climate crisis in totality, but many people feel gratitude towards other people who are active in climate matters. Inspiration and empowerment are also closely connected to climate action, not just the climate crisis per se.

A closely related issue is normativity and the question of connotations. For example, is climate anger always thought to mean pro-environmental anger? And do people have expectations about what a sensible human being should feel in relation to the climate crisis, for example in relation to climate injustice? Philosophers and psychologists have discussed these issues, and while there may be different opinions about how terms should be used, at least the underlying questions should be discussed with audiences. For example, Julia Mosquera and Kirsti Jylhä (2022) raise the importance of thinking critically about different normative assumptions in relation to eco- and climate emotions.

As mentioned, the polycrisis causes the need to think about various objects of emotion. The same issue can evoke climate emotions as well as other kinds of emotion. For example, war causes general worry but also environmental sadness and climate powerlessness. In relation to religion and science, there is the possibility of thinking about objects of emotions in relation to both as well as their interconnections, and all this can interact with how climate emotions and polycrisis emotions are perceived and experienced.

Concluding Reflections

In this interdisciplinary article, climate emotions have been discussed in the context of the polycrisis, with special attention to religion and science. Polycrisis emotions have been briefly explored, but further research is needed to study the various kinds of lived experience amidst the polycrisis.

The Climate Emotions Wheel has been used as a focal point for discussion of the dynamics of climate emotions. It is hoped that the wheel, related guides (e.g., see Pihkala 2024a), and this article could support in-depth engagement with climate emotions with various audiences, including communities and institutions related to religion and science. This article originates in the conference of the International Society for Science and Religion in Swindon, UK, in the summer 2025, where the wheel led to fascinating discussions.

Since emotion wheels have been found useful, should a special emotion wheel be developed for polycrisis emotions? This remains an open question, but for the time being, the Climate Emotions Wheel can also be used for discussions of polycrisis emotions. People could reflect on how the emotion words in it reflect polycrisis emotions and what emotion words might need to be added to capture some specific experiences of the polycrisis.

It has not been possible in this article to engage deeply with topics related to coping with climate emotions and emotion regulation. It should be mentioned that religious and spiritual practices can, at their best, engage with a wide range of (climate) emotions, and it would be important to continue to develop various kinds of methods for this, including rituals (e.g., see Clinebell 1996; Pihkala 2024d; Borovica et al. 2025). Contemplative practices can be helpful, such as mindfulness (Macaulay et al. 2025). Amidst a world in crisis, all kinds of institutions and methods are needed for the creative work of adaptation, mitigation, and transformation.

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Competing Interests

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What Can Ecotheology Learn from Science-Engaged Theology?

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The recent popularity of science-engaged theology has prompted several reflections on methodological frameworks and scholarly approaches within the field of science-and-religion. This article seeks to ask what, if anything, ecotheology might learn, both positively and negatively, from science-engaged theology. Is it helpful to think in terms of an ecologically engaged theology, and, if so, what are its principal features? The article engages with eight key characteristics of science-engaged theology: a commitment to empirically testable claims; an awareness of the instability of terms like "science" and "religion"; a rejection of overarching typologies; an insistence on very specific research questions; a desire to see science as a source for theology; a wider "theological turn" in scholarly approach; a hope for two-way exchange between scientists and theologians; and an invitation to all theologians to engage with the sciences. In each case, there are potential lessons for ecotheology to learn.

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Introduction

The recent popularity of science-engaged theology has prompted several reflections on academic approaches within the field of science-and-religion. In this article, I seek to ask what, if anything, ecotheology might learn from science-engaged theology. Is it helpful, for example, to think in terms of an ecologically engaged theology, and, if so, what are its principal features?

For some, science-engaged theology represents a potentially radical break from more traditional approaches to science-and-religion, while for others, it is considered a helpful subdiscipline within the wider science-and-religion stable (Leidenhag 2024a, 402; Harris 2023b, 34). My aim here is not to imply that ecotheology needs to undergo wholesale reformation in light of science-engaged theology, not least because there are several instances where ecotheologians are already aware of the sorts of insights that science-engaged theology might have to offer. For instance, when it comes to focusing on specific local contexts, ecotheologians might even be one step ahead (for a sense of Christian ecotheology's attention to local context see the summaries by denomination, region, and approach in Ernst M. Conradie [2023, 11–15]; for a set of examples see Raimundo C. Barreto, Graham McGeoch, and Wanderley Pereira da Rosa [2024]). Moreover, I do not want to assume that science-engaged theology has already replaced, or necessarily should replace, the traditional science-and-religion conversation. There may be just as much to learn from the critics of science-engaged theology as there is to glean from its proponents. Instead, my goal in this article is to critically assess how some of the issues raised by science-engaged theology might prompt and sharpen certain methodological reflections within ecotheology.

However, it is not particularly straightforward to offer a concise or widely shared definition of ecotheology. Indeed, one of the purposes of this article is to think further about the variety of ways in which ecotheology is construed and conducted. We might start with the idea that ecotheology involves "reflection on different facets of theology" in light of "cultural concerns about the environment and humanity's relationship with the natural world" (Deane-Drummond 2008, x). Yet the academic study of theological and religious interactions with ecology, nature, and the environment takes place under several different headings—including ecotheology, religion-and-ecology, and religion-and-nature—and it is important to recognize that these different titles imply different priorities and emphases. One important distinction follows the theology/religious studies divide: ecotheology tends to indicate an internal or confessional stance, while religion-and-ecology tends to indicate an external or social scientific approach (Bauman 2011, 377). In this article, when I ask, "What can ecotheology learn from science-engaged theology?", I am interested in a discussion that involves the whole ecotheology/religion-and-ecology nexus. In fact, it is exactly these

sorts of potential fault lines that deserve further interrogation in conversation with the insights of science-engaged theology.

Science-Engaged Theology

The notion of science-engaged theology emerged as a strategic priority of the John Templeton Foundation around 2017 (Leidenhag 2024a, 403). The first scholars to use the phrase in print were John Perry and Sarah Lane Ritchie in a 2018 *Zygon: Journal of Religion and Science* article (Perry and Ritchie 2018). Since then, numerous projects and publications have employed the nomenclature, but a lot of the theoretical thinking has been pursued by Perry and by Joanna Leidenhag, and they coauthored the first book-length treatment of the idea in 2023 (Perry and Leidenhag 2023).

In basic terms, science-engaged theology is "theology which engages the work of natural and human scientists" (Leidenhag 2024b, 3). To flesh out what this entails in practice, the exponents of science-engaged theology invoke three principal images. First, Perry and Ritchie (2018, 1087) propose an analogy with a Swiss Army knife. Their point is that not all questions can be answered with the same methodological tools: some questions require a corkscrew, while others require a nail file. For any given question in science-and-religion, there are quite specific parts of theology and quite specific parts of science that will need to be brought to bear on the problem at hand. A second metaphor imagines science-engaged theology as a series of puzzles: miniature theological conundrums to be solved with the help of empirical evidence. As Perry and Leidenhag (2021, 247) put it, the aim of science-engaged theology is to "study narrowly-focused theological questions that are already entangled with scientific theories and findings." On this account, many theological discussions already presume certain ideas about the empirical world, and the science-engaged theologian is simply checking these presumptions against the available empirical evidence. The third route into science-engaged theology is to think about science as a source for theology. As Perry and Leidenhag (2023, 1) put it, "the local tools and products of the sciences ought to be sources for theological reasoning." According to the Wesleyan Quadrilateral, scripture, tradition, reason, and experience are all legitimate starting points for theological reflection. It is conceivable that science could be considered a fifth source, but Perry and Leidenhag (2023, 50) prefer to think about how science is already implicated in the four existing sources. Scientists read the "book of nature" in similar ways to how theologians read scripture: scientific discourse operates according to a tradition of learning that is bound by certain institutions and practices; science is understood to proceed on a logical and rational basis; and scientific work depends on sensory experience of the world around us, albeit in a formalized and often technologically mediated fashion (Leidenhag 2024a, 405). Together, these three images help to crystallize

something of what science-engaged theology is about. The Swiss Army knife analogy highlights its "interdisciplinary and pragmatic" nature; the puzzles metaphor emphasizes "highly-localized questions" and "specialized methods"; and the science-as-source idea "gives logical priority to theology" (Leidenhag 2024b, 6–7). The three images overlap in various ways, but they also contain potentially divergent elements, and some scholars prefer to use just one of the images for their definition of science-engaged theology (Kopf 2025, 4).

It is also worth considering the impetus for science-engaged theology. Perry and Leidenhag trace three different motivations for its initiation (Perry and Leidenhag 2023, 7–47; Leidenhag 2024b, 8–10). The first stems from internal shifts within the field of science-and-religion. Work by John Hedley Brooke, David Livingstone, and especially Peter Harrison has increasingly indicated that "science" and "religion" are not transhistorical or transgeographical categories but rather interconnected and context-dependent enterprises (Brooke and Cantor 1998; Livingstone 2014; Harrison 2015; Perry and Leidenhag 2023, 17–20). Science-engaged theology therefore encourages scholars to forgo large-scale methodological questions about the overall relationship between science and religion and focus instead on more specific and more local concerns. Second, science-engaged theology dovetails with the shifting authority of theology over the course of Western intellectual history. To abbreviate a complex historical narrative, one could say that modernity placed theology on the back foot, forcing theology to either adhere to the standards of other disciplines or else become an increasingly sectarian and private affair. But the twentieth century saw theology regain academic confidence as a discipline that is allowed to ask, on its own terms, what the sciences can contribute to theological priorities. Third, science-engaged theology fits well within the postmodern academy, which tends to reject overarching metanarratives or essentialist metaphysics. Science-engaged theology's commitment to interdisciplinary conversation in the absence of stable definitions for some of the key terms is consonant with this reigning anti-essentialism.

So, what might this mean for ecotheology? In what follows, I examine eight specific hallmarks of science-engaged theology. Some of these emerge from its proponents, while others are emphasized by its critics. The eight hallmarks are: a commitment to empirically testable claims; an awareness of the instability of terms like science and religion; a rejection of overarching typologies; an insistence on very specific research questions; a desire to see science as a source for theology; a wider "theological turn" in scholarly approach; a hope for two-way exchange between scientists and theologians; and an invitation to all theologians to engage with the sciences. In each case, I assess what the issue at hand might indicate about the way ecotheology is conceived and practiced.

Empirically Testable Claims

At the root of the science-engaged theology project is a deeply held commitment to empirical investigation. According to Perry and Leidenhag (2023, 49), it is one of theology's "intellectual virtues" to want to be held to a certain "empirical accountability." In fact, they specifically applaud "risky" theologies that are not afraid of making concrete claims that can be subjected to empirical testing (Perry and Leidenhag 2023, 55). As Jonathan Jong (2021, 483) points out, these empirical claims very often lie in the realm of the cognitive, affective, and social sciences—a notable change from the traditional diet of physical and biological sciences that tended to dominate the early decades of the science-and-religion conversation.

Turning to ecotheology, this commitment to empirical testing meets with a mixed reception. On the one hand, ecotheology has long been interested in empirical engagement. Many ecotheologians point to Lynn White's (1967) (in)famous study on "The Historical Roots of Our Ecologic Crisis" as a starting point for the discipline. For various historical, genealogical, feminist, and decolonial reasons, ecotheologians are increasingly moving away from White as a founding figure (Bauman 2011, 377–80; Taylor 2016, 277–86). But it is noteworthy how many subsequent studies have been devoted to an empirical assessment of a version of White's central claim (for a summary of this literature, see Bron Taylor, Gretel Van Wieren, and Bernard Zaleha [2016, 318–30]). White's argument was that the predominance of anthropocentric thinking within Judeo-Christian theology has been the ultimate cause of much of the environmental destruction of recent times. If this is true, then sociologists ought to be able to find more negative environmental attitudes and behaviors among Christians and Jews than among members of other faiths. To date, the results of these studies have been largely inconclusive, presumably because there are so many other relevant factors that have to be disentangled. But the key point is that one of the most well-known instigators of ecotheological thinking was making a claim that is, at least in theory, empirically testable.

Moreover, Taylor explicitly argues that some of the central pillars of scholarship in the field (which he prefers to call religion-and-nature) are inherently empirical claims. For example, the notion that "religious ideas are important drivers of environment-impacting behaviors," or that "the world's religions have ideas that can spur environmentally friendly behavior and increasingly are doing so," cannot just be accepted at face value but must be proven with social scientific data (Taylor 2016, 296). Together, this cluster of claims forms what Taylor calls "the Greening of Religion Hypothesis." Again, the results thus far have not been terribly conclusive. But Taylor (2011, 253) agrees with science-engaged theology when he insists that "the field needs to move beyond anecdotal information and wishful thinking and develop a much more complex

and robust, mixed methods social science to explore the religious dimensions of the quest for environmental sustainability and conservation." It is frustrating that there is not yet sufficient data to reach firm conclusions on either White's or Taylor's thesis. As Jong (2021, 487) notes in his critique of science-engaged theology, the empirical work that is needed is often not yet available—and this certainly appears to be true here. But the sentiment is very much in line with what science-engaged theologians are recommending.

However, there are also many ecotheologians who do not follow through on the empirical implications of their theological statements. This is the flipside of Taylor's argument. He identifies and evaluates four methodological approaches to religious interactions with environmental concerns: "hortatory and normative" studies encourage certain ethical behaviors but do not engage with the sciences; "historical and anecdotal" studies make a claim about the green credentials of a religion but do not seek to evaluate it empirically; "qualitative/ethnographic" studies get rather closer to Taylor's data-driven ideal; but only "quantitative/empirical" studies can, in Taylor's view, reliably assess empirical hypotheses (Taylor, Van Wieren, and Zaleha 2016, 309). Taylor is particularly worried that partisan protagonists, who are already committed to either an environmental or a religious agenda, produce work that is confessional and insufficiently neutral to assess the empirical claims being made (Taylor, Van Wieren, and Zaleha 2016, 307). Taylor's sharp contrast between what counts as "confessional" and what counts as "neutral" is subject to debate (Jenkins 2017, 27–28), but the broader point about failing to follow through on the empirical dimensions of a theological claim is pertinent for ecotheology.

To give just one example: many ecotheologians find themselves attracted to a panentheist, or pantheist, understanding of the God–world relationship. Leading ecotheological thinkers, such as Sallie McFague (1993, 149–50) and Leonardo Boff (1997, 152–54), have argued for panentheism on the grounds that it presumably results in more environmentally friendly behaviors. Lina Langby (2023, 56) calls this the "panentheistic argument from environmental concern": panentheism is favored because it is believed to "invoke more responsibility, more care, and a more profound feeling of holiness toward our environment" than classical alternatives. Furthermore, panentheism is said to contribute directly to "action regarding the ecological and climate crises" (Kerber 2023, 219). There is a clear logic as to why such beliefs might be true: if nature exists within God such that there is a heightened sense of divine presence within nature, then believers may well be prompted to treat nature with greater reverence. Yet there is almost no empirical evidence to confirm these presumptions. In fact, one preliminary study of a select sample of Christian climate change activists indicates that panentheism might be no more motivating than a traditional concept of stewardship (Malcolm and Scott 2025).

This is where a science-engaged theologian would suggest that there are new research questions for an ecotheologian to explore, and much work to be done.

Nevertheless, it is particularly notable that ecotheologians rarely make claims that require empirical verification by the environmental sciences (as opposed to the cognitive, affective, and social sciences Jong identifies). Plenty of ecotheological works rely on generic scientific accounts of climate change or biodiversity loss, but it is harder to see how, for instance, conceptions of ecological sin would be substantively affected by, say, temperature projections for the year 2100. Empirical environmental science is important for establishing the magnitude, severity, and even irreversibility of the environmental problems at hand—and these insights undoubtedly influence the directions taken in ecotheology—but ecotheologians do not typically put forward ideas that can then be tested by the environmental sciences. This relative lack of engagement with the specific findings of the environmental and ecological sciences is an issue that recurs in the later section "Science as a Source for Theology," but it is salutary to wonder whether ecotheologians might be able to engage a wider range of empirically testable claims in their work. As just one example: theological statements about the finitude and contingency of creation could be both nuanced and evaluated on the basis of work in Earth system science about the character of various planetary boundaries (see Richardson et al. 2023).

Terminological Instabilities

Another insight at the heart of science-engaged theology is the recognition that science and religion are inherently unstable categories, varying substantially across time and place. There is no core essence to either science or religion. As Harrison (2015, 6) demonstrates in *The Territories of Science and Religion*, science and religion are "not self-evident or natural ways of dividing up cultural territory." They are not universal propensities of human beings, nor are they necessary features of all human societies (Harrison 2015, 194). It is this anti-essentialist revelation that has prompted so much methodological reflection in science-and-religion in recent years.

Yet ecotheologians face exactly the same sort of terminological instabilities. Words like "ecology," "nature," "environment," and "climate" are just as slippery. Likewise, defining "religion," "theology," "faith," and "spirituality" is as challenging for ecotheology as it is for science-and-religion. Two examples illustrate the wider point.

"Nature" is especially contested. Within the ecotheological literature, Sigurd Bergmann (2017, 13) notes how "nature" tends to be interpreted as "creation" in the Abrahamic faiths, and is more akin to "life" or "earth" in many African and Asian cultures, yet is closer to "land" for many Indigenous groups. There is too much cultural and geographical variability for ecotheologians to operate

within a single definition. Moreover, from a theological standpoint, Alister McGrath (2001, 133) proposes that nature itself "offers no ontology," while Timothy Morton's (2007) *Ecology Without Nature* specifically criticizes the idea of nature as a foundational or stable entity that is out there to be preserved, conserved, or restored. Instead, nature is arguably better understood as an "interpreted and socially mediated category" that has varied across time and place (McGrath 2001, 133). In addition, many of these definitions of nature have sought to isolate humans from ecological systems, thereby contributing to the very problems environmentalists are seeking to address (Bauman 2011, 384–85). Ecological thinkers have therefore had good reason to deconstruct assumptions about the category of "nature." This move to rethink nature and problematize the nature/culture binary is in keeping with the anti-essentialism implied by science-engaged theology.

Definitions of "religion" are also hotly debated. "Religion" has received widespread use in the ecotheology/religion-and-ecology field—especially by the Religions of the World and Ecology initiative led by Mary Evelyn Tucker and John Grim. This particular project was a notable success, producing a series of edited volumes on each major world religion in relation to ecology that have gone on to define and shape the field (Tucker 2006, 407–8). Yet in Willis Jenkins's (2017, 24) analysis, "religion is an irreducibly pluralist concept," and "any field that would anchor itself to it as foundation will find itself dropping into unfathomable waters." Indeed, the very idea of a "world religion" is often thought to be a colonial attempt at comparison that is a particularly poor fit for Indigenous cultures and traditional ecological knowledge (Jenkins and Chapple 2011, 443; Jenkins 2017, 26). The risk is that if the practices of Indigenous communities are rendered as religion, then they can be privatized, severed from the land, and dismissed in order to enable resource extraction. Taylor (2010) is also particularly worried that the category of religion is often defined so narrowly that it excludes many nature-based spiritualities that are central to the religion-and-nature conversation. Moreover, religion is a phenomenon that operates at widely varying temporal and spatial scales, and clarity is needed about whether one is referring to personal beliefs, group dynamics, institutional structures, or global movements. For example, environmental declarations by particular denominations or religious leaders can be very different to the stance of local communities or the actions of individuals (Haluza-DeLay 2014, 266).

A further feature of these difficulties with terminology is the fact that certain terms are used very differently in different disciplines, stretching and potentially distorting their meanings. Perry and Leidenhag (2023, 57–58) label these "entangled concepts." "Ecology" is a good example. It can refer to the scientific study of organisms in relation to their environment, an ethical view about such relationships, a political movement for social change, a metaphor for interconnectedness, or even a framework for interpreting religions (Jenkins

2017, 28). Much ecotheology uses "ecology" in the second (ethical) sense, but clarity is needed about how the concept is entangled and whether or not its different disciplinary usages overlap.

Ultimately, Harrison (2015, 194) admits that, for pragmatic reasons, we have little choice but to continue to use words like "science" and "religion", albeit in a chastened manner. Likewise, critics of science-engaged theology point out that it is still dependent on the terms "science" and "theology" (Grey 2021, 489–90). In the same fashion, ecotheologians are not going to escape words like "nature" or "religion," but they do need to be forthright about the inherent instability of this vocabulary.

Rejection of Typologies

Given the problems associated with the umbrella categories of "science" and "religion," one of the key features of science-engaged theology is its explicit rejection of typologies (Perry and Leidenhag 2023, 13–14). Historically, the science-and-religion field has been enthusiastic about such typologies, and numerous proposals have been put forward. The most famous are Ian Barbour's (1990, 3–30) fourfold model of conflict, independence, dialogue, and integration, and Stephen Jay Gould's (2002, 47–67) notion of non-overlapping magisteria. But science-engaged theology seeks to move away from these typological characterizations. Perry and Leidenhag (2023, 15) worry that typologies only serve to entrench the idea that science and religion are natural kinds. Historians of science-and-religion also point out that the anachronistic application of Barbour's popular typology often fails to account for historical complexity and that biographical accounts afford much greater latitude for nuance and context (Cantor and Kenny 2001). Moreover, typologies are frequently employed normatively rather than descriptively, meaning they can be misused in service of a given author's wider agenda. Nevertheless, there is still some discussion about the ongoing utility of typological approaches to science-and-religion, especially in pedagogical contexts (Sollereder 2019; Loke 2023).

This debate about the merits of typologies raises some interesting questions for ecotheology. Several ecotheologians have developed typologies for categorizing different religious approaches to environmental concerns, though they tend to be almost exclusively Christian (Conradie 2011, 3). Rosemary Radford Ruether (1992, 205–53) divides between (typically Protestant) covenantal ecotheologies, which emphasize right relationships within the Earth community, and (typically Catholic) sacramental ecotheologies, which emphasize communion with the nonhuman realm. Michael Northcott (1996, 124–63) classifies the various positions taken up by Christian theologians and ethicists writing on environmental themes as humanocentric, theocentric, or ecocentric. Peter Scott (1998) plots Christian ecotheologies on a two-dimensional set of axes: provincial approaches remain loyal to traditional Christian doctrine,

while secular approaches lean on philosophies of nature that derive from the natural sciences; each set of approaches is then subject to modernizing or anti-modernizing tendencies, which is plotted on the other axis. Paul Santmire (2000, 6–10) distinguishes between apologetic strategies, which seek to defend the Christian tradition from the accusation that it has legitimized environmental harm, reconstructionist strategies, which seek to completely rebuild theological thinking on the environment, and revisionist strategies, which seek more moderate updates to Christian doctrine. Heather Eaton (2014, 199) also puts forward a similar scheme of retrieval, reinterpretation, and reconstruction. There are others, including those based on denomination or geography, that could be added to this list. Yet none of these typologies are terribly well known. Certainly, none of them share in the sort of widespread fame enjoyed by Barbour or Gould.

This observation could lead in two different directions. On the one hand, ecotheology could be deemed one step ahead. If science-engaged-theologians are correct about the problems associated with typologies, then no additional work needs to be done to encourage ecotheologians to shrug off the constraints of inherited typologies, because no such limitations exist. On the other hand, it is worth asking why ecotheological typologies have not caught on. Even in 1998, Scott (1998, 8–9) felt like the "flood" of writing on ecotheology meant that "some sort of typology or system of classification thereby becomes urgent in order to gain some useful overview of the area, recognize existing tendencies and identify new directions." Nearly three decades later, the quantity of literature in ecotheology has only ballooned. Ernst Conradie (2011, 1) also worries that a confusing array of theologies all claim to be able to undergird environmental concern. Pragmatically, or at the very least pedagogically, it is tempting to suggest that ecotheologians would find some introductory typologies helpful. Yet the warnings from science-engaged theologians are threefold: ecotheologians must remain wary of entrenching any of the unstable terms outlined here; avoid enabling the monopoly of a single typology; and continue to allow for local nuance and creative thinking. Ecotheologians do not want to fall into the twin traps of perpetuating unhelpful narratives or confusing description with prescription (Perry and Leidenhag 2023, 14–15). Any renewed focus on typologies within ecotheology must be about providing entry points rather than fashioning a straitjacket.

Insistence on Specificity

A further central characteristic of science-engaged theology is its insistence on specificity. Instead of asking generic questions about the relationship between science and religion, science-engaged theology asks how a particular piece of empirical research might help answer a precise theological concern. For instance, Perry and Ritchie (2018, 1086) suggest that "What do science and religion say

about … evolution?" is not a good question because it is insufficiently exact. Instead, "What can [the] neuroscience of addictions and the Eastern Orthodox liturgy teach us about moral habit formation?" is a much better question, they say, because it is more specific and therefore more answerable (Perry and Ritchie 2018, 1086). Questions should be narrowly focused, and answers should draw on specific subdisciplines. As Carmody Grey (2021, 489) states, "granularity is potent."

In an analogous manner, the immediate questions for the field of ecotheology/religion-and-ecology are, as Jenkins (2017) puts it, "Whose religion?" and "Which ecology?" Specificity is key. Environmental and climatic processes are having such heterogeneous impacts across the globe, and religions are responding in such a wide variety of ways, that a single generic question about, for example, religious responses to ecological catastrophe is almost impossible to answer (Haluza-DeLay 2014, 266). As Randolph Haluza-DeLay (2014, 273) writes, "we should begin to talk more specifically about particular religions in particular contexts." For instance, Hindu debates about whether the divine *Gaṅgā* can overcome the dangerous levels of fecal bacteria in the River Ganges will be utterly different to the way in which North American evangelical Christian eschatologies are fueling skepticism about the existential importance of global average surface temperature increases. The effect of any given religion on environmental behavior also depends on numerous contextual factors, such as whether that religion is a majority or minority faith; the cultural homogeneity of that religious group; and the diasporic, colonial, or historically rooted nature of that community (Haluza-DeLay 2014, 268). Indeed, it is this lack of specificity in the questions posed that might explain why neither the White thesis nor the Greening of Religion Hypothesis have thus far been settled satisfactorily. Both are empirical claims, but they may well remain unproven until they are posed at greater levels of granularity. One interesting possibility for future research would be to consider how the regional variations predicted by global climate models might be employed to help shape context-specific ecotheological responses. Many such localized studies exist, but they could be further augmented by detailed engagement with scientific outputs focused on the region in question (Kirkpatrick-Jung and Riches 2020; Chitando, Conradie, and Kilonzo 2022).

In tandem with their insistence on specificity, science-engaged theologians also indicate a desire to get down to business without too much methodological preamble. Mark Harris (2023b, 22) agrees that specificity is helpful precisely because it involves getting on with a problem and seeing what happens, in much the same way that scientists themselves apply a trial-and-error mentality. However, critics of science-engaged theology suggest that it is not quite so easy to dispense with methodological concerns: Grey (2021, 492) insists that "the question of method cannot be suspended"; Harris (2023b, 34) worries

that science-engaged theology has "underestimated the relevance of long-running methodological debates"; and Simon Kopf (2025, 5–7) even argues that this "no methodology thesis" should not be taken as an essential feature of science-engaged theology. Grey (2021, 494) concludes that the granular focus of science-engaged theology calls for a more local consideration of methodology: each theological puzzle needs not only empirical findings but also a sense of how those empirical findings were produced. This chimes with Perry and Ritchie's (2018, 1086) initial suggestion to "work out, as needed, points of methodology on an ad hoc basis." However, Kopf (2025, 6) continues to push for the importance of "grand methodology" on the grounds that, in his view, theology should be attempting "consistent reflection on the whole of reality." Harris (2023b, 15) also questions whether this promotion of specificity is really so new, arguing that science-and-religion "has always included fine-grained activity." The shift is that science-engaged theology prioritizes the granular over the methodological rather than the other way around (Harris 2023b, 17).

Within ecotheology, there has been less of an issue with large-scale methodological debates drowning out more focused case studies—and the relative lack of any overarching typologies attests to this. For instance, Simone Kotva (2022, 46–49) suggests that while the "rarefied exchanges" of the science-and-religion debate are rarely embodied in practice, the ecological crisis is already forcing science and theology into an "unforeseen togetherness" in a whole raft of practical situations. Given that the vast majority of the global population is religious, many of the projects that seek to mitigate or adapt to climate change inevitably involve scientific collaboration with specific faith groups on the ground. In other words, attending to specific local contexts is already a very natural part of ecotheology. As Celia Deane-Drummond (2022, 174) puts it, ecotheology "reminds theologians to stress the grounded and contextual aspect of their work."

If anything, ecotheology's problem might be that the balance between the granular and the methodological tips too far in the other direction. For example, Harris (2023b, 23) worries that the wider methodological questions that he sees as particularly relevant to "ecotheologies and theologies of nature" have been somewhat neglected. His concern is that some of the difficulties associated with defining nature—as sketched earlier—risk undermining these same ecotheologies and theologies of nature. Further methodological introspection is needed, he thinks, to avoid naive correlations between the science and the theology. Yet it is not immediately clear that ecotheologies are always aiming to do the same thing as theologies of nature, or at least there are many ecotheologians who are not pursuing the sort of systematic questions implied by an overarching theology of nature. Nevertheless, the advice, it seems, is to remain specific without completely neglecting the methodological issues that might arise within any specific arena.

Science as a Source for Theology

Much of the discussion to this point has focused on what ecotheology might learn by considering the analogy of science-engaged theology, but a focus on science as a source for theology draws a more literal connection, highlighting the ecological and environmental sciences themselves. As noted, in-depth engagements with the precise outputs of these sciences are less common within ecotheology than one might expect.

When thinking about the relationship between science-engaged theology and traditional science-and-religion, Leidenhag (2024a, 401) suggests that the two streams of enquiry might actually be asking fundamentally different questions. Science-and-religion is interested in the overall relationship between two sets of beliefs or spheres of enquiry. This makes intuitive sense because much of the science-and-religion field was forged in an apologetic context to defend theology from the apparent onslaught of the sciences (Harris 2023b, 15; 2023a, 1). By contrast, science-engaged theology asks whether and how science can be a source for theological thinking and practice, so there is no need for the science-engaged theologian to assume such a defensive posture.

This poses a challenge for ecotheology. Much ecotheological writing also takes place in an apologetic vein, either seeking to bring about an ecological conversion among people of faith or trying to persuade the secular world that religion can be of assistance in the face of the current ecological crisis (Pope Francis 2015, §216–21; Hulme 2017). Recently, there has been a move towards ecotheological writing in a more therapeutic vein, since religions may contain some of the wisdom and coping practices needed as the catastrophe continues to unfold (Malcolm 2020; McCarroll and Kim-Cragg 2023). For many thinkers, the whole raison d'être of ecotheology is to bring about, or measure, social change; it is inherently practical, contextual, and political (Gottlieb 2006, 7). None of this literature is wrong. In fact, it is sorely needed. But these approaches do run the risk of instrumentalizing theology for either apologetic or therapeutic purposes. When new theological concepts are proposed, they are often developed and employed with one of these other goals in mind.

Yet science-engaged theology prompts ecotheologians to ask whether the findings of the ecological and environmental sciences might serve as resources for theology in its own right—and such engagements are much rarer. As Deane-Drummond (2022, 174) highlights, ecotheologians have "not always taken the details of the science seriously enough." To return to McFague's panentheism, it is possible that this could be chalked up as an example of science being used as a theological source. McFague (1993, ix, 149) certainly claims that her work "uses science as a resource for theology," and she is adamant that viable theology must be "commensurate with contemporary science." She arguably holds a panentheist position precisely because of scientific descriptions of the ecological crisis. However, McFague's theology does not make empirical claims

that can be adjudicated on the basis of the ecological sciences. One could consider the world as the body of God without necessarily knowing anything specific about living organisms, ecosystems, or the biosphere. It might be possible to assess McFague's implicit claim that panentheism leads to improved environmental attitudes and behaviors on the basis of the social sciences, as indicated, but much of this work is yet to be done. As such, her ecotheology is arguably science-inspired but not necessarily science-engaged.

This is also a pattern that applies more generally to science-engaged theology. According to Jong (2021, 484–85), much science-engaged theology is insufficiently dependent on the science in question. For Jong, the science ought to alter the theology in the same way that premises alter conclusions; the differences ought to be substantive rather than superficial. Plenty of interesting theology might be science-inspired, he argues, but it is not strictly science-engaged unless removing the science makes a tangible difference to the theology. For Jong (2021, 484), science-inspired theology uses scientific knowledge to "vivify" the theology, but it is not essential to it. Reassuringly, perhaps, ecotheologians are not alone in struggling to say how scientific sources make a tangible difference to the theological direction taken. Jong (2021) evaluates a whole series of examples of science-engaged theology from a special issue of *Modern Theology*, and very few of them live up to his critical scrutiny. As Perry and Leidenhag (2023, 7) admit, "using science as a source is one thing, doing so well is far more difficult." The ecological and environmental sciences are certainly prompting and inspiring theological thinking, but it is less common to find ecotheologians posing theological questions where these sciences are being consulted as a source. Science-engaged theology therefore opens up the possibility of a much more extensive vein of ecotheological research along these lines, where the outputs of the environmental and ecological sciences do make a substantive difference to the theology in question.

The Theological Turn

Science-engaged theology is quite clear that it is seeking to answer explicitly theological questions about aspects of doctrine and practice (Leidenhag 2024a, 406). Harris (2023a, 1; 2023b, 15) therefore identifies the science-engaged theology mindset as part of a wider "theological turn" in the science-and-religion field. Some of this stems from theology's new boldness within the academy, but it also reopens discussions about the possibility of theology assuming a rather more "imperial" role as the "queen of the sciences"—something Perry and Leidenhag (2023, 31) want to resist (Harris 2023b, 21, 30). While there is reason to welcome the newfound confidence of the theological turn, there are also some risks to be borne in mind. Science-engaged theology does not seek to actively exclude other faith traditions—it is perfectly possible to pursue Islamic or Jewish theology in a science-engaged fashion (Malik 2021, 2022; Tirosh-

Samuelson 2023)—but there is a concern, especially in Western universities where the theological norm often remains Christian, that the theological turn in science-and-religion will do little to challenge the Christian dominance of the field. Indeed, Harris (2023b, 13) notes that science-engaged theology might be a helpful label precisely because it is more honest about the fact that the vast majority of what has been written in science-and-religion is really about Christian theology rather than religion in general. Another risk of the theological turn, especially if science-engaged theology were to completely replace science-and-religion, is that a religious studies approach to the science-and-religion conversation gets lost. As Harrison (2021, 477) remarks, the category of "religion" retains importance for science-and-religion because it "serves as a caution against simply reducing religion to theology." Science-and-religion is much broader than just theology because it also includes philosophical, sociological, psychological, anthropological, and historical questions (Kopf 2025, 17). Nor should this be a zero-sum game: an increasing focus on theological questions does not have to come at the expense of religious studies concerns.

So, where does the theological turn in science-and-religion leave ecotheology? Perry and Leidenhag (2023, 46) suggest that ecotheology might already be a good example of what they hope science-engaged theology will achieve. They want to be able to speak, they say, of biological theology, psychological theology, and geological theology in the same way we already speak of historical theology, philosophical theology, and ecotheology. In practice, this means there are "theologians who are particularly adept and attentive to the use of the tools of … ecology in their constructive work—without fears that we are somehow diluting theology or selling-out" (Perry and Leidenhag 2023, 46). But if ecotheology has already negotiated the theological turn successfully, then there are also some concerns it has to face. Is ecotheology at risk of assuming a Christian norm or downplaying the insights of religious studies?

In practice, Christian exclusivity arguably has been marginally less of a problem for ecotheology than for science-and-religion. Christianity has certainly been a central player in ecological conversations, but a keen awareness of the interconnected nature of planetary crisis has meant that ecotheologians of all stripes have always been naturally inclined to consider an interfaith approach (Haluza-DeLay 2014, 269). The comparative work of Tucker and Grim in the Religions of the World and Ecology initiative also did much to shape the field in an explicitly interfaith direction. But it would feel like a retrograde step if the theological turn implied by science-engaged theology were to limit the extent of future interfaith engagement in the ecotheological sphere.

Likewise, the prominence of the "religion-and-ecology" label—especially at the American Academy of Religion—means that a religious studies approach to climate, nature, and the environment is not realistically at risk of being lost. If anything, the shift has been in the other direction. In 2007, *Ecotheology*—one

of the leading journals in the field—was renamed the *Journal for the Study of Religion, Nature, and Culture*. Several other factors were undoubtedly at play, but in his opening article for the renamed journal, Taylor (2007, 8) is quite clear that, in his view, a focus on theology (or even on worldviews) is "unduly confining and insufficiently welcoming." The move caused a good deal of debate. Mark Wallace, in his response, pushes back against Taylor's characterization of theology as "the crazy uncle in the attic," arguing that theology can be open-minded and even "methodologically agnostic" in the way Taylor desires (Wallace 2009). Actively excluding theology, says Wallace, would be to implement the very boundary policing Taylor wants to avoid. But the key point is that ecotheology/religion-and-ecology/religion-and-nature reemphasized its religious studies dimension not long before science-and-religion started to reemphasize its theological dimension. Again, the two approaches need not be in competition; coalitional thinking may well be the most fruitful way forward. But suffice to say that ecotheology is unlikely to suffer from any of the potential dangers of the theological turn any time soon.

Two-Way Traffic

One of the early ripostes to science-engaged theology was the concern that the sciences have as much to learn from theology as theology has to learn from the sciences, and that we should therefore be calling for a theology-engaged science (Torrance 2018). In part, this is about paying attention to the theological and metaphysical dimensions of the practice of the natural sciences (Grey 2021, 490). It might also involve allowing theological commitments to sway a decision between two equally plausible scientific theories or to inform which scientific questions are deemed worth investigating (Harrison 2021, 481). But, at root, theology-engaged science simply asks how theological discussions can also shed light on scientific discussions. Many examples of science-engaged theology in action have been published, but two in particular pertain to ecotheology, and both happen to illustrate the parallel possibility of theology-engaged science—and hence of two-way traffic.

First, Matthew Whelan (2021, 432) suggests that the science of agroecology can "concretize" Catholic social teaching's concern for the environment. Specifically, a theological reliance on natural law implicates certain empirical realities: if there are principles inherent in nature, then agroecology ought to be able to help fill out their content. But Whelan (2021, 410, 431) goes on to propose that Catholic social teaching's account of integral ecology also supplements agroecology by helping it tease out its own moral vision. The relationship is not necessarily completely symmetrical, yet "just as social teaching can benefit from engaging agroecology, agroecology can benefit from engaging social teaching" (Whelan 2021, 432). Ideas flow in both directions.

Second, Bethany Sollereder (2021) asks whether theology can help us understand the human role in environmental restoration. Restoration ecology does not necessarily contain the tools for making moral judgments about how much human interference is required and what benchmark should be set for a given restoration project. Sollereder discusses four positions in Christian anthropology—stewards of creation, created co-creators, priests of creation, and participants in the community of creation—to make suggestions about legitimate levels of human intervention. The constraints and predicted impacts of certain practices in restoration ecology could be used to decide between different theological anthropologies, but Sollereder frames her article the other way around, asking how the different theologies might impact the practical decisions restoration ecologists have to make. The first approach demonstrates science-engaged theology, while the second is a good illustration of theology-engaged science.

Together, these examples indicate how science-engaged theology might apply quite directly to ecotheological concerns. Moreover, both Whelan and Sollereder remind ecotheologians that the lessons of science-engaged theology would ideally involve two-way traffic.

An Invitation to All Theologians

Finally, science-engaged theology is an explicit invitation to all theologians that they might like to consider scientific and empirical work in their thinking. As Leidenhag (2024b, 1) writes, science-engaged theology "encourages all theologians, across the many traditions and institutional communities of theology, to use scientific research to aid their work when appropriate."

By analogy, ecotheologians may well want to encourage all theologians to see ecological concerns, both scientific and political, as an important touchstone throughout their work. Every theologian stands to benefit from thinking about their work as taking place in a specific ecological and climatic context—in this case, a context of accelerating global heating and the planet's sixth mass extinction event. Deane-Drummond (2022, 173) proposes that "we are all charged with the task of taking our current ecological and global climate scientific context seriously, whether, as theologians, we choose to use the language of eco-theology or not." Meanwhile, Conradie (2023, 27), in his summary of ecotheology for the *St Andrews Encyclopaedia of Theology*, suggests that "an ecological awareness is now found as a transversal in most forms of theological reflection." This is exactly the state of affairs a science-engaged theologian would want for ecotheology: namely, a sense that theologians of all stripes are, to varying extents, engaged with the present context of ecological breakdown. To put the point somewhat provocatively, we might wonder, for example, whether it is even possible to write a contemporary theology of sin

without considering ecological sin, or a contemporary theology of community without considering nonhuman communities, or a contemporary eschatology without considering the ultimate fate of life on Earth. Ecotheologians certainly hope that other theologians feel an impetus to bear such concerns in mind. But ecologically sensitive theology also needs to emerge organically, by invitation rather than diktat.

Conclusion

In this article, I have asked what, if anything, ecotheology can learn from science-engaged theology. The results are not as straightforward as a simple list of recommendations, not least because many scholars in ecotheology already have many of these issues in mind, but a brief summary is still in order.

First, ecotheologians are, and should continue to be, in the business of making empirically testable claims. Central ideas, such as the White thesis and the Greening of Religion Hypothesis, are already subject to empirical scrutiny, but there is plenty of room for ecotheologians to submit their assumptions, especially about the practical efficacy of specific doctrines, to more rigorous social scientific testing and formulate new research questions that make use of a wider range of empirical results. Second, ecotheologians are already well aware of the fluid and contested character of the terms they employ. Science-engaged theology serves as a salutary reminder of just how quickly terminology can ossify, and of the misguided essentialism that can follow. Third, ecotheologians might like to think about the pragmatic and pedagogical benefits of establishing some widely shared typologies. However, they should only do so if they are willing to heed the warnings of the science-engaged theologians about the degree to which such typologies risk entrenching unhelpful narratives and categories or occluding the nuances of context. Fourth, there is certainly scope for reminding ecotheologians about the potency of granularity. Many studies are already embedded in specific times and places, but it is useful to refresh the insight that there are only ever multiple answers to large-scale questions about, for example, religious views on climate change. Fifth, science-engaged theology challenges ecotheologians to see if they can allow the environmental and ecological sciences to serve as a source for theological questions. This is not easy to do, and it would severely limit ecotheological reflection if it were the only mode of thinking permitted, but it is a helpful corrective to the tendency to instrumentalize religion in the service of solely ecological agendas, and it could open up a comparatively under-explored branch of ecotheological research. Sixth, ecotheology needs to remain wary of the theological turn implied by science-engaged theology. Precise theological questions are to be welcomed, so long as they do not presume any sort of Christian, or theological, exceptionalism. Seventh, there is always room for the possibility that ecological scientists can learn from ecotheologians at the same time as ecotheologians

learn from ecological scientists. Interdisciplinary dialogue requires two-way traffic. Finally, if science-engaged theologians hope that all theologians consider scientific and empirical work in their thinking, then ecotheologians should hope that all theologians consider ecological insights and contexts in their research. If there is such a thing as ecologically engaged theology, then these reflections might just provide a starting point.

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Religious Materialism and Ecology

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Arguing against the assumption that religion and materialism are incompatible, this article develops a procedural "religious materialism" as an epistemic connector between religion and ecology in the Anthropocene. Distinguishing the material turn from the turn to immanence, I argue that transcendence can register and affirm materiality and thereby resist the charge that transcendence requires the humiliation of matter. Drawing on Raymond Williams and Sebastiano Timpanaro, I frame constituted—and reconstituted—materiality through embodiment, limitation, and vulnerability; with the help of a recent reading of Theodor Adorno, I approach materialism via the primacy of the subject; and I interrogate new materialisms and biological debates (e.g., organicism versus mechanism) to resist programmatic, reductive materialism. The result is a chastened, procedural method that treats religions as repositories of material commitments, offering an expansive (not restrictive) reductionism framed for ecological instability.

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Religion, Ecology, Matter

In addressing climate change (among other ecological issues), religious traditions are developing their ecological credentials. This development may involve hermeneutical repair work, the retrieval of marginalized insights, or bolder reconstructive efforts. The interaction between religion and ecology is not abstract, however. It is taking place in a period of transition from the Holocene to the Anthropocene. "Anthropocene" is partly a misnomer here. The term correctly identifies the fearful power of a petro-carbon industrial society as the key driver in anthropogenic climate change. It succeeds less well, however, in capturing the negative feedback—the runaway climate change, the unstoppable warming climate, the unrecallable rises in sea levels—that are unleashed thereby. (For the science behind this claim, see IPCC 2023.) This transition to the Anthropocene provides the material conditions in which the interaction between religion and ecology takes place. Given this, it is no surprise that there should be a renewed interest in materialism, the study of matter.

In this article, I propose and defend what I call "religious materialism." Against the widely and strongly held view that religion and materialism are incompatible, I argue precisely the opposite. There are in my view important resonances between religion and materialism. Moreover, and doubling down on the compatibility, I argue for a positive and constructive relationship between matter and transcendence. In other words, I argue against a powerful tendency in the religious study of ecology that stresses immanence over against transcendence. This is the common view that ecological pressures force or require a turn to immanence in the religions. Instead, I argue that the turn to immanence and the material turn are not the same: these turns are related rather than identical moves. Understood procedurally (more on this later), religious materialism secures an interaction between religion and ecology in which both transcendence and ecology are articulated. In other words, the connector between religion and ecology is materialism. Yet for materialism to function well as the connector between religion and ecology, a specific interpretation of materialism is required, as we shall see.

In insisting on the relevance of the material turn, I refer to my opening claim that the engagement with materialism is an epistemological move: How do the material conditions of the Anthropocene inform the interaction between religion and ecology? An important misstep at this point is to focus too closely on which "sector" of matter should be the main starting point for thinking about matter—for example, biology or human psychology. This is in part an issue about disciplinary boundaries among the sciences. Such a presentation might suggest that materialism presents us with a set of theories about matter, and that these theories can be related to—and perhaps are in competition with—religions. The key areas of debate are likely to be cosmological or psychological, to follow the distinction made by Charles T. Wolfe (2016, 10–11) on differences

in materialism, that is, addressing either an ontological claim about matter as all there is or the issue of mind and brain. In order to make this conversation allegedly more productive, religions must then be reconstructed as religious cosmologies; or, if the focus is on anthropology, then with particular attention to what makes the human distinctive (or not). As such, the contrasting of cosmological and psychological theories of matter with religious cosmologies and psychologies is amenable to being inserted into a "religion and science" discussion, either as cosmological (value) or psychological (spirit/soul/mind/brain). In my view, however, it is important to stress that materialism is also *method*: materialism invites our attention to certain sorts of evidence, with the immediate proviso that a materialism also constructs, selects, and interprets such evidence. The provocation of materialism to religions therefore should not be assimilated too quickly to a religion and science discussion.

Although the term "materialism" is a reasonably recent arrival in English—the Oxford English Dictionary records its earliest use in 1678, by the English theologian Ralph Cudworth—there is some agreement that something we can without anachronism call materialism dates back at least to Democritus (460–370 BC). There has also, in the twenty-first century, been a renewed interest in materialism in Anglophone discussion (for materialism and religion, see Keller and Rubenstein 2017). In terms of cultural atmosphere, materialisms have tended to be understood as opposed to religion: the stress on matter resists spirit, the attention to nature undermines supernature, and so on. (Early modern arguments about materialism focused on the immateriality and immortality of the soul and whether the latter required the former [see Thomson 2008].) In its first reference in English however, Cudworth also offers an alternative term for materialism, what he calls Hylopathian Atheism. This alternative term already indicates the tangled history of materialism and religion; hylopathy refers to a power to affect matter. The recent material turn—sometimes called the "new materialisms"—seems partly to join with this older terminology of Hylopathian Atheism in that the orientation of the new materialisms resists the disenchantment of matter in favor of material powers.

Despite this rapprochement, there remain considerable difficulties in the religious engagement with materialism. First, as regards methodology, some proponents of materialism argue that it is a comprehensive theoretical approach that covers nature, society, and the human. (This issue has bedevilled Marxism almost since its inception: recall the contrast between historical materialism and dialectical materialism.) Should this comprehensive or programmatic approach be deployed for the human person and for human society as well as nature? Are the objects of knowledge of the natural sciences like the objects of knowledge of the human sciences? Must the procedures operative in the first be the ones applied in the study of the second? Or is such a reduction in fact a narrowing of what we might judge precisely as material? Indeed, as Simon Jarvis (2004, 80)

points out, it is hard to remove fully a "metaphysical" element in materialism: "Far from being in any straightforward way opposed to metaphysics, any thinking which starts out from the principle that 'only matter is real' is itself dependent on a metaphysical claim. It makes, that is, a claim about the nature of the world in advance of an assessment of the means by which knowledge of the world is to be secured." It is unlikely that a metaphysical or programmatic materialism of this sort will be a congenial connector in the interaction between religion and ecology. To develop the conversation, we shall need a different, chastened materialism. In turn, this suggests that a difference between nature and society, and between the natural sciences and the human sciences, will need to be maintained by such a chastened materialism.

Second, there are determined attempts to defend materialism as atheistic. Consider this: "The heart of materialism is the withholding of belief in the existence of certain kinds of entity and certain kinds of phenomena. There are, it claims, no gods and devils, no ghosts, no spirits. There is, also, no such thing as Providence, or luck or fate. Reality consists of material things and things that are wholly dependent for their existence on material things" (Brown and Ladyman 2019, 9). This would suggest that with the turn to materialism comes a particular account of immanence that is not easily digestible by religious traditions. Later, I argue that such exclusionary moves are not helpful. Critically, I maintain that a purported atheism is not the vital issue here.

My argument proceeds as follows: in the second section, I develop a specific interpretation of materialism that is both chastened and procedural. In the third section, I expand on the meaning of religious materialism—not least to affirm that religious materialism resists the humiliation of matter. In the fourth section, I distinguish between the material turn and the turn to immanence. I suggest that the material turn may be the more creative option in developing the relationship between religion and ecology. In the fifth section, I seek to show how religion may be developed in ecologically fresh ways by reference to this procedural materialism. Finally, in the sixth section, I comment further on the significance of materialism as a connector between religion and ecology. My argument thereby proceeds in a contrast between programmatic materialism and procedural materialism, that is, between materialism as a claim about the ontological nature of matter and materialism as a responsive approach to living within limitations and constraints.

On Materialisms

To begin this inquiry on materialism as an epistemological connector between religion and ecology, I make several distinctions. Religious materialism is to be distinguished from material religion and materialist religion. Material religion in my analysis refers to the material artefacts in religious use, from buildings as sacred spaces to the utensils used in worship.[1] Materialist religion describes the

ways in which religious traditions construe issues of embodiment, contingency, ecological dependence, and the like. Suffering as a religious thematic is important here.

Although consonant with these two meanings, religious materialism is, by contrast, a normative argument. It claims, in line with materialist religion, that religious traditions are responses to materiality. Additionally, however, religious materialism argues that modalities of transcendence are always repositories of material responses. It is not that materiality curtails flights of transcendence. Instead, transcendence is precisely material insofar as it records the ungovernability of materiality; matter therefore confronts us with limitation. (As an aside, I consider that this position relates constructively to certain other meanings of transcendence, for example, matter as given and matter as being redeemed in that both these suggest that matter is not circumscribable by human action. On the other hand, meanings of transcendence that inform ideas of "gift" or teleological anthropocentrism are less assimilable to my position.) In my argument, transcendence operates as a way of identifying such constraint and of requiring a certain epistemic modesty in the face of these considerations in materiality. And more than this, reference to transcendence as a record of materiality may provide an affirmation of materiality. This is to say more than that religions are responses to materiality. It is also to argue that, in some cases, such religious responses rebut the humiliation of matter and affirm the limitations and constraints associated with matter. It is this claim of a procedural religious materialism I seek to expound and defend.

What emerges as significant at this point is that religions have materialist elements. That is, if all religions circle around the themes of suffering and responses to suffering—bodily, social, and political—as well as mortality, loss, and grief, then these themes may be understood materially as registering the unruliness and limitation of matter. All three relate to an understanding of the human as material: as requiring certain sorts of support, and as being exposed to illness and death, and reactions to that. (Following Arendt 1998, 8–9, I consider that, alongside mortality, natality is among the *conditions* of human action; however, Arendt argues that natality resources political action, and as political action is not my concern here, natality is not central to my argument.) The interpretations and practices that religions offer in consolation and interpretation may not always be materialist—but nonetheless we can understand these religious responses as identifying the vulnerable and contingent embodiment of human beings at various scales. This embodiment demands renewed attention in the unstable transition into the Anthropocene. Matter limits, we might say—and religions include interpretations of these limitations and responses to such limitations. We should not therefore be distracted by the link between materialism and atheism into drawing the false conclusion that religions are unrelated to materialism; indeed, religions are not

only to be understood as material in their practices, etc., but also as *responses to materiality*.

What sort of evidence does materialism collect and preserve? At the start of the opening chapter of volume 1 of *Prolegomena to any Future Materialism*, Adrian Johnston (2013, 13) writes of materialism:

> Materialism, the brute insistence that there is nothing alien to matter, appears to offer no place whatsoever to anything even vaguely intangible or spiritual. It denies that there are ineffable entities or forms set apart from the immanence of incarnate beings. … More specifically, materialist philosophies throughout history exhibit a common hostility towards religiosity insofar as the latter appeal to the supposed existence of some extra physical, immaterial dimension of transcendent (ultra-)being … A properly materialist ontology posits matter alone—nothing more, nothing less.

For present purposes, I note the programmatic nature of this affirmation: matter alone, and only matter alone. I think we should read this as identifying certain priorities in inquiry and a desire to create and preserve certain sorts of evidence. The point I am making here, adapting Terry Eagleton, is that on such a materialist view, matter does not need to be rescued from the humiliation of being matter.[2] As we shall see shortly, there remains also the question of whether religions by their constitution require, so to speak, the humiliation of matter. We also get our first glimpse of what will be a recurring theme: What is the relation between the material and the immanent? More on both points shortly.

In that it is opposed to the humiliation of matter, we may appreciate the appropriateness of the material turn. It directs attention to matter rather than beyond matter. Moreover, it raises questions about and against human exceptionalism. A glance at Julien Offray de La Mettrie's (1747, dated 1748) celebrated work *Machine Man* nicely illustrates the anti-exceptionalist point: "Therefore nature made us to be beneath the animals, or at least to show up all the better the miracles worked by education, which alone can remove us from that level and finally lift us above them" (La Mettrie 1996, 18). Nonetheless, we may note that as presented—matter alone; only matter is real (that is, no spirit[s])—this program of inquiry suggests a metaphysical theory. In terms of materialism as a method, this seems to suggest some a priori decision to treat any explanandum as "matter." What, however, is the basis of this decision?

It remains unclear whether the programmatic account of matter adverted to here requires a prevenient claim: that is, to treat all activity as only to be understood as some event in matter. Is not such an a priori methodological operation a sort of exceptionalism—a methodological decision made not from within matter but somehow having an independent view of the matter

on which a materialist methodology operates? We return to Jarvis's point that ridding materialism of all metaphysical elements is a hard task. In light of the foregoing discussion, we may now appreciate a certain difficulty. If the material turn is also an affirmation of the existence of only immanent matter, it is not clear if such an epistemological judgment is a materialist judgment or not. We can of course agree that the intention of the affirmation "only matter is real" is towards an affirmation of the reality of matter for religions and religious inquiry. Nonetheless, it seems to be an affirmation that escapes its own premises: the dyke between "meta" and "physics" is leaky.

Hence, in distinction, my recommendation of a *procedural* materialism. In other words, in this context it may be more compelling to understand materialism as procedural rather than programmatic.[3] Part of the defense of religious materialism requires that materialism be understood differently. Rejected are materialism's claims to epistemological sovereignty, its ontological monism, and its reductive procedures. In short, what is rejected is a programmatic materialism of the sort I describe as metaphysical. Instead, in my argument, materialism is to be understood as procedural: as producing, collecting, and preserving certain sorts of evidence of the ecological basis of human living. Further, this procedural materialism is a "weak" method. That is, its method does not require "the same procedures … [to be] followed to investigate different kinds of material" (Jarvis 2004, 80). Its rigor lies elsewhere: in its capacity for engaging with and responding to material limitations and constraints. When religious inquiry and procedural materialism are combined, my argument is that religious materialism is a style of procedural materialism in which, via its accounts of transcendence, materialist emphases around embodiment may be recorded and displayed. Above all, a procedural materialism is a way of recording certain sorts of evidence, and religions may make a positive and constructive contribution to this materialist recording.

Materialism and Ecology

In this section, I advance the discussion regarding procedural materialism. At this point, we need to make some distinctions regarding contemporary materialisms. Materialism gives priority to matter, as we have seen. At its fullest, this is more than affirming "nature" preexists humanity in the important sense that humanity depends on nature, which does not apply in reverse: nature does not depend on humanity. For such a materialism—that is, an ontological materialism—such dependence is constitutive of the human.

Responding to Sebastiano Timpanaro's work on materialism, Raymond Williams commends the elaboration of such a materialism. What is required is a "constituted materiality" in which the themes of a "fundamental materialism" emerge, including "inherent physical conditions—a specific universe, a specific planet, a specific evolution, specific physical lives—from which all labour and

all consciousness must take their origins" (Williams 2005, 108). Williams notes further: "There are dimensions quite beyond us, or there are basic forces—the obvious examples are gravity and light—which have entered so deeply into our constituted existence that they are conditions of everything we are and do, over the whole range from the most passive to the most active modes" (Williams 2005, 108). One way of reading day six of creation in Genesis 1:26 (NRSV)—"Then God said, 'Let us make humankind in our image, according to our likeness; and let them have dominion over the fish of the sea, and over the birds of the air, and over the cattle, and over all the wild animals of the earth, and over every creeping thing that creeps upon the earth"'—would be to identify such a presentation as in *active* mode. What is less developed within the text, despite the materialism of days one through five, is the constituted materiality of the human in *passive* modes. Moreover, Williams (2005, 113) counsels against treating human biology as a mere datum; instead, the analysis of sociohistorical activity must take into account the "relatively stable biological conditions which are at least elements of much human cultural activity." This is not reductionism as usually understood: it is not that humans are reducible to biological conditions but instead, as Williams argues, that humans are constituted by them. The task of a procedural materialism is to gather the evidence of this constitution.

In that procedural materialism is also a critical materialism, I make three points here about how we might consider this gathering of evidence. First, we might regard "relatively stable biological conditions" as too benign a reading as we transition from the Holocene to the Anthropocene. Given that ecology is an inquiry within biology, or at least closely related to it, our entry into a period of relatively *un*stable ecological conditions presents a challenge: How are we to comprehend our constituted materiality through such a transition?[4] Thereby, constituted materiality will need to engage with such ecological instability. Second, we may wish to expand Williams's fundamental materialism to record that humanity's planetary inheritance includes oil and coal and thus speak of a *re*constituted materiality. That is, as part of the epistemological movement of a reflexive materialism, the planetary inheritance contains material that can be used by humans as part of their repertoire of responses to constituted materiality. A reconstituted materiality stresses that materiality must always be considered historically. Moreover, we can treat this reconstituted materiality dialectically also: in their contribution to a warming climate, the material effects of these carbon products form part of a new constituted materiality, as is captured, for example, by the phrase "runaway climate change" and the high likelihood that global temperatures will not be restricted to 1.5° Celsius above preindustrial levels. Third, if the challenge of transition is recorded, and responded to, in human cultural activity, this has implications for the religions. Williams does not refer to religious traditions but instead to art and music. If, however, we include religious traditions as part of cultural activity, then the question of

how materialist religion will record this transition emerges. If, as we might say, the spirit is willing but the flesh is unstable, what are the implications of this for materialist religion? How might materialism function here as a connector between religion and ecology?

One way of furthering this analysis of a procedural materialism would be to focus on the body. To adopt such an approach once again calls into question the division of materialism into psychological and cosmological. In an epigraph in *Minima Moralia*, Theodor Adorno (2020, 21) opines that "[l]ife does not live," and in his recent interpretation of Adorno's ethics of vulnerability, Peter Gordon (2023, 105) argues that Adorno's position can thereby be understood as materialist: "My claim is that Adorno can be understood as a materialist in a broad and nondoctrinal sense in so far as his philosophy identifies our this-worldly and sensuous being as the locus of all human fulfilment. In this respect, his philosophy draws inspiration from the Marxist principle that we cannot conceive of our satisfaction as human beings apart from our 'relationship to the sensuous external world.'" Or again: "This [sc. Adorno's] understanding of human flourishing is broadly materialist, in the sense that it involves what he calls an 'emphatic' concept of the human being as a sensual and embodied creature who holds fast to the possibility of our species-wide happiness" (Gordon 2023, xvii). Nor is Gordon alone in the presentation of Adorno as a materialist in this distinctive sense. Tom Whyman (2023, 1–18, especially 8–10) argues that Adorno's materialism is of an expansive rather than reductive kind and best understood as ethical rather than metaphysical. Whyman's conclusion connects nicely to the skeptical point I have been making about the relation between materialism and metaphysics. Such a materialism seems more limited in scope than some of the materialisms encountered already: it is less metaphysical, more attentive to human fulfilment, and thereby contributes to a chastened materialism.

Having said that, Adorno's materialist analysis of nature is deeply indebted to post-Kantian traditions embedded in the distinction between subject and object. Adorno writes then of the *priority* of the object and the *primacy* of the subject. In Gordon's analysis, Adorno is arguing that it is not possible simply to switch from subject to object, away from the individual towards the material. To do that is one way of "creating" the problem of mind: you switch your attention from mind to matter and then suddenly "mind" becomes a problem. Whereas before the perceiving subject confronts nature, now the switch to nature produces an "alienated" mind, which appears epiphenomenal and requires to be "explained" (Gordon 2023, 108). Adorno prefers a different route in which subjectivity is the starting point towards materiality. What needs to be explained is how the subject is dependent on the object—to repeat, the subject has primacy, but the object has priority—and the way to such an explanation is through subjectivity itself. As Gordon (2023, 110) puts the issue:

"[M]aterialism is best discovered not by simply abandoning the subject, but rather by interrogating the subject's ownmost domain in order to shatter the illusion of its authority." The theoretical implications of Adorno's position are interesting and demanding. As Deborah Cook (2006, 722) notes: "Not only do material objects make subjective experience possible, there is a substantively material dimension to the subjective experience as well." Materialism is not opposed to consciousness in any straightforward sense. Indeed, Adorno seems to be suggesting that materialism can only be properly established once it has received, so to speak, the critique based in the primacy of the subject. The terms of contrast with which Adorno works, given his philosophical heritage, are materialism and idealism. We do not need to follow him in that. Nonetheless, the philosophical tradition in which Adorno is working has often associated idealism with religion. An intriguing possibility now emerges: Would it be possible to approach materialism via the idealisms of religion?

There are links between this Adornian position and some contributions from the perspective of the new materialisms. Although the focus of the reception of some new materialisms has been on the entanglement of material worlds, including the human, together with an insistence on the agency—and sometimes the vitality—of matter, other contributions have questioned such approaches from the perspective of arguments within Marxist materialisms. For example, Pheng Cheah (2010, 70–91) draws on the writings of Jacques Derrida and Gilles Deleuze to critique the place of the human subject and a historical teleology in some Marxisms, thereby encouraging a move away from "organismic vitalism." Similarly, Jason Edwards (2010, 281–98) argues that any contemporary defense of historical materialism must be antihumanist and antihistoricist—thereby providing a point of contact with other authors in the new materialist tradition such as Karen Barad and Jane Bennett. Nonetheless, there remains a sustained caution about appeals to a materialist ontology understood as metaphysical—for reasons that overlap with the concerns presented in the earlier discussion on programmatic materialism.[5]

What sort of evidence does a procedural materialism generate and preserve? What pressures does it respond to? What sorts of answers does it provide? We can see that a range of interpretations of matter is available and changes over time. This invites the re-characterization of materialism as a *method*. What, then, is characteristic of materialism's method, if the account of matter can change? We should be cautious about explanations based only in one area of inquiry. Why? Because I am suggesting that in terms of method, the focus of a procedural materialism should be limitation and constraint. Limitation and constraint are vital in understanding the attraction of materialism. Materialism thereby insists on what Nicholas Lash (1981, 108) calls "the authority of the tragic" and "the burden of inescapable fact." This is the theme of limitation: the boundedness of human life through bodiliness and contingency. As Timpanaro

(1980, 34) notes, "We cannot … deny or evade the element of passivity in experience: the external situation which we do not create but which imposes itself on us." What of subjectivity, however? I raise this because limitation and constraint are always experienced from a standpoint: Whose experience is being recorded, and who is included in "us"? What might then be discussed is "whose subjectivity," which should always be tested by reference to the range of human responsiveness, including most emphatically the suffering of vulnerable bodies. Having said that, I think we should not give up on content in materialisms: Galileo's and Newton's mechanics are clearly a significant advance, and the consideration of human embodiment in this way may be helpful in some areas (medicine, for example) but not in others (politics, for example). In relation to ecology, the debates over whether adaptation occurs at the level of the gene or the organism might be responded to from the materiality of religious traditions themselves. Such a response is not ruled out by a procedural materialism.

Note, above all, that the focus on body, suffering, and limitation and the ways these are constitutive for human living and experience is not centrally concerned with the matter of immanence in a religious sense. To be sure, an ontological materialism is concerned with the immanent sphere: it is concerned with matter. Nonetheless, it is a further step to argue that this immanent sphere is in competition with transcendence; that is, to appeal to matter is to deny spirit.

Disciplinary Materialisms and the Turn to Immanence

Williams discussed biology, as we have seen, but in a general sense. If, however, we now turn our attention to biology in a disciplinary sense, we encounter a different meaning of materialism. Here, the priority of matter is to be understood as working from a view of the world as independent of human knowing. Moreover, we encounter ecology too: James Justus (2021, vii) notes in his introduction to the philosophy of ecology "the indispensable contribution both ecology and evolutionary science make to understanding the biological world." In *The Metaphysics of Biology*, John Dupré works with a materialist view of the world. He affirms the specialness of life but declines to endorse vitalism and notes that his position is broadly materialist. I quote at length:

> Materialism itself, however, remains a much-disputed concept. The part of it that is not so much disputed is the thesis that there are no immaterial stuffs or things, where material is understood as the subject matter of chemistry and physics. Everything made of anything is made of electrons, quarks, etc., and if souls, Gods, or *élans vitales* purport to be made of non-physical stuff, they do not exist … It is a claim about what things are made of, and provides no more than weak constraints on what they may be like, how they may behave,

> or how their features and behaviour may be explained. And there are surely entities – numbers, places, perhaps fields (in the sense from physics)—that are not made of anything. But of course, even the narrow claim is not generally accepted: most people believe in souls, Gods, ghosts, or other entities that are not supposed to be material in this sense, but have the kind of substantial reality generally associated with material beings. (Dupré, 2021, 62)

This excerpt merits some comment. First, I think by its range of reference we may appreciate that the materialism being affirmed is an epistemological materialism. The claim being called narrow is an epistemological claim: knowledge of material entities is the theme. Second, the content is odd: "the material" does not need to be understood as only that which is presented in the subject matters of chemistry and physics; the move seems both reductionist and narrowing. Moreover, it seems to be an example of what C. S. Lewis (1960, 19–21) calls a "methodological idiom" in which matter has come to be understood by reference to what is studied in certain disciplines. Third, the immaterial in Dupré's presentation refers to two issues: the immateriality of numbers, places, and fields and the immateriality of souls and gods. Are these not, however, different sorts of immateriality, one of which is concerned with explanation, and the other is not? A "field" in physics contributes towards an explanation of the force generated by electrically charged objects. Additionally, climate change may be described as immaterial in an epistemological sense: it is known through data gathered by global monitoring systems and interpreted through computational models. The instruments are material, but what is the status of the judgments drawn from their data? If weather and climate are not the same, is the scientific evidence for climate change immaterial in the sense intended by Dupré? Nonetheless such evidence provides an explanation of a warming climate. In contrast, is "soul" or "god" an *explanation* of anything? Are these terms best understood in any way as an explanation? About which x is "soul" an explanation? When Ludwig Wittgenstein (2009, 187) opines that "[t]he human body is the best picture of the human soul," I do not think he is suggesting that the best explanation of the soul is the body (on explanation, see Staley 2025, 265–94). Such considerations suggest that there may be more than one sort of immateriality and that these sorts should not be too hastily combined.

After noting his limited agreement with materialism as a term, Dupré (2021, 63) specifies his preferred term: organicism. By organicism, he refers to two premises: "[F]irst, that biological theory starts with the organism, and second that the organism exhibits a mode of organisation very different form [sic] that of a machine" (Dupré 2021, 63). The contrast between machine and organism allows Dupré to insist that the stability of an organism needs to be understood as top-down as well as bottom-up: the behavior of some parts is an outcome of the behavior of the whole. This draws on the case made earlier by Dupré

(2021, 9) for downward causation: that is, "causation that acts from wholes on the parts of which they are composed." Moreover, notwithstanding Dupré's forceful argument, we should note that in the philosophy of biology, there are probably more votes for mechanism than organicism.

There are nonetheless theological contributions that also draw heavily from the organicist strain in biology and understand themselves as contributing to the debate from among the new materialisms. A contribution by Philip Clayton and Elizabeth Singleton offers "a theory of biological agency" that ranges from the unicellular organism to Gaia (Clayton and Singleton 2017, 136, 138). Alert to the charge of the "illicit projection" of human attributes (or anthropomorphism), Clayton and Singleton argue that all organisms value in some sense; they desire to succeed, that is, to feed and to reproduce. They readily concede that this value is not present to the cellular organism itself—not reflectively. It is therefore an awkward argument. We, as human observers, can appreciate that without nutrients the cell dies. In that sense, nutrition matters to the cell from an external perspective. If, however, it does not matter from an internal perspective—as Clayton and Singleton (2017, 140) concede, "simple organisms could not use this language themselves"—I wonder what the force—indeed, meaning—of the valuing language can be? Clearly, this is a discourse being stretched, as is suggested by their drawing on biosemiotics. Clayton and Singleton (2017, 142; emphasis added) write:

> One will expect to find *analogs* to many human functions in more simple organisms. Simple organisms perceive their environment, though without eyes; they know or are aware of features of their surroundings, though without conscious awareness. They act to fulfil goals, though without forming conscious intentions. In short, they are interpretive agents, agents of interpretation—which makes life a sort of hermeneutical agency.

Yet, *pace* Clayton and Singleton, this seems not to be analogical language—like and unlike—but more the use of metaphor. If successful, clearly such a metaphysical inquiry would establish all biological levels as agential and, in a certain sense, teleological. Moreover, such an approach is materialist in the sense of being non-dualistic. It seems, broadly speaking, to focus on immanent fields. Nonetheless, as Clayton and Singleton (2017, 149) argue, "An agent-centred biology invites theologians into an ancient-future space of reflection. There is no reason why God, having shed 'his' imperialistic trappings, cannot be invited back into this space of agential-life-lived-together." Again, the language seems strained: since when have gods been biddable? Moreover, are biddable gods not better known as idols? Above all, agency at this organic level must be defended by reference to more than metaphorical stretching and the collapsing of internal/external perspectives. Otherwise, reference to agency does not in fact identify an agent. This has serious theological consequences: the invitation

to God to return when an account of agency has not been secured renders God effectively lifeless, which once more suggests that this proposal is working within the turn to immanence.

Here, materialism is part of an argument over transcendence/immanence as contrastive. We may now see that religious efforts to affirm matter have tended to develop religious resources that emphasize immanence rather than transcendence.[6] The *Bloomsbury Handbook of Religion and Nature* provides an example: editors Laura Hobgood and Whitney Bauman argue for a shift of attention away from transcendence and towards immanence. The environment should not be understood, they argue, with reference to transcendent forces but instead to immanent causes. This turn to immanence also includes a critique of the "exceptional" human: on this immanentist view, the human does not mark a qualitative difference in nature; and common ways of identifying a difference—reason, soul, mind, language—unhappily suggest that human beings transcend nature. These common ways are found in philosophical worldviews and religious traditions and encourage human beings to misunderstand their relationship to the nonhuman in terms of, say, the superiority of the mental or the spiritual. In turn, the "inferior" world, as only immanent, is mere matter: dead or inert (Hobgood and Bauman 2018, 2).

I pick up here a question I flagged earlier: How are the turn to immanence and the turn to the material related? Are there any differences between them? On the turn to immanence, I note that such a turn is not meaningful unless the contrast with transcendence is at least implied. The turn to immanence just presented here—and many other examples could be found[7]—is agonistic: the more immanent, the less transcendent, and the opposite. What is proposed is a passage from the transcendent to the immanent, from the supernatural to the natural, from metaphysical to empirical, from otherworldly to this-worldly. In the background are the religions. The dynamic of the material turn is different, I argue: orientated in and towards matter, the turn seeks to avoid any exceeding of matter. In the background are the sciences. To call the material turn this-worldly in a sense goes too far—for there is no "other world" against which a "this world" might be established, even in negation.

What more, then, can be said about the relationship between the turn to immanence and the material turn? The turn to immanence sets up the issue in a particular way: the relation to matter of certain key concepts such as the divine, the sacred, and life. The core issue is whether reference to "beyond matter" devalues matter or secures its value. Is the "realness" of matter secured only truly from elsewhere—whether that elsewhere is construed theistically or pantheistically—or does any reference to "elsewhere" humiliate matter? For this focus, the energy travels between the two poles of immanence and transcendence, and materialism features as a proxy for immanence. A different way of proceeding, and the way I am developing here, would be to consider the

material turn as a provocation for the religions to display their own materiality, and to develop it. On this view, materialism is a proxy for materialism! This procedural materialism suggests that a religious approach that includes reference to transcendence contributes to the understanding of materiality. How does it do so?

Materializing Religion and Ecology

To begin to answer this question, I return to the difference between the terms materialist religion and religious materialism. Materialist religion asserts that there are material elements in religion, mostly associated with human embodiment. Religious views on the care of the human corpse, despite their diversity, speak to this. Materialist elements in religion, however, are not themselves a contribution to a religious materialism. Can this work be extended from materialist religion to religious materialism? A procedural materialism of the sort I have been recommending seeks in an expansive way to record materiality, beginning from human materiality. This is the pressure on religions generated by the material turn. What seems to be required in response is the development of this materiality rather than a turn to immanence. The critical issue is not an agonistic struggle à outrance, so to speak, between matter and spirit—despite rhetoric on both sides. Instead, the question is: What, with reference to transcendence and cognates, does religious materialism offer to the consideration of matter? The issue here is not simply the reference to transcendence but whether in and through this reference something significant about materiality is preserved and communicated. This would be a matter of expansive reduction, with reference to religion—acknowledging always that construals of materiality are selections and interpretations.

Nonetheless, how is this a contribution to the understanding of materiality? Consider the following: Can the material turn affirm the religious commitment to the person while also insisting that full individuality is a social and historical task within a constituted materiality? For example, Nathmal Tatia (2002, 3) argues that in Jainism, "humanity is the most developed class of living beings, but … is not privileged in any sense. Human reality is not at the center of things." Yet, the "whole force of their religion [for Jains] is directed to the central truth in every religion that each person needs to remake himself or herself in the image of the divine ideal" (Tatia 2002, 5). A key question here is whether the ethical tension of such remaking can incorporate the passivity of experience to which Timpanaro directs our attention. This is a highly important question in the Anthropocene. In a survey for a research project[8] analyzing the theological views of Christian environmental activists and advocates, over 300 respondents were asked what they thought of the statement that the resurrection of the body refers to the recycling of human bodies back into the earth.[9] The statement scored low, meaning it was strongly disagreed with. How to interpret this result? Does it mean that as individuals even

Christians who are environmentalists do not wish to be constrained by matter—at least, not finally? Or does it mean that the religious commitment to the person is finally ineliminable—presumably, atheist materialists would cite this as evidence that it is not possible for religious people to give up on "the soul"—and so religious materialism is an oxymoron?

A different response—a response of a procedural materialism—would be to interpret such reluctance to understand resurrection as recycling as a way of hoping for the final incorporation of human bodies. In other words, it expresses the hope that our bodies *and* our sense of our bodies—a difference we feel especially at times of illness—might coincide (Eagleton 2016, 22). This interpretation addresses the key themes of a procedural materialism: limitation and subjectivity. Transcendence—here, the resurrection of the body—records a materialist desire for the incorporation of human bodies or a materialist desire for the establishing of the full sensuousness of the human body. Put in a different idiom, what is being suggested is that our bodies might communicate without reserve. Further, if as a constituted materiality the human body depends in a strong and comprehensive sense on the broader material body of the planet, a materialist reading extends this hope for full communicability to that broader body itself. That is, there is a material link between the incorporation of human bodies and other "bodies." This would be one example of the content of a procedural religious materialism. Moreover, this finding is significant for atheist materialism for it suggests that materialists—religious and secular—are participating in a common, if differentiated, project.

We can go further still. Let us assume that the distinctiveness of the human that is secured by the concept of *imago Dei*/imaging God is compatible with evolutionary science. Let us assume thereby that what is distinctive of the human may be secured by reference to ecological and evolutionary processes: that is, such distinctiveness must be emergent in some way in this planetary history. That would be to insist on the constitutive role of evolutionary development of this planet: no *this* animal without *this* planet. Could such a commitment then be deployed to criticize efforts to consider moving *Homo sapiens* off planet, so to speak? *Homo sapiens* images God not as an abstract form but as an ecological, biological, and evolutionary form emergent from this, and only this, processual planetary history. On such a view, a religious tradition carrying such an interpretation of *imago Dei* might be understood as recording, displaying, and performing a history that, if it is to continue, will require investment in this planet's material basis. Of course, it is not a given that *imago Dei* functions like this—mine is not an epistemological purism; this is an interpretation and an argument. Yet, the crucial point is not that *imago Dei* has some hidden material component that can suddenly be produced: look, a material rabbit from a spiritual hat! (Does the *imago Dei* interpreted as relational operate in this way?[10]) Instead, in its imaging

of transcendent action, there are important material commitments. Might religious materialisms be amplified along lines such as this? Moreover, might a broad range of materialists, although for different reasons, agree on such a material investment?

A caution. If religions are responses to material limitations and are repositories of such responses, we may ask: Are these responses always liberatory? At this point, we might note that some efforts—one thinks of Elon Musk—to escape the material limitation of this planet by planning to transfer to another planet present an unstable mix of secular and religious. "Secular" in the sense of its technological optimism and its refusal of limitation, but also secular in the sense of claiming that the resolution lies within human capability; "religious" in the sense of its implied exceptionalism, for such a planetary move declines to see the human embodied form as informed and constituted by this planet's evolutionary history, and so assumes that recognizably human life could continue under radically different planetary conditions. It is, paradoxically, as if on this account the human body is a ghost in the planetary machine, and available for transfer. As Hannah Arendt (1998, 10) has pointed out, however, it is not clear that we would be the same after transfer: "[A]n emigration of men [sic] from the earth to some other planet … would imply that man would have to live under man-made conditions, radically different from those the earth offers him … Yet even these hypothetical wanderers from the earth would still be human; but the only statement we make regarding their 'nature' is that they're still conditioned beings." This sense of human availability for transfer, and the differently artificial character of the conditions that humans would experience after transfer, suggest exceptionalism.

At this point, viewed through the insights of a procedural materialism, religions may be wiser than at first sight seems to be the case. Although I have associated religion with exceptionalism, there are also indications of materialism within religions that counter such exceptionalism. (Nonreligious materialists may welcome such a finding.) Consider, for example, the vision of a new heaven and new earth in Revelation 21:1–2 and the presentation of the river of life in Revelation 22:1–2, thus:

> Then I saw a new heaven and a new earth, for the first heaven and the first earth had passed away, and the sea was no more. And I saw the holy city, the new Jerusalem, coming down out of heaven from God, prepared as a bride adorned for her husband …
>
> Then the angel showed me the river of the water of life, bright as crystal, flowing from the throne of God and of the Lamb through the middle of the street of the city. On either side of the river is the tree of life with its twelve kinds of fruit, producing its fruit each month, and the leaves of the tree are for the healing of the nations.

Part of the wisdom of the vision is its clear implication that in this new earth and new heaven, humans would not be as they now are. That, it seems to me, follows from the fantastical character of the presentation, precisely because the fantastical is to be understood materially: it records, in a fantastical register, the heavenly transformation of earthly conditions. At the point of reference to eschatological destiny—surely an unpromising place to look for evidence of materiality—we encounter evidence of limitation. To exceed these limits is to enter a different realm: a new heaven and a new earth. In the procedural interpretation of materialism I am advancing here, this is one of the meanings of transcendence.

Conclusion

I have been arguing that one way of relating religion and ecology is by reference to a religious materialism, interpreted procedurally. Religious materialism is thereby identified as a method: as this planet enters the instabilities of the Anthropocene, my account of religious materialism proposes that religions function as repositories of materiality. Religions focus on embodiment, limitation, and responses to these. They are thereby part of a wider—that is, planetary—materialist effort. More than this, however, and in accordance with the procedural materialism being advocated here, the relation between transcendence and materiality may be one way of securing a material emphasis. It is not that religions are best understood as spiritual, but with material elements. The task of religious inquiry in the Anthropocene is not thereby an effort to maximize any material element—an approach, as we have seen, that is found in the turn to immanence. Instead, in and by their transcendence, religions record material commitments—and, moreover, may with reference to transcendence affirm these material commitments. For a procedural religious materialism, transcendence is not otherworldliness. Religions are repositories of materiality on account of, and not despite, transcendence.

In this regard, for a religious materialism, the association of materialism with atheism is a distraction—and this moreover is an important finding for atheists too. There is no doubting that the opinion that materialism is atheistic is strongly held. For example, in developing his own "transcendental materialism," Johnston (2013) argues that religious traces remain in contemporary materialism and must be extirpated. Robin Gordon Brown and James Ladyman (2019, 9) make the same point: "Materialism believes the vital psychological phenomena of our human and animal existence are wholly dependent on the material nature of our bodies. Though it remains obscure to human understanding, they emerge, in some way or other, from our material being." From here, as Brown and Ladyman (2019, 9) proceed to argue, atheism follows: "There is no soul independent of our bodies, let alone one that could survive the destruction of our bodies. There is no afterlife." At this point in my argument, I have collated

sufficient evidence to query whether in terms of its history this is an adequate account of materialism. The focus on its secular character, epistemology, and the reference to psychology are very specific interpretations. We might speculate—and this will be hard for some atheistic materialists to hear—that such hostility to religion should be understood as deflecting concern over the hard-to-eradicate "metaphysical" element in materialism: the rejection of religion discloses a concern over the non-materialist epistemological basis of programmatic materialism.

In another way, however, this atheistic summary is helpful in that it puts the question about the materiality of religion. My response has been to focus on religious materialism. That is, rather than respond directly to materialism's purported atheism, I demonstrate how religions in their reference to transcendence are also records of materiality. In that such materiality is materiality in transition into the Anthropocene, transcendence records instability, ecological dependence through limitation, and affirmation of matter. By deploying a procedural religious materialism as a connector between religion and ecology, I have tried to show how it does this. For a procedural religious materialism, the vital issue is the relation between transcendence *and matter*, and not the atheistic critique of the relation between transcendence *and immanence*. (Again, this has significant implications for the debate between religious and atheistic approaches in materialism.) As such, this suggests that the turn to immanence is concerned with atheism whereas a procedural religious materialism is concerned with transcendence. Indeed, more boldly: for a procedural religious materialism, transcendence resists the humiliation of matter and secures its affirmation. Transcendence makes matter matter—or, at least, it may do so.

Finally, I consider the objection of reductionism. I have argued that with reference to ecology, transcendence identifies both the inescapability of limits—there are ecological dependencies that cannot be "mastered" or surpassed—and desires for a more fully satisfying material life. Such procedural religious materialism should be understood as a specific form of expansive reductionism. That is, reductionism may be understood in restrictive and expansive ways. Physicalism, argued by some to be the successor of materialism in the area of mind/body, may be reductive in a restrictive fashion (Brown and Ladyman 2019, 88–94). In contrast, to refer human activity to its material conditions and limitations—a constituted materiality—is reductive, but expansively so. As such, it indicates the ecological conditions and limits about which institutions and societies, as well as religious traditions, must decide how to respond. Religious traditions emerge thereby as important repositories of such expansive reduction. Such repositories might be more fully developed ecologically, along the lines of a procedural religious materialism. This development, which has implications for all materialisms, will be the task of a religious materialism in the Anthropocene.

Notes

[1] My use of the term material religion is in line with the account offered of the field by Birgit Meyer, David Morgan, Crispin Paine, and S. Brent Plate (2010, 207–11).

[2] Eagleton (2016, 10), objecting to an aspect of the new materialisms: "Matter, in short, must be rescued from the humiliation of being matter."

[3] In my reading of what is admittedly a dense passage, Raymond Williams suggests an account of materialism along these lines: materialism is not committed to a system nor a set of conclusions; instead, it is concerned with attention to certain sorts of evidence and specific procedures (see Williams 2005, 103–4).

[4] See Thomas Nail (2021, 1): "Most people are accustomed to treating the earth as a relatively stable place they live on and move on. Today, however, this stable ground is becoming increasingly unstable--for some of us more than others."

[5] Cf. Alyson Cole (2018, 167–79). This subtle position is indirectly resisted by Eagleton (2016, 10–11), in which he calls the materialisms as presented in Diana Coole and Samantha Frost (2010) "pagan."

[6] I acknowledge these are terms with a specific, mostly "Western," history.

[7] For example, Catherine Keller and Mary-Jane Rubenstein (2017, 1, 5): "disembodied transcendence" contributing to a "materiaphobia."

[8] Religion, Theology and Climate Change project (https://research.manchester.ac.uk/en/projects/religion-theology-and-climate-change).

[9] For a detailed presentation of findings from the project's survey, see Finlay Malcolm and Peter M. Scott (2024, 167–89).

[10] For a discussion, see Marc Cortez (2010, 14–40).

Competing Interests

The author declares that they have no competing interests.

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Dual Cognition, Spirituality, and Environmental Sensitivity

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A distinction is made between two modes of central human cognition, one conceptual and the other more intuitive and embodied. It is suggested that conceptual cognition does not generally lead to significant behavioral change and that conceptual cognition about environmental issues, including scientific research, may not result in much change in how people interact with the environment. Science is one of the most impressive achievements of conceptual cognition, but the detached, investigative approach to nature that is characteristic of science may have contributed to the present environmental crisis. Cultivating a more embodied sensitivity to the natural world may have more impact on environmental behavior. Spiritual practices, because they often foster an embodied mode of cognition, may provide a helpful basis for cultivating environmental sensitivity and enable religion to contribute to alleviation of the environmental crisis.

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The environmental challenges facing humanity are considerable. Humanity will need all possible resources, including scientific and religious, to tackle them successfully. The contribution of science is obvious in that it provides an accurate description of the environmental challenges humanity face and the best available predictions about what will happen if the current trends continue. However, scientific data are not always good at motivating people to change their behavior. For example, though it is well known that diet and exercise affect the risk of heart disease, progress changing lifestyles has been slow and faltering. It is one of the major problems of health care that people generally take very little notice of medical advice or evidence about what is good for them. Similarly, widespread knowledge of the looming environmental crises does not seem to be motivating people as much as it might to change the behavior causing this crisis.

In this article, I align myself with those who have suggested that an adequate response to the present environmental crisis will require a more engaged, participatory way of relating to the natural world rather than the detached, analytical one that has underpinned the advancement of science. I develop that approach using dual-cognition theories from psychology, applying them to the challenge of developing a more engaged relationship with the environment. That leads to a discussion of the potential role of spiritual practices in facilitating such environmental engagement, building on recent work on spiritual practices from the perspective of dual-cognition theory, and I suggest that they can foster environmental engagement.

Detachment or Participation

The present environmental crisis is widely agreed to be attributable to the impact of technology. However, in this article, I align myself with those who attribute the environmentally adverse impact of technology to the new way of relating to the natural world that developed in the seventeenth century (Cohen 1994). One aspect of this was a more detached, less engaged sense of relationship to the natural world rather than a sense of being a participant in the natural world, what Nicholas Lash (1995) calls the "spectorial" consciousness, which is noticeable from the seventeenth century onwards. The other, closely related, change was the use of investigative, experimental methods that involved manipulation of the natural world, first to "force nature to give up its secrets" (Midgley 1992) and later to make nature serve human needs. Over the past few centuries, with the industrial revolution being one of the major contributing factors, human beings have come to see the natural world as something separate from themselves that they are free to use and abuse.

Science has made effective use of the kind of conceptual cognition that takes a detached, objective, disengaged view of the natural world of which humanity is part. Over the past 400 years, humanity has accumulated an incredible wealth of scientific understanding, including scientific data about climate change and

its predictable consequences. Those data have been crucial in making humanity aware of the dangers in which they now find themselves. However, the detached objectivity about the natural world that has made science so successful may also have contributed to the insensitive, uncaring attitude to the natural world that has led to the current environmental crisis. It is possible to celebrate the achievements of science while still recognizing that the scientific mindset has contributed to our current environmental problems.

How humans think affects how they behave. Generally speaking, how they think about things (or persons or creatures) affects how they act towards them. In the mechanical philosophy of Descartes, nonhuman creatures such as dogs came to be seen as mere mechanisms, with no soul. It has been suggested, though this is hard to verify, that a mechanistic view of dogs led to changes in how people actually treated dogs. Thinking about them as mere mechanisms led to treating them more insensitively. There is a similar danger that thinking about the natural world in mechanistic terms will lead to treating it with indifference.

There has been growing awareness over the last hundred years of the problems caused by an increasingly detached mode of human cognition, and a recognition that resolving environmental problems will require a different mode of consciousness and a new and more sensitive way of engaging with the natural world. This line of thought can be found in slightly different forms in the work of Rudolf Steiner, Carl Jung, Martin Heidegger, Iain McGilchrist, and others.

Steiner (1861–1925), an Austrian polymath and clairvoyant, developed a complex narrative about the evolution of human consciousness, accessibly expounded by Owen Barfield (1957) and Charles Davy (1961). In brief, there was a gradual fading of the earlier animistic consciousness, in which humanity participated in a natural world that was experienced as being imbued with spirit. That was replaced by an onlooker consciousness, associated with the development of modern science, in which the natural world was experienced as soulless. Steiner believed that reconnection of spirit and nature was possible, but it would come with a new kind of imagination-based consciousness, what Barfield (1957) calls "final participation," in which humanity is able to look out in the world with spirit-imbued eyes. In 1924, building on that general framework, and in response to growing concerns about a deterioration in the quality of soil, Steiner ([1924] 2004) gave a lecture course on biodynamic agriculture that was designed to reconnect nature and spirit. Dan McKanan (2017) in *Eco-Alchemy: Anthroposophy and the History and Future of Environmentalism* claims that Steiner was the first advocate of organic farming and argues that his biodynamic agriculture has had an important influence on the environmental movement.

A convergent line of thinking can be found in Carl Jung's ([933] 2017) *Modern Man in Search of a Soul*, especially in the chapters contrasting archaic and modern man. Jung sketches a similar view of the evolution of consciousness,

in which humanity has gradually become detached from both the unconscious and nature. In the earlier mode of consciousness, there was no sharp boundary between "I" and "not I." The natural world was experienced as enchanted and had both soul and agency. However, with the development of scientific rationalism, the world became increasingly disenchanted. Jung maintains that this increasing detachment left modern man a "precarious creature." Jung was writing before the present environmental crisis, and did not address it directly, but his thinking can readily be applied to it (e.g., Kiehl 2012; Yunt 2001). For example, there needs to be a redressing of the balance between the dominance of the thinking function over the feeling, sensing, and intuiting functions. Like Steiner, Jung did not think it was possible to simply go back to the earlier mode of consciousness, but considered that humanity needs a new integration of the earlier engaged consciousness with the later achievement of conceptual clarity.

Another similar approach comes from Charles Taylor's (2007) influential work on the emergence of secularism in *The Secular Self*. Taylor makes a distinction between the more "porous" self associated with earlier religious cultures and the "buffered" self that has developed as a feature of secularism. Claire Gilbert (2025) has recently published an extended, scholarly analysis of the implicit porosity in the work of the late mediaeval mystic Julian of Norwich and drawn out its implications for the current environmental crisis. She suggests that a close engagement with Julian's writings can help people recover the more porous consciousness she believes is necessary if the environmental crisis is to be resolved.

Gilbert also draws on Heidegger's ([1954] 2013) critique of technology, which has led to a distinctive environmental philosophy and was an important influence on the "deep ecology" movement founded by Norwegian philosopher Arne Naess (1973) and developed by Rachel Carson (1962) and others (e.g., Tobias, 1989). Key features of deep ecology are biocentrism rather than anthropocentrism as its primary value; a view of nature as a web of interconnected parts rather a storehouse of resources; a goal of ecological harmony and equilibrium rather than sustainable development; and a strategy of cultural and spiritual transformation rather than technical and legal reform.

Two Modes of Human Cognition

I propose that it will be fruitful to develop these various lines of thought about how to engage with the environment by connecting them with current psychological work on two modes of human cognition (e.g., Evans and Frankish 2009), one intuitive and the other more deliberative. The most colloquial version of this distinction is as being between "head" and "heart" (Watts and Dumbreck 2013). For humanity to respond to environmental issues effectively, it may be necessary to appeal to hearts as well as heads. Dual-cognition theory can give greater precision to the kind of cognitive relationship to the environment that

seems likely to be necessary if the present environmental crisis is to be resolved. The religious traditions of the world, especially their spiritual practices, are well placed to help.

Numerous psychologists have distinguished between two modes of cognition but, unfortunately, there is as yet no generally accepted version of the distinction (Evans and Frankish 2009; Watts 2013a). Different theorists make the distinction in slightly different ways, and in different terminology. Sigmund Freud's well-known distinction between the conscious and unconscious mind was an early attempt. Another influential formalization came from the social psychologist Seymour Epstein (1991), who distinguished between rational and experiential cognitive systems.

McGilchrist's (2009) distinction between left-brain and right-brain is currently one of the best-known versions of dual-cognition theory. In part two of *The Master and His Emissary*, McGilchrist (2009) sets out a theory of how human consciousness has changed in recent centuries, with increasing dominance of a rational and analytical mode of cognition (which he calls "left brain"), associated with the advance of science, and a growing eclipse of the evolutionarily older mode of cognition that is intuitive and embodied (which he calls "right brain"). At various points in *The Matter with Things*, McGilchrist (2021) explores the implications of this shift in cognition for environmental issues.

McGilchrist's use of neuroscientific data has been criticized (e.g., Spezio 2019). Evidence from careful study of people who have suffered damage to just one side of the brain is strongly supportive of his claims about lateralization (McGilchrist 2009, chap. 2). On the other hand, empirical work using brain scanning methodology suggests a more complex mapping of modes of cognition onto areas of the brain, and there is no evidence from brain scanning studies of over-dominance of one hemisphere over the other (Nielsen et al. 2013). It is important to emphasize that the brain always operates as a whole, and each hemisphere operates in the context of the other, unless one suffers significant damage. For present purposes, I am more concerned with McGilchrist's distinction between two different modes of cognition than with his mapping of these modes on to structures of the brain, and some may prefer to take "left brain and "right brain" as metaphors for two modes of cognition.

The version of the distinction between two modes of human cognition with which I have engaged most extensively is Philip Barnard's cognitive architecture, interacting cognitive subsystems (ICS). One mode of cognition is intuitive, practical, embodied, holistic, affective, and participatory. It is a continuation of the phylogenetically older intelligence of our primate ancestors. In addition, humans have a distinctive rational, analytical, conceptual intelligence that works with linguistic or other symbolic representations of reality rather than engaging in a practical way with the real world. Again, both central subsystems are always

active, and each operates in relationship with the other. Nevertheless, there is a lot of variability from moment to moment in how functional relationships between the subsystems are configured. There is a distinction between these two modes of cognition, but it is not being suggested that they operate separately from each other.

The clearest and most accessible account of Barnard's distinction between these two modes of central cognition is provided by John Teasdale (2022, chaps. 2–4) in his recent book on mindfulness. ICS provides what is probably the most rigorous version of the distinction between two modes of central human cognition and can be regarded as achieving a computational level of precision, even though it has not been fully implemented in a computer program (see Watts 2024). It has also spawned a wide range of applications, including modelling the cognition involved in spiritual and religious practices (Teasdale 2022; Watts 2024).

ICS also comes with a helpful account of the evolution of cognitive architectures, from the relatively simple four-subsystem architecture of an animal such as a zebra to the complex nine-subsystem architecture of human beings (e.g., Barnard 2019). On Barnard's account, animals such as a zebra would have three sensory subsystems (visual, auditory, and body states), feeding into a multimodal central processor. Two significant developments led to additional subsystems. The use of tools required an additional motor subsystem as well as an intermediate subsystem integrating visual input with motor output. Similarly, speech led to an articulatory subsystem as well as an intermediate system integrating auditory input with articulation. Finally, the central subsystem spawned an additional subsystem for conceptual intelligence, leaving the central subsystem free to focus on a more embodied and intuitive mode of central cognition.

Barnard's ICS emphasizes that conceptual cognition deals with symbolic representations of the external world rather than experiencing things directly. In ICS, visual, auditory and body state all feed directly into intuitive, nonconceptual cognition. However, visual and auditory input to conceptual cognition is filtered through the more recently developed intermediate subsystems to provide us with representations of reality (or with visual or auditory imagery) rather than arising from direct experience of the environment. In a similar vein, William James ([1902] 2012), one of the pioneers of modern psychology, was well aware of the importance of conceptual cognition in human beings but, interestingly, also recognized that there was something unusually "pure," direct, and unmediated about mystical experience (Forman 1990).

Conceptual cognition is even more cut off from somatic experience, which, in ICS, has input only to embodied, nonconceptual cognition, not conceptual cognition. McGilchrist (2009) makes a similar point about the disconnectedness of left-brain cognition when he points out that the components of the left brain

are very tightly interconnected within it but have little connection with the rest of the body. In contrast, he points out that the right brain is well connected with other parts of the body, such as the guts. It seems that human cognition is structured so that the contact between somatic, embedded cognition and conceptual cognition is limited and tenuous. In addition, conceptual cognition always simplifies and filters out much of the rich meaning of more intuitive cognition.

In making claims about human distinctiveness, it is always important to distinguish between description and evaluation. Many people now say that it is pernicious to see humans as special. I would say humans are different, in that they have an advanced linguistic, symbolic, conceptual intelligence that is found only in embryonic form in other species—but that need not imply humans are better. Humans have more advanced conceptual capacities than other species, which they can use for good and ill. Descriptively, humans are different; evaluatively, they are not better. Humans may have exceptional influence on the planet, but that does not necessarily make them more important.

The contrast between two modes of cognition has a parallel in biology, in the debate between organicist and mechanistic ways of understanding life (Ruse 2010). For the most part, mainstream biology has taken a mechanistic approach, and organicist views, such as Lovelock's "Gaia" (that the Earth is a single self-regulating organism), have been side-lined (Ruse 2013). However, as Rupert Sheldrake (1990, 3–4) argues, there has often been a discrepancy between official views of nature as "the inanimate source of natural resources" and an unofficial private world, chiefly identified with the countryside, to which people feel an intuitive emotional connection.

Sheldrake has, over many years, taken a particular interest in adaptive behavior, such as bird migrations, that are not easily explained on current mechanistic assumptions. For example, adult cuckoos migrate from the United Kingdom to Africa in July, leaving their offspring to be brought up by other species. About a month later, the offspring gather and fly to exactly the same destination without having ever met their parents. To explain how such things are possible, Sheldrake has developed a theoretical framework in terms of procedural memory (morphogenetic fields) and extended mind (Sheldrake 1995; Watts 2011).

Though biology has officially clung to a mechanistic framework, the case for allowing a broader range of explanatory factors has become increasingly strong. On many topics, there is a strong case for moving at least to an expanded version of the mechanistic approach that allows contextual and holistic factors (Reiss and Ruse 2023). Self-organizing processes are observable at many levels in the natural world (Kauffman 1996).

The contrast between these two modes of human cognition has also been played out in psychology. Psychology, particularly cognitive psychology, came to focus mainly on the conceptual capabilities of mind, learning, problem-solving, etc. Of course, emotion was acknowledged, but it was all too often

subordinate to other concerns, such as the role of emotions in learning or decision making. However, more recently there has been an upsurge of interest in embodied, or "4E" (embodied, embedded, enacted, and extended) cognition (e.g., Newen et al. 2018).

Interestingly, an important source of this current interest in embodied cognition came from authors influenced by Buddhist thinking (Varela, Rosch, and Thompson 2017). There has been a good deal of subsequent interest in the implications of embodied cognition for theology and religious studies, by Warren S. Brown and Brad D. Strawn (2012); Jones (2019); Strawn and Brown (2020); Fraser Watts (2013b, 2021); Tobias Tanton (2023); Patty Van Cappellen, Stephanie Cassidy, and Ruixi Zhang (2023).

Environmental Applications

Human beings engage with environmental issues using both kinds of cognition. Scientific analyses of the problems created by climate change, and predictions of its consequences, are an example of the power of human conceptual cognition. Humans can think about the environmental crisis, using their special capacity for conceptual cognition, and reflect on environmental issues. For example, they can distinguish between different meanings of ecology and reflect theologically about human beings having the same creator God as the natural world of which they are a part, or whether human beings have a responsibility, under God, to contribute to the redemption of the whole of creation, not just the human race.

Human beings can also use their phylogenetically older mode of cognition to engage with the natural world around them in a way that is more similar to how animals engage with it. People can sense the world around them at an intuitive level, and respond to it instinctively, without necessarily stopping to conceptualize what they are aware of. In other words, they are capable of sensing, and responding to, what is happening around them—sunlight and rainfall, for example—in an animal-like way. They can touch, taste, and smell what is around them in much the same way as other animals do.

A central claim of this article is that the capacity of conceptual cognition to change how human beings interact with the environment is limited, and indeed that the overreliance of human beings on our rather detached kind of conceptual cognition has contributed to the widespread despoiling of the natural world. However, humans still have an animal-like intelligence available to them, even though it tends to be overshadowed by the distinctive human capacity for conceptual cognition. If humanity could recultivate a more embodied, empathic awareness of how the natural world is suffering as a result of how they have treated it, this would naturally lead to treating the natural world better. In order to cultivate environmental sensitivity, humanity needs to inhabit its animal intelligence more richly. That may involve sometimes putting conceptual intelligence to one side so that humanity can function better as animals.

Many animals seem to be well connected to planetary intelligence in a way that leads them to live alongside the planet much better than humans do (Bridle 2022). We humans need to recover our capacity to participate sensitively and effectively in that planetary intelligence. Nonhuman creatures showed evidence of a nonconceptual awareness of climate change, and started to adapt to it, long before humans realized it was occurring. In 1736, Robert Marsham, a Norfolk landowner, began keeping records of the arrival of spring, and these records were continued by him and subsequent family members until 1958. The records show clear evidence of rising temperatures, especially in winter months; and that is correlated with changes in the behavior of plants and animals, such as oak leaves appearing a little earlier. As temperatures rise, migrations occur earlier (Bridle 2022, chap. 4). Humans now tend to over-prioritize propositional knowledge to the point where they fail to have the kind practical, intuitive knowledge of the changes going on around them that is evident in other species. Often, humans try to override environmental changes rather than adapt to them.

The Role of Spiritual Practices

I now explore, drawing on cognitive psychology, how spiritual practices might help people engage with the environment more sensitively and interact with it less destructively. I would not claim that spiritual intelligence is a necessary accompaniment of environmental sensitivity. People can cultivate environmental sensitivity without approaching it as a spiritual practice. However, I claim that there is a natural affinity between spiritual intelligence and environmental sensitivity, and that spirituality provides one route by which environmental sensitivity can be cultivated.

Spiritual *practices* are potentially most useful in cultivating environmental sensitivity, though such practices are generally supported by assumptions and beliefs. The interconnectedness of beliefs, practices, and experiences is as much a feature of spirituality as of religion (Watts 2017, chap. 8). Spiritual practices may be either located within religion or adopted by those who regard themselves as "spiritual but not religious" (e.g., Watts 2022). They can lead to the cultivation of a kind of "spiritual intelligence," which Marius Dorobantu and Watts (2025, 5), following Robert A. Emmons (1999), characterize as having "a sense of meaning, unity and connectedness, the focus on ultimate purpose and meaning, and a set of beliefs and practices that facilitate a relationship with the transcendent."

Rowan Williams (2023), in an unpublished conference talk, suggests that spiritual intelligence is an embodied and *located* kind of intelligence. For him, the key question about ourselves, from the point of view of spiritual intelligence, is not what we are, or even who we are, but where we are (Watts 2023). That

implies that that environmental sensitivity is a key feature of spiritual intelligence, and that spiritual intelligence is a highly embodied kind of intelligence. Physical activities and postures play a key role in spiritual practices, especially in sacramental Christianity (e.g., Van Cappellen, Cassidy, and Zhang 2023; Watts 2021).

Spiritual practices are quite variable in their focus. So far, there has been little attempt to classify them, though Sheldrake (2019) suggests that there are three basic types: some that induce a state of deep repose, some that enlighten understanding, and some that involve activity. It is possible to develop a related classification in terms of the ICS cognitive architecture. Some spiritual practices involve conceptual cognition, but many that do not. Of those that do not, some prioritize meditative attention to sensory stimuli of one kind or another, while others focus on activity. Though it is possible that all spiritual practices may lead to increased environmental awareness to some extent, those that involve sensory attention seem most likely to do so.

One of the best researched spiritual practices involving sensory attention is mindfulness. Mindfulness-based cognitive therapy has a good track record of effectiveness in the treatment of conditions such as depression (Piet and Hougaard 2011), and there is growing evidence for the effects of mindfulness on the brain (Trichal 2026). In principle, people can train themselves to give mindful attention to anything, but most practitioners of mindfulness focus on somatic awareness, using a focus on breathing, or perhaps the soles of the feet, to avoid conceptual cognition and locking onto intrusive auditory or visual stimuli. John Teasdale (2022) has used ICS to develop a theoretical understanding of mindfulness in terms of its avoidance of conceptual cognition. In mindfulness, people train themselves to prioritize the more intuitive mode of cognition, which notices things without conceptualizing or evaluating them.

There is now a growing body of research on such environmentally focused mindfulness, with promising findings. Mindfulness leads to an increased sense of connectedness with nature, as well as improvements in health, wellbeing, and sociality (Thiermann and Sheate 2021). A variant of mindfulness that focuses more explicitly on environmental awareness might make an even more significant contribution to resolving the environmental crisis. Somatic awareness (or "interoception") is an important feature of many spiritual practices (Beharrell 2019). However, it would be possible to develop a spiritual practice that enhances environmental awareness, rather than somatic awareness, but in the same mindful way. Like other kinds of mindful attention, it would involve simply noticing how things feel, noticing temperature, sound, silence, the quality of air, and the rich range of things in visual field. As with other kinds of mindfulness, it would presumably avoid locking onto any of these things or conceptual thought about them and instead simply noticing the environment.

Many religious traditions have rich frameworks of understanding that would provide background support for such a practice, as evident in, for example,

The Routledge Handbook of Religion and Ecology (Jenkins et al. 2017). Buddhism is probably a particularly rich resource (Tucker and Williams 1998), highlighting the interconnectedness of all things and emphasizing that humans are not separate from nature but rather an integral part of it. Within the Christian tradition, Celtic Christianity had a particularly rich engagement with the natural world (Low 1996).

Another rich resource for developing an environmentally focused spirituality is the engagement of many Indigenous peoples with their land (Jenkins et al. 2017). Particular places often play an important role in spiritual traditions. Watts (2019) notes that in the Hebrew Bible, there is a rich set of engagements with both places in the natural world and particular buildings, such as the temple. There is a particularly rich engagement with the land to be found in Indigenous cultures, such as the Aboriginal people of Australia. Something similar can be found in the relationship of the ancient Israelites to the "land," as evident in the Hebrew Bible. The environmental cognition of Indigenous culture is often closely connected with their spiritual worldview. For example, in Aboriginal culture, there is a sense of having a deep spiritual connection to the land. Humans are seen as belonging to the land rather than the land belonging to humans. This sense of connection to the land is rooted in the concept of the "Dreamtime" (or *Tjukurrpa*), when ancestral beings created the world and all life (Elkin 1956). This Dreamtime is not just a distant past but an ongoing, living reality that shapes life now.

In the Aboriginal worldview, it is believed that ancestral spirits created the land as well as the relationships between people, animals, and the environment, and that the land is not merely a resource but a spiritual and living entity infused with the spirits of ancestors. This belief fosters a sense of responsibility to care for and protect the land and waters, as people see themselves as stewards or custodians rather than landowners. Further, the connection to ancestral land is central to Aboriginal identity, so being removed from their land is seen as a separation from a vital spiritual and cultural connection. Among religious groups, a sense of attachment to the land is often particularly strong among diaspora groups who no longer live in their ancestral land but whose identity is maintained by an ongoing sense of connection to it, which can be seen as a kind of "place attachment" (Counted and Watts 2019; Counted et al. 2024). There is a growing body of empirical research on the sense of connectedness with nature (Keaulana et al. 2021), which is now quite common, and often quasi-religious.

The Need for Balance and Integration

To address the environmental crisis, I suggest that humanity will need to draw on both modes of human cognition. Humanity needs rational decision-making about technological advances, such as sustainable aviation fuel. However, I

am suggesting here that it would help if human beings could also cultivate the kind of environmental sensitivity that naturally develops from many spiritual practices. I suspect that attentive spiritual intelligence is more relevant to the environmental crisis than abstract religious beliefs and offers a more effective route to changed environmental behavior via enhanced environmental sensitivity. Like scientific data, conceptual beliefs about creation are likely to be too abstract to motivate behavioral change unless they are accompanied by spiritual practices.

A key issue is how best to deliver the changed behavior necessary to deal with the environmental crisis. Scientific data seem to have limited value in motivating people to change. Humans are capable of both hot (affective) cognition and cold, detached cognition. I suggest that hot cognition is more effective in bringing about behavioral change, and that cold cognition, on its own, struggles to do that.

There is, of course, scope for crossover between the two modes of cognition, and for their integration. For example, there are ways of doing science in an unusually participatory and meditative way, such as Goethe's way of meditating on plants. The Goethean practice of meditating on the form of plants (Bortoft 1996) is the kind of spiritual practice that would be expected to enhance environmental sensitivity. There is also currently a lot of fascination among the wider public with the interdependence found in the ecosystems of the natural world, brilliantly popularized in TV programs by people such as David Attenborough. Humanity will need to integrate all possible approaches to tackle the environment crisis.

The cognition of particular individuals is embedded in a wider societal and cultural context, with a to-and-fro between individual and societal cognition. While many of the adverse effects of human environmental behavior are indeed a consequence of blinkered conceptual thinking, this can nonetheless be balanced by constant, societal-level dialogue with belief systems about how conceptual cognition is best developed and deployed. There needs to be not only a rebalancing between conceptual and participatory cognition but a challenging of the substance of societal beliefs, such as the current widespread belief in economic growth as a panacea for all problems.

Individual minds will need to be embedded within societal enabling conditions for a trajectory to develop that will lead to better human relationships with the planet. That may involve at least five system levels. Neurological systems are nested within psychological systems, which in turn are nested within behavioral systems, which are nested within local human groups and cultures, which are nested within more global human groups and cultures. The schematic models that individuals develop are based on all the interactions they have in their behavioral world and on what filters down from their local culture and

its relationship to other global cultures. Environmental issues arise at all these levels. Changes in belief systems are needed that permeate all non-brain levels.

This article argues that scientific rationality needs to be supplemented with the cultivation of the kind of environmental sensitivity that grows naturally out of spiritual practices. Humanity may be able to use its conceptual intelligence to focus attention back on the need for a more personal, sensitive approach to the environment. Perhaps humanity can cultivate a kind of science that involves a more personal sense of connection with the natural world. Humanity needs the objective, detached gaze of science, but needs to integrate it with seeing ourselves as embodied creatures situated within the environment, not outside it. Integrating these two kinds of gaze is a key challenge for scientific and religious work on the climate crisis humanity faces.

In as far as religious communities are currently responding to the environmental crisis at all, they often do so in a rather limited and unambitious way, focusing just on the carbon imprint of their own premises, such as eco-churches or eco-mosques. The scale of the environmental crisis calls for a bolder and more ambitious response, which has not often been forthcoming. An impressive (and early) exception was when, in 1972, A. H. ("Horace") Dammers (2004, chap. 6), then a canon at Coventry Cathedral, became aware through chance circumstances of environmental issues and responded by founding the Lifestyle Movement, with its slogan, "live simply that others may simply live," aiming to change the lifestyles of as many people as possible (Dammers 1982), and planned an international conference on Christian environmental responsibility (Lester 1975). Humanity needs more religious responses to the environmental crisis of comparable ambition. Religion connects with intuitive, embodied cognition in a way that science cannot easily emulate; and it has the resources within its spiritual practices to foster enhanced environmental sensitivity.

Competing Interests

The author declares that they have no competing interests.

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Eco-Ethical Knowledge from the Indigenous Amazon and the Reimagining of Nature

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This article explores how Indigenous communities of the Brazilian Amazon conceive the relationship between humans and the natural world, contrasting their relational, eco-ethical understanding with the mechanistic view of nature that emerged in early modern Europe. Drawing on ethnographic work among the Yanomami, Tukano, Enawene-Nawe, Wajãpi, and Krahô, we connect early Indigenous critiques of the European drive for accumulation to present-day debates over multispecies agency. Since these Indigenous ontologies frame plants, animals, and spirits as intentional beings within networks of reciprocity, they reveal a metaphysical continuity between humans and nonhumans, challenging Western assumptions about nature as inert matter. By juxtaposing these perspectives with contemporary reflections—from Eduardo Viveiros de Castro to Davi Kopenawa—we argue that Indigenous eco-ethical knowledge from the Amazon offers an alternative to the exploitative logics driving the current ecological crisis and expands previous concepts of Indigenous relationality. We suggest that the Indigenous Amazonian worldview invites a reimagining of human–nature relations grounded in complex forms of multifaceted relationality.

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Introduction

In 1934, when Claude Lévi-Strauss (1972) first arrived in Brazil, he carried a book by a Calvinist missionary, Jean de Léry (1993). Tucked in the anthropologist's jacket, *History of a Voyage to the Land of Brazil*, originally published in 1578, describes the surprise experienced by both sides as Europeans encountered Brazil's Indigenous people.

Léry reports that the Tupinamba people were astonished by the French desire to secure large quantities of brazilwood. With evident confusion, an old man from the tribe asked, "What does it mean that you Mairs and Peros (that is, French and Portuguese) come from so far for wood to warm yourselves? Is there none in your own country?" Léry responded that they desired the wood not as fuel but for dye, but this did not satisfy his interlocutor. "Very well," he replied, "but do you need so much of it?" Léry patiently explained the mechanics of commerce in sixteenth-century Europe, in which merchants accumulated vast quantities of valuable goods well beyond their individual needs. According to Léry, however, this did nothing to clear up the matter: "'Ha, ha!' said my savage, 'You are telling me of wonders.'"

Léry (1993, 101–2) reports that his Tupinamba interlocutor continued with a series of penetrating questions:

> Then, having thought over what I had said to him, he questioned me further, and said,
> "But this man of whom you speak, who is so rich, does he never die?"
> "Certainly he does," I said, "just as others do."
> At that (since they are great discoursers, and pursue a subject out to the end) he asked me,
> "And when he is dead, to whom belong all the goods that he leaves behind?"
> "To his children, if he has any, and if there are none, to his brothers, sisters, or nearest kinsmen."

Once again, Léry's explanation is entirely conventional according to the norms of early modern Europe: the merchant class accumulates wealth in order to enrich themselves and support their inheritors. However, following Léry's response, the Tupinamba man drew the following conclusion: "I see now that you Mairs (that is, Frenchmen) are great fools; must you labour so hard to cross the sea, on which (as you told us) you endured so many hardships, just to amass riches for your children or for those who will survive you? Will not the earth that nourishes you suffice to nourish them?" (Léry 1993, 102). For someone who had learned to trust the nurturing earth, the European desire for wealth seemed like simple insanity.

Immediately after, Léry (1993, 102) shrewdly adds the following gloss: "And there you have a brief and true summary of the discourse that I have heard from the very mouth of a poor savage American. This nation, which we consider so barbarous, charitably mocks those who cross the sea at the risk of their lives to go seek brazilwood in order to get rich."

Revisiting this dialogue now—following four and a half centuries of unfettered commerce—the Tupinamba critique is compelling. In an echo of this insight, some argue that the pursuit of wealth has been enormously damaging for the people who were colonized, the ecologies damaged by exploitation, and the communities distorted by the strange desire for accumulation. It seems that Lévi-Strauss was drawn to Léry because he describes an Indigenous response to a European mindset. Despite the limitations of his missionary narrative, Léry offers a window into the other observing us, refracting European habits in a way that clarifies that they are (within the wide span of the world) unusual.

This article argues that Indigenous communities in the Brazilian Amazon conceive the relationship between humans, nonhumans, and the natural world in a way that blends specific knowledge (of plants, animals, seasons, etc.) with ethical and social behavioral rules. Theorists such as Akeel Bilgrami (2010) and Mohamed Meziane (2024) connect colonial and economic exploitation to an objectified understanding of nature as something inert, subject to calculation and manipulation. In contrast, Indigenous Amazonian communities understand the ecology of the forest to be continuous with human relationships of power and meaning. As we will describe, this is particularly evident in the boundary between humans and nonhuman beings, which involves a complex form of relationality that often includes strict rules of acceptable and forbidden behavior. By exploring this perspective, we aim to suggest that Western people might relate differently to the world—and to each other—than the prevailing economic and knowledge systems allow.[1]

Naturalism and Exploitation

As the example of Léry suggests, modern Europeans have tended to view the natural world as inert matter, available for exploitation and devoid of spiritual meaning. According to Bilgrami (2010), members of the Royal Society in England argued that the universe operates according to immanent laws, free from disruptive intervention by the divine. Following the work of Isaac Newton and Robert Boyle, matter came to be understood as "brute" and "stupid" (Bilgrami 2010, 39). This meant that material regularities could be studied in the emerging sciences, but it also prevented the world from imposing any normative constraints on human action (Bilgrami 2010, 40). Bilgrami concludes that this impersonal attitude toward the world was inseparable from efforts to exploit it

for economic profit. From this perspective, the plantation, the colony, and the laboratory rest on a shared understanding of mechanical nature.

Charles Taylor (2007) calls this understanding of nature "the immanent frame," which separates nature from a supernatural order that transcends it. In Taylor's (2007, 542) analysis, the emergence of post-Galilean natural science sparked this shift in perspective; once the physical universe was understood to be governed by ordered regularity, understanding these laws did not require any reference to the intentions of a creator. Just as this allowed the immanent realm to be understood on its own terms, a new conception of the self-sufficient individual, buffered against outside forces, enabled people to experience immanence in everyday life (Taylor 2007, 543).

Recent scholarship has shown that this understanding of immanence is culturally contingent. In Peter Harrison's (2024) analysis, the success of the natural sciences led some people to conclude that material reality is all that exists. On this narrative, medieval people believed in supernatural forces, but modern science has shown that everything can be explained with reference to natural laws. As Harrison describes, changing attitudes toward the miraculous were pivotal to this shift. Whereas premodern Christians thought God regularly intervened in the natural world, miracles came under increasing suspicion in the early modern period. This shift began in intra-Christian polemics: following the Reformation, Catholic theologians appealed to miracles to bolster the authority of the church, while Protestant theologians sought to discredit them (Harrison 2024, 104–10). Before long, critics of religion such as David Hume (2008) adapted these arguments to discredit all miracles, including those described in Christian scripture. Once the supernatural came under suspicion, the natural world came to seem stable and self-contained.

When refracted through the prism of scientific progress, Indigenous worldviews seem like a misunderstanding that modern naturalism has dispelled. In Jean de Léry's dialogue with the Tupinamba leader, it is clear that these Indigenous peoples experienced the boundary between human and nonhuman beings to be porous and flexible. Although this violates the perspectival foundation of empirical science, Harrison's scholarship suggests that the binary between naturalism and supernaturalism is not simply a fact about the world—it is a historically and culturally specific interpretation. Where many assume that scientific naturalism supplanted the mystifications of medieval religion, the concept of the supernatural only took hold in the early modern period. As Harrison (2024, 255; 2006) describes, classical Greek and early Christian authors did not have a term through which they could refer to events violating the laws of nature. For them, the miraculous was associated with the experience of wonder rather than with a specific kind of causation (Ward 1999; Daston 1991; Newheiser 2025). This suggests that the division between empirical science and

spiritual experience is not inevitable: whereas naturalism and supernaturalism were both invented in modern Europe, experience has taken different forms in other times and places.

Metaphysical versus Physical Discontinuity between Humans and Nonhumans

Whereas modern Europeans have tended to divide the natural order (governed by mechanical laws) from the spiritual realm (which stands above or beyond nature), the Tukano and Yanomami trouble the familiar distinction between nature and the supernatural: for them, the material world is permeated with spiritual meaning. According to the Brazilian anthropologist Viveiros de Castro, Indigenous Amazonian communities see the division between what is a human, what is an animal, and what is an invisible entity as fluid and multidimensional: an animal can, under certain circumstances, experience reality like a human, and vice versa. Nonhuman entities, whether animal or gods, can think like humans, and so can humans think like other entities. Viveiros de Castro (2016, 197) calls this multispecies sense of agency perspectivism:

> Typically, in normal conditions, humans see humans as humans and animals as animals . . . Animals (predators) and spirits, however, see humans as animals (as prey), to the same extent that animals (as prey) see humans as spirits or as animals (predators). By the same token, animals and spirits see themselves as humans: they perceive themselves as (or become) anthropomorphic beings when they are in their own houses or villages and they experience their own habits and characteristics in the form of culture—they see their food as human food (jaguars see blood as manioc beer, vultures see the maggots in rotting meat as grilled fish etc.), they see their bodily attributes (fur, feathers, claws, beaks) as body decorations or cultural instruments, they see their social system as organized in the same way as human institutions are (with chiefs, shamans, ceremonies, exogamous moieties etc.). This "to see as" refers literally to percepts and not analogically to concepts.

This presents a clear contrast to the naturalism that has shaped Western science. Where scientific naturalism holds that there is nothing beyond the mechanical operation of natural forces, Indigenous Amazonian ontology sees nature itself as vibrant, permeated by a variety of nonhuman beings that think like humans—not only animals and trees but also spiritual beings and spirits of dead ancestors.

To take one example, the Yanomami state that the spirits of the dead think of themselves as living, embodied beings. In her fieldwork with the Yanomami, the anthropologist Hanna Limulja found that, although these spirits are dead,

they appear in the dreams of the living, asking them to come and join them in the new village they now inhabit. In this ongoing life after life, the spirits carry on as usual: fishing, hunting, eating, and engaging in sexual intercourse (Limulja 2022). These dreams are understood not as mere subjective experiences but as real encounters with dead ancestors.

Another example of the fluidity between our world and that of the spirits comes from the Tukano. They tell stories of special places in the forest that are gates to the spirit world, which you can walk into and talk to the spirits, who are similar to humans but taller and stronger. However, time moves faster there, and if you do not return quickly to the human world, you will find your young children as adults upon your return (Barreto et al. 2018). This detail underlines that the Tukano see nature as permeated by nonhuman beings that think and act like humans while remaining significantly distinct.

Levi-Strauss (1973, 384) provides an example that presents a similar contrast: "In the Greater Antilles, some years after the discovery of America, whilst the Spanish were dispatching inquisitional commissions to investigate whether the natives had a soul or not, these very natives were busy drowning the white people they had captured in order to find out, after lengthy observation, whether or not the corpses were subject to putrefaction." What the Indigenous peoples were inquiring about was whether the European bodies were human, like their own bodies, or whether they were spirits "dressed up" as humans—in which case, their bodies would not corrupt like human bodies. In this Indigenous system, the realness of the spirit is uncontested; all beings are understood to have an identical spiritual essence. Hence, for Indigenous people in the Greater Antilles, theological scrutiny by Christian inquisitors was entirely senseless. From their perspective, it is not the spirit that differentiates us from other beings, or from other humans, but the body.

Viveiros de Castro (2002) describes this as an example of what he calls multinaturalism. On this interpretation, Europeans posit a metaphysical discontinuity between humans and animals, which places humans above animals. In contrast, Indigenous Amazonian peoples acknowledge a physical discontinuity between humans and animals but claim that there is a metaphysical continuity between them, since all beings share a common spiritual nature. The human, animal, or spirit form becomes a kind of clothing that "conceals an internal human form, usually only visible to the eyes of the particular species or to certain transpacific beings such as shamans" (Viveiros de Castro 2016, 198). Thus, while modern Westerners tend to assume that there is one nature and various cultures, these Amazonians hold that there is one single spiritual essence (since we are all human under our clothing) but various "natures" (i.e., different bodies).

Our Common Humanity

According to Darwinian theory (1859), humans and nonhuman animals share inherited characteristics, but humans ultimately developed traits that make them distinct. In contrast, Amazonian cultures say that it is humanity rather than animality that is our common heritage. The leading Yanomami activist and shaman Kopenawa explains, "A very long time ago, when the forest was still young, our ancestors—who were humans with animal names—metamorphosed into game. The human wild pigs became wild pigs" (Kopenawa and Albert 2013, 61). Despite this metamorphosis from human into animal, he adds that "we are still their fellow creatures. Though we are humans, they give us the same name they give themselves. This is why I think our inner part is identical to that of game" (Kopenawa and Albert 2013, 387). In a reversal of the evolutionary narrative, the Yanomami and other Indigenous Amazonian peoples hold that in the beginning, humans were not animals but animals were human. This view, as Lévi-Strauss reminds us, is widely inscribed in Indigenous creation stories: "If you ask an American Indigenous person [what a myth is], their answer would very likely be that it is a story of the time when humans and animals were not different" (Lévi-Strauss and Eribon 1990, 178).

This could seem counterintuitive from the standpoint of Darwinian biology, but there are echoes with Western paradigms. In European schools, children are often taught that, from a biological perspective, humans are animals. However, this assumption does not entail that one must relate to a colleague or neighbor in the same way one would relate to an ox or a cow. Although continuities between humans and animals are acknowledged, distinct modes of relationship are maintained. In similar fashion, an Indigenous person meeting a jaguar in the Amazon would not usually relate to him as if they were meeting one's cousin. The difference is that the jaguar is also understood to have its own culture, with its own villages and special food and drink (Viveiros de Castro 2002, 405).

Because this Indigenous worldview may be unfamiliar, it is important to consider how it operates in specific examples. We will focus on the *multifaceted* relational character of the Indigenous interaction with the natural world. This multifaceted relationality includes the acquisition and utilization of practical knowledge about nature, but it does not set up a hierarchical division between the various dimensions of existence. On the other hand, this type of relationality is demanding for humans: there are clear rules relating to nonhuman beings, which, if not followed, may result in illness or even death. We will briefly describe three examples, one concerning the collection of honey from stingless bees by the Enewane-Nawe, a second regarding the plantation of sweet potatoes by the Krahô, and a third about the plantation of mandioc by the Wajãpi.

The Enewane-Nawe are an Amazonian tribe that mostly lives by fishing, planting manioc, and collecting honey. Their first contact with Western people was in 1974 (Mendes dos Santos 2006). The Enewane-Nawe search for and collect large quantities of honey for three months of the year. The honey is both consumed by humans and given as an offering to benevolent deities who protect them, as well as to plants they cultivate (which they also entertain by playing them music). Field research has shown that the Enewane-Wane are able to identify and differentiate between forty species of bees by associating their morphology to social and ecological characteristics such as the place and structure of their nests, their behavior, their alimentary habits, and the amount and flavor of their honey (Mendes dos Santos and Antonini 2008). Mendos dos Santos and Antonini give the example of the multitude of behaviors the Enawane-Nawe have learned about one species of bees whose honey is particularly sought and that feeds off the meat remains and excrements of the hawk (Harpia harpyia). Through closer observation, they have found that the hawk sweats more profusely after eating monkey meat, and its sweat attracts the bees.

Modern Europeans are accustomed to thinking that causal mechanisms help us explain phenomena in the real world, but the Enawane-Nawe exemplify a form of perception that is not concerned with explanation. Rather than theorizing causal relationships, the meaning and nexus of Enawane-Nawe knowledge is based on a series of connections and relations between various beings—human, animal, vegetable, spiritual. This way of knowing inverts the epistemological paradigm of European naturalism: where Western scientists aim to produce maximum objectivity by removing the observer's subjectivity and intentionality, the Enawane-Nawe see understanding as a way to venture more deeply into the intentionality of the object being studied by relating to it personally. Viveiros de Castro (2002, 408) explains: "Let us be subjective, a shaman would say, or we shall not understand anything. The [Indigenous] epistemological sin is lack of subjectivity."

Our second example is drawn from the Krahô, a group of Indigenous people from the center of Brazil. During her extensive fieldwork with the Krahô, Ana Morim de Lima (2017, 2018) found that Krahô women establish a relationship with the sweet potatoes they grow for food. They are like a parent to these potatoes: just as Krahô women undergo various food and behavioral restrictions after having a child, including sexual abstinence and not eating certain types of food, they practice the same restrictions after planting their potatoes. Restrictions of this kind are common throughout Krahô life, particularly during puberty and pregnancy, and they share a link: eating and sexual intercourse are often described with the same words in many of these Indigenous cultures (see Lévi-Strauss, 1962). Some of the practiced dietary restrictions are clearly based on the sense of humanlike perspective animals possess: women should not eat

a yellow armadillo when the sweet potatoes are growing because the family of the killed tatu will seek revenge by eating the potatoes. As the tubers grow, once the leaves begin to show, the Krahô women see themselves as good mothers, but if the potatoes fail to grow, they see themselves (and are seen by others) as mothers who have abandoned their children.

A third example concerns the Wajãpi and the plantation of mandioc (*Manihot esculenta*). The Wajãpi live in both Brazil and the French Guiana; in Brazil, they were officially contacted in 1973 and live in different locations in the Amazon region. They are known to cultivate over 100 varieties of mandioc (Oliveira 2012). In an interview with Joana Oliveira (2025), the first author of the present article queried why they would not tend to select the largest or least toxic mandioc, as it would be advantageous for them. She replied that they do not think in a Darwinian way about their vegetables; instead, they situate the mandioc within a network of relationships: this potato was given to me by a parent, that one comes from my cousin, this other one has a particular red flower. She went on to note that there is an adaptive value in having more diverse crops, for if one variety is killed off by a particular disease, the others may survive. A similar diversity has been recorded with the Tukano of the high Rio Negro, who are known to keep over 100 varieties of mandioc (Emperaire et al. 2009; França 2023). As with the Wajãpi, we find social, moral, and aesthetic reasons that justify keeping so many varieties—variety itself is a clear sign of a beautiful, well-kept mandioc plantation.

This Indigenous model where one parents vegetables follows a different pattern from the framework of European naturalism, which pursues technological mastery over nature. For the Krahô, Wajãpati, Tukano, and other Indigenous Amazonian peoples, nature is not simply mechanical—plants, like humans and animals, have wishes, desires, and social connections. This same logic underlies the behavior of the Enewane-Nawe when they offer honey and music to the plants they grow. While it is tempting to perceive this fostering of noninstrumental biodiversity as a Romantic enterprise where humans are deeply connected to nature, we must emphasize that human–nonhuman relationships contain practical knowledge of two kinds: first, knowledge about where and how to grow vegetables, find and retrieve honey, etc; second, knowledge about how to organize and shape the shared environment. This practical knowledge is dictated not only by a moral sense of respect for nonhuman species but by the biological need to share the same space, which often requires interspecies negotiations. For example, when the Wajãpi prepare the soil for planting, they first plant peppers in the middle of the plot, so that the powers who rule that space are driven away by the sting of peppers and do not feel disturbed by the human planting activity (Oliveira 2025).

From Mystical Participation to Eco-Ethical Knowledge

Classical anthropology has sometimes described Indigenous worldviews as imbued with a kind of undifferentiated holism, as in Lucien Lévi-Bruhl's (1926) sense of "mystical participation," which blurs the boundaries between self and nonhuman agents. In fact, Amazonian animism values the nonhuman world—plants, animals, spirits, and ancestors—as a deeply relational web of agents that are nevertheless distinct. In contrast to a generalized sense of mystical participation, these communities emphasize the agency of nonhumans with whom humans establish relations for their everyday living (Descola 2013). It is by living in this thick relational web that they have established a sustainable way of living that attends to the cycles of seasons, the characteristics of animals, plants, etc. We are not suggesting that Lévi-Bruhl (1926) was wrong to emphasize a sense of relationality within Indigenous cultures that, seen from a Western perspective, is densely interconnected. However, Indigenous Amazonian peoples describe a more complex form of relationality than previously considered, one that includes the possibility of nonhuman agents having a subjective interiority and culture.

Earlier authors have drawn on Indigenous traditions to associate ecology and relationality. Gregory Cajete (2000, 183) has argued that, for many Indigenous people, there is a reciprocal sense of "care and responsibility" between humans and nonhumans, which "is continually reaffirmed through the various expressions of Native technology." Enrique Salmón (2000, 2015) writes of a kincentric ecology, wherein humans view nonhumans as kin and they depend on each other for survival—if the conditions of kinship are broken, the integrity of the whole ecological system may be threatened. Similarly, Yuria Celidwen and Dacher Keltner (2023, 1) write of kin relationality and ecological belonging as two key dimensions of an Indigenous ethics that emphasizes, on the one hand, the interdependence of all living beings and, on the other, the way in which human identity is shaped around emotions of "responsibility and reverence for Nature."

In our analysis, Amazonian eco-ethical knowledge complicates these attempts to link ecology and relationality in three ways. First, the examples we have discussed ascribe a metaphysical continuity between humans and nonhumans; this provides an ontological ground for the thick relationality that characterizes earlier conceptions of eco-ethical knowledge. For the Amazonian groups we have described, eco-ethical knowledge emerges not simply from a feeling of respect for other species or concern for ecological balance—it entails awareness of a common multispecies origin that includes the presence of culture in nonhuman species. This awareness is enacted both in stories about other species and in behaviors that seek to manage how to relate to these nonhuman species.[2]

Second, Amazonian eco-ethical knowledge acknowledges a multifaceted relationality that varies according to the type of nonhuman agent, the context, and the circumstances of the encounter. In contrast to Lévi-Bruhl's (1926) undifferentiated sense of participation with nature, we find that the thick relationality of eco-ethical knowledge is highly structured. Nonhuman agents relate to humans in different ways: a jaguar is a predator who tastes human blood as if it were a good beer, while a tortoise requires a less demanding level of communication. Beyond a generalized respect for nature, eco-ethical knowledge addresses a multifaceted form of relationality that carries specific behavioral rules.

Laura Rival (2015) provides an illustration of this complex, multilayered relationality in her ethnography of the Huaorani from the Amazonian Ecuador. She writes that as they walk through the forest, they convey messages that combine ecological knowledge with human history, but this is a multifaceted form of knowing:

> Not only do walkers converse endlessly about the traces left by animals or about the material signs that evoke times long gone . . . but they also communicate different messages about the world according to context and circumstance. For instance, the same tree can be admired and poetically commented upon for its brand new and shiny leaves one day, only to be feared the next day, when a tempestuous wind animates it with a different, and much more dangerous, kind of energy (Rival 2015, 95).

As in the examples discussed, rather than experiencing a holistic relationship with nature as such, these walkers are attuned to material traces that are extremely specific.

Third, Amazonian eco-ethical knowledge explicitly engages European conceptions of nature as inert material available for exploitation. In Léry's dialogue, his Indigenous interlocutor is perplexed by the European desire to accumulate more and more wood. For him, this madness is a failure to trust in the nurturing world—the forest that feeds me will also feed my children, he says. Contemporary Yanomami leaders make a similar point. Kopenawa writes of Western people:

> [M]erchandise is truly like a fiancée to them! Their thought is so attached to it that if they damage it while it is still shiny, they get so enraged that they cry! They are really in love with it! They go to sleep thinking about it like you doze off with the nostalgia of a beautiful woman. It occupies their thoughts even after they fall asleep. So they dream of their car, their house, their money, and all their other goods—of those they already possess and those they desire again and again. It is so. Merchandise makes them euphoric and obscures all

> the rest of their mind . . . If the white people could hear other words than the words of merchandise, the way we do, they would know how to be generous and would be less hostile towards us. They would not want to eat our forest with such voracity. (Kopenawa and Albert 2013, 333)

For Kopenawa, "eating the forest" is not a metaphor. He was a child when his people had the first contact with a white man, a Canadian Evangelical missionary. As a young adult, he realized the only way for his people to survive was to become an international political activist, to fight the illegal goldmining in their lands.

Modern economies make every unit of exchange indistinct. (A dollar is the same as any other, just as a unit of gold is convertible to other currencies.) This obscures the human impact of extractive economies. As Kopenawa describes, mining brought new diseases that devastated groups who had no immunity, and it poisoned the river waters they used for drinking and cooking. Kopenawa attributes these tragedies to immeasurable greed. But rather than treating this as merely a moral failure or a civilizational obsession, he points at something psychologists would call a cognitive anomaly or even impairment: "Merchandise makes them euphoric and obscures all the rest of their mind." Our ability to reason and think clearly, Kopenawa suggests, becomes obscured through the euphoria of greed.

There are other instances in which Kopenawa expands on this cognitive impairment. In contrast with the Yanomami, "their minds are really forgetful . . . Their words do not seem to be able to stay in their minds. If they listen to a great number of them without making any drawing, they instantly vanish from their thought" (Kopenawa and Albert 2013, 372). At other times, he describes European thinking as foggy, their sleep as shallow, and their ability to dream as narrow and forgetful (in contrast with the Yanomami's ability to keep their dreams sharp in their minds throughout the day).

Crucially, Koepanawa indicates that these cognitive deficits are not exclusive to Western people. Kopenawa describes how those Yanomami hunters who do not follow the rules that forbid them to eat the meat from their own game are "seized by dizziness," walk through the forest "in a slumber," and are not able to see properly. By contrast, the good hunter not only sees his prey clearly at a distance but attracts them towards him by virtue of his behavior. This shows how, for the Yanomami, ethical behavior is associated with cognitive abilities such as seeing clearly and moral qualities such as generosity. On this view, to develop and sustain eco-ethical knowledge, one must follow various behavioral injunctions.

These examples suggest that Indigenous eco-ethical knowledge is a dynamic process and not simply something that, once acquired, remains unaltered. If an individual does not follow certain behavioral guidelines, this process can

be broken. This brokenness shows itself at the cognitive and physical levels (dizziness, slumber, etc). In our view, Amazonian eco-ethical knowledge can help us to connect the economic and political dimensions of the environmental crisis with moral and cognitive assumptions that are often overlooked.

Conclusions

As we have described, in early modern Europe, a mechanical understanding of the natural world emerged, which made it vulnerable to exploitation. Although this worldview presents itself as a purely empirical matter, some scholars have argued that it was bound up with politics from the beginning (Asad 2018, 10, 149–51). Bilgrami (2010, 44) writes, "To see God in every body and piece of matter, they anxiously argued, was to lay oneself open to a polity and a set of civic and religious institutions that were beholden to popular rather than scriptural and learned judgment and opinion." This suggests it is no accident that political authorities resisted the view that God is immanent in the world. On Bilgrami's analysis, elite power found the emerging scientism to be politically expedient because it centralized knowledge among established authorities. Some worried that a distributed spirituality was dangerous because it carried the potential to democratize moral knowledge. Against this background, studying the eco-ethical knowledge of Indigenous people may open new possibilities for public understanding, centered on the entanglement of spiritual and material realities.

For five centuries, narratives of encounters with Indigenous peoples in the Americas have stimulated both wonder and estrangement. Only recently, spurred by the climate crisis, we have started looking at how Indigenous forms of living present an ecologically bound cultural identity that contrasts with the Western dissociated identity where humans do not see themselves as part of nature. In this article, we have focused on Indigenous perspectives from the Amazon, which present a specific system of eco-ethical knowledge, characterized by a complex multifaceted relationality that differentiates itself from a generalized sense of "human interconnectedness within nature" (Redvers et al. 2022) or "mystical participation" with nature (Lévi-Bruhl 1926).

Although European cultures have themselves linked ecology and relationality in a range of ways, educated elites often assume that the material world is all that exists. This form of naturalism is often associated with (1a) a duality between humanity and nature, (2a) a utilitarian relationship with natural resources, and (3a) a hierarchical ontology where humans are above other species. In contrast, Indigenous Amazonian peoples espouse (1b) a fluid boundary between humanity and nature, (2b) reciprocal relationships with nonhuman species, and (3b) a horizontal ontology where humans, animals, and spirits share a common humanity.

As we have argued, these contrasting views have material consequences. Environmental scientists advocate on empirical grounds for biodiversity and ecosystem conservation, but this aim is the basis of existence for the Indigenous Amazonian peoples (Levis et al. 2024). Against Romantic views of unspoiled wilderness, Indigenous people have successfully conserved their environment by actively managing resources, not through simple inaction (Levis et al. 2017). Nor does Indigenous eco-ethical knowledge depend on a vague holism; it is built on a disciplined form of ethical practice, one characterized by intricately structured experience with nonhuman species.

Based on ethnographies of Indigenous Amazonian groups, the theoretical framework of anthropologists such as Viveiros de Castro (2002, 2016), and the critical insights of Indigenous leaders (e.g., Kopenawa and Albert 2013), our analysis of Amazonian eco-ethical knowledge expands previous work on the link between ecology and relationality in Indigenous thought. Building on concepts such as kincentric ecology (Salmón 2000, 2015) and ecological belonging (Celidwen and Keltner 2023), we have argued that Amazonian eco-ethical knowledge displays a multifaceted relationality that varies according to the type of nonhuman agent, the material environment, and the circumstances. By linking cognitive capacities and ethical practice, Amazonian groups specify behaviors that sustain and rupture this form of knowing.

Although eco-ethical knowledge has social, economic, and political ramifications, our focus on cognition brings with it fresh possibilities of exploration for disciplines that have rarely considered Indigenous knowledge. Such exploration is timely for two reasons. First, it intersects with the emergence of new forms of "crossed anthropology" in the Brazilian Amazon, where Indigenous anthropologists conduct ethnographies of the Western world from the perspective of their own Indigenous cultures (Mendes and Dias 2009). Second, this form of eco-ethical knowledge encourages scholars across many disciplines to reimagine how we conceive of nature.

Although the Indigenous Amazon is distant from early modern Europe, thinkers like Kopenawa point to possibilities that have been obscured by Western habits of imagination. The history of science suggests that these possibilities remain alive. As Harrison (2024) has shown, scientific naturalism was contested when it first emerged, and it represented a departure from the framework it replaced. In the late medieval period, the world was divided between inert matter and the spiritual realm. By the nineteenth century, theorists such as Thomas Henry Huxley (2009) came to see the spiritual as a superfluous hypothesis, leaving bare matter as the sole object of genuine knowledge. However, prior to these developments, Europeans did not separate the natural and the supernatural, and even now, many continue to live as if this boundary were blurry (Storm 2017).

If secular disenchantment remains contested, European traditions contain seeds of the eco-ethical knowledge represented by Kopenawa and others (Newheiser 2026). As Indigenous Amazonian traditions remind us, there are alternatives to the nexus between economic exploitation, ecological devastation, and disembodied relationship with the natural world. Engaging with the model of knowing we have explored here stimulates us to reimagine what nature might be and how we may relate to it.

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Notes

[1] There is a separate literature on Indigenous studies and the decolonization of research methods (e.g., Smith 2006; Romm 2015), which is not the subject of the current article and will not be dealt with here.

[2] A similar ontological perspective has been observed with Indigenous groups outside of the Amazon, such as with the Chewong in Malaysia (Howell 2015).

Competing Interests

The authors declare that they have no competing interests.

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Culture and Ecotheology in Proximity to *Te Ao* Māori: An Interweaving

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In Aotearoa New Zealand, the 1840 Treaty of Waitangi and its revival in the 1970s have served as a catalyst for significant legal and customary changes, challenging and decolonizing the dominant Western culture and the church. *Te ao* Māori (Māori worldview) and *te reo* Māori (Māori language) act as an interruption to life as normal within a modernist framework, allowing room for nature's powers and *wairua* (spirit) to be appreciated in everyday life, in the science curriculum, and in the church. These changes have been instituted for justice and treaty reasons but have resulted in a profound metaphysical shift, opening space for a new integration of science and faith. Everyday life is also affected, including media, government, education, language, personhood for natural features, stories, rituals, and health care. *Te ao* Māori has challenged the naturalism and reductionism of Western science, encouraging a metaphysics much more favorable to all faith and all ecotheological concerns. In partnership with *te ao* Māori, Western theological language is enlarged, restored, and reframed.

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> *[L]ives are led not inside places but through, around, to and from them, from and to places elsewhere where inhabitants meet, trails are entwined, as the life of each becomes bound up with other. Every entwining is a knot, and the more that life-lines are entwined, the greater the density of the knot.*
>
> Tim Ingold, *Boundless Worlds: An Anthropological Approach to Movement*

Introduction

This article is written as a European New Zealander, or Pākehā, living in a world very different from that of my ancestors, who go back five generations to 1840 in Aotearoa New Zealand on my father's side.[1] I am a lay Anglican theologian, trained in the United States but now living in Aotearoa. The argument of this article emerges from a long-standing dissatisfaction with the science/theology conversation as it is usually framed. That dialogue has largely taken place within categories shaped by Western scientific paradigms and categories, and its tensions are therefore, in most respects, a distinctly Pākehā problem. From that location, I examine the incorporation of Mātauranga Māori (Māori ways of knowing), *te reo* Māori (Māori language), and *te ao* Māori (Māori worldview) into New Zealand common life, science education, law, and ecclesial practice. I do so not as an interpreter of *te ao* Māori, but as a Pākehā attending to what is now visible and generative in shared public spaces.

My central claim is that the contemporary resurgence of *te ao* Māori is producing more than social or symbolic change and greater equity. It is also loosening the hold of a reductive secular imagination by making public space more hospitable to concepts such as *wairua* (spirit), *mauri* (life force), *whakapapa* (genealogy), and multiple layers of causality. This matters especially in the field of science, where the inclusion of *Mātauranga* Māori opens a framework in which multiple levels of explanation can coexist without collapsing into direct competition. I am not arguing that historical injustice has been overcome; rather, I argue that the growing public presence of *te ao* Māori is widening and shifting the metaphysical conditions of common life in ways that make both science/faith dialogue and eco-theological reflection more culturally plausible.

The Treaty Revival and Aotearoa's Shifting Metaphysical Horizon

Before turning to the present-day incorporation of *Mātauranga* Māori into everyday life and science teaching, I will briefly sketch the historical setting. Two recent histories of Aotearoa New Zealand, Michael Belgrave's (2024) *Becoming Aotearoa* and Erik Olssen's (2025) *The Origins of an Experimental Society*, explore the ways in which Pākehā and Māori cultures have mutually influenced each other and continue to do so. That mutuality should not obscure the violence of settler history, including measures such as the Tohunga Suppression Act 1907, which criminalized Māori healing practices (Belgrave 2024, 546). The limited

argument of this article is not intended to gloss over injustices, systemic or intermittent. It is saying that out of the wheat and tares of colonial history something new has emerged in the last fifty years that has shifted the whole culture into a different register, albeit with some resistance.

Before 1840, the British had no clear intention of colonizing New Zealand. But the increasing numbers of missionaries; sealers; convicts from Australia; potential settlers fleeing famine, class stigma, and deprivation at home; and other adventurers forced their hand (Olssen 2025, 156–57). The first steps included a Declaration of Independence/He Whakaputanga, signed or marked by Māori chiefs in 1835, asserting New Zealand sovereignty and independence from Britain. Following on from that was the Treaty of Waitangi/Te Tiriti o Waitangi, a groundbreaking document signed by Māori chiefs and the British Crown in 1840. This hard-won agreement gave more heed to the people of the land than previous English colonies had done, and it was to have far-reaching consequences. In 1841, New Zealand became a fledgling colony of Britain, struggling to gain economic solvency and any common understanding of land ownership between the two cultures (Belgrave 2024, 248–52). The treaty was quickly betrayed and was always muddled by the language chasm; it has dual Māori and English versions.

Some would dismiss the original treaty as forged in bad faith by the missionaries who were translating it into *te reo* and intentionally deceptive in its use of words. Recently, Ned Fletcher (2022) has argued that the two versions agree, and "sovereignty" in the treaty is in reference only to English settlers. It is not necessary to take a position on these issues to see that the institution of the treaty has now had wide-ranging outcomes and an imaginative application well beyond its original intentions. The treaty, concluded in haste and confusion in 1840, has borne fruit. Some of its intentions were egalitarian; this was, after all, an era that saw the British government legislate against slavery (1807, 1833), an age dominated by new humanitarian thinking (Olssen 2025, 154). The treaty encapsulates in law a level of equality in ownership and outcomes that, while far from realized, is an ongoing, hard-worked-for goal requiring the decolonizing and reimagining of all areas of life in Aotearoa New Zealand. The changes may be only symbolic, and there is much work still to do. Time will tell definitively. But symbols have a way of wielding their power, and I am arguing that this is already happening.

These outcomes are only possible because the treaty was revived in 1975 with the founding of the Waitangi Tribunal, under which the treaty now serves as an unofficial constitution, bringing ongoing and deeply felt changes, both critical and constructive, to New Zealand's common life, education, church,[2] and law. Apart from land reparations, the tribunal also oversees widespread changes and decolonizing challenges to every ritual, expression, and institution in New Zealand life. Education, medicine, government, health, and law are all affected (Waitangi Tribunal, n.d.). The original treaty and its subsequent implementation and enforcement have enabled not only decolonization but a

positive and imaginative bicultural blending and interweaving of language that are capable of shifting common metaphysical assumptions toward the spiritual and cultural and make Aotearoa New Zealand unusual in the contemporary world. In New Zealand, the revival of the Waitangi Treaty, though much contested and challenging in its implementation, has served as a form of collective "repentance"—together with an ongoing decolonizing narrative—for previous breaches of trust.

Half a century into this new order, spoken and written English is now transformed. Māori language is everywhere and recognized and used even by those who have no formal training. The concepts of *whānau* (family), *iwi* and *hapū* (tribe and subtribe), *tangata whenua* (people of the land), *wairua* (spirit), *tapu* (sacred), *kaitiaki* (guardian), *mauri* (life force), *taniwha* (monsters), *whakapapa* (genealogy), *tikanga* (custom), *kapa haka* (formal song and dance), and *karakia* (prayer), and so on are deeply ingrained in and sprinkled through spoken English, along with Māori greetings, myths, and names for things (Roy 2018; de Bres 2010). Major events and school years begin with *pōwhiri* (formal Māori welcoming ceremony), spoken mostly in *te reo*. Graduation ceremonies are studded with spontaneous *waiata* (song) interjections by family. Meetings begin with *karakia*. I assert that the proximity and embeddedness of a language with quite a different metaphysics have nudged secular New Zealand culture away from a generic Western materialism, and have the potential to move it further.

The argument proceeds in four stages. First, I locate the discussion within the history of treaty revival and contemporary decolonizing discourse in Aotearoa New Zealand. Second, I draw on Taylor's (2007, 233, 517) account of secularism and social imaginary to suggest how *te ao* Māori works to "re-enchant" the world and open the common culture to *wairua* (spirit) realities. Third, and most importantly, I examine science education as the clearest site at which this *te ao* Māori interruption becomes consequential. Case studies from other areas of life are also noted. Finally, I consider the implications of this widening cultural imagination for churches and ecotheology, arguing that a society more open to *wairua* and the vitality of the natural world is also more open to theological and ecological forms of thought.

Decolonization Critiques Have a Stake in This Story

This article does not argue that the revival of the treaty and the formation of the tribunal have magically eliminated injustice or whitewashed the past. A conversation led by critical race theory and the decolonizing literature (Asafo and Tuiburelevu 2021) continues alongside these arguments. I acknowledge that both critical race theory and post-colonialism have a stake in this story. Science stands in an unstable relationship to both and is often seen as a particularly egregious form of white supremacy (Sheldon et al. 2023, 9). I would agree that there are aspects of science that resonate with the current power structures

in imperialistic, racist, and sexist ways, and also that contemporary science perpetuates a reductionistic, mechanistic worldview that is hard to escape. But I continue to believe that humans have always done something like science, and that many of the findings and methods of the sciences increase our sense of awe in the world (a common religious sentiment), are an extraordinary application of human imagination and discovery (McLeish 2016), and will help us in the urgent tasks ahead, especially those of feeding the world, converting to sustainable energy, and climate change mitigation.

Christian theology is subject to a related critique because of its entanglement with settler history. I would argue there are wheat and tares in this narrative also. Missionary activity in Aotearoa New Zealand was undeniably mixed in motive, but Māori engagement with Christian faith was also early, substantial, and often Māori-led (Belgrave 2024, 103, 115; Kaa 2020, 30). Māori communities did not merely absorb imported belief. Hirini Kaa (2020, 7–8) has argued that Māori were changed by contact but responded dynamically to the pressures by adapting and coopting the gospel for their own purposes and expression. Similarly, theology today can simultaneously be implicated in colonial sins as well as an agent of renewal.

The academic dialogue between science and religion has flourished for decades, yet it has often failed to reshape popular imagination or ecclesial practice. One reason is that theology has largely acquiesced to the naturalism of science and tried to squeeze itself between the cracks (as argued by Paul Tyson [2022]). The rapprochement offered was never satisfactory or satisfying. This is why the increasing presence of Mātauranga Māori within science education is so significant. It does not merely ask whether theology can survive within a naturalistic frame; it helps expose the limits of that frame itself.

Myrna Perez Sheldon, Ahmed Ragab, and Terrence Keel describe one hope of critical work on science and religion as the creation of alternative futures in which we might live better together (Sheldon et al. 2023, 4). I am making the very limited claim in this short article that the Waitangi Tribunal and associated Māori renaissance in Aotearoa New Zealand are moving towards this goal and already helping to create a public space more capable of sustaining wider accounts of reality than hitherto allowed.

Why *Te Ao* Māori Changes What Is Plausible

Taylor's *A Secular Age* provides a helpful conceptual frame because it explains secularity not simply as a decline in belief but as a transformation in what a society takes to be plausible. In late medieval Europe, disbelief was possible, but belief remained the default horizon. The world was experienced as charged with agency, symbol, mediation, and spiritual significance. Taylor (2007, chap. 1) argues that modernity gradually replaced this enchanted world with an immanent

order in which natural processes could be understood without reference to God or other spiritual powers.

When Europeans made contact with Māori, they encountered a world in which land, ancestors, people, gods, and communal life were understood as deeply interwoven. By that time, European culture was already on its way to becoming the "Western" culture against which indigeneity has distinguished itself. European culture had come through the Reformation with its democratization and reform of religion and started a process of critique and doubt concerning deep sacred realities. Science was beginning to take precedence over religion, education over church. In Taylor's (2007, 98) words, this led to a disenchantment of the world and to its portrayal as a large machine to which God may or may not providentially attend.

Although most of us who are religious find this "immanent order" unsatisfying, it is the sea in which we all swim (Taylor 2007, 306, 309). Throughout the past few hundred years, Māori have at first tentatively—and in the past fifty years, increasingly—held onto and revived an Indigenous view of the world in spite of embracing the religion of their colonizers and much of the technical capacity of *te ao* Pākehā, beginning with paper, muskets, writing, and English law. While *te ao* Māori was always a latent voice within the culture, it is now a significant partner with *te ao* Pākehā in New Zealand society, as I argue here, and therefore has the potential to disrupt and even partially reverse the secularizing project.

The Waitangi Tribunal (n.d.), as the current interpreter of the original treaty, deals not only in the business of reparation and restoration of land and resources to Māori tribes (*iwi*), it also safeguards and encourages—under Article 3 of the treaty—the use of Māori language (*reo*), *taonga* (treasure), and *tikanga* (custom) at every level of Aotearoa New Zealand society. In the past fifty years (and especially in the past twenty), this has led to gradual and increasing use of *te reo* in the public sphere, and Mātauranga Māori is now influential and visible in every institution and classroom.

The following case studies—science teaching, legal personhood, ritual practice, public story, and health—offer a snapshot of that change. Taken together, they suggest a culture in which *wairua* and more-than-human agency are becoming easier to name in public. My claim is not that Aotearoa New Zealand has become post-secular in any simple sense, but that its social imaginary is widening in ways that matter for both theology and ecotheology.

Science as the Crucial Locus of Disruption

Although the Waitangi Tribunal reforms affect many areas of public life, the most consequential arena for this article is science. Science matters here not because it is culturally neutral but because it has so often been treated in modern universities as the paradigmatic discourse of objectivity and the

principal counterweight to anything spiritual. If *te ao* Māori is altering the conceptual world of science education, then it is reshaping one of the strongest institutional carriers of secular modernity. Ocean Mercier and Anne-Marie Jackson (2019, 63) said recently: "Māori have become a pivotal force in New Zealand's science system, with the torsion of tikanga Māori inviting the system to open its doors to indigenous values. Increasingly, Mātauranga Māori—encompassing Māori knowledge, Māori methods of knowledge creation and Māori ways of knowing—is being consulted, aligned with or brought into conversation with science."

Across Aotearoa New Zealand, substantial changes are occurring in school science and undergraduate teaching. These reforms are often described as efforts to decolonize science, but for the purposes of this article, their significance is more specific: they expand what counts as a meaningful account of nature. The development of *Pūtaiao*, or Māori science projects grounded in local knowledge, Indigenous values, and community-shaped research questions, is especially important here (Moko-Painting 2023). Such initiatives do not simply add cultural content to an otherwise unchanged discipline. They press on the assumptions of the sciences themselves by emphasizing relation, value, and inherited forms of knowledge.

These reforms have included proposals for the compulsory teaching of Mātauranga Māori within undergraduate science, and there has been widespread debate over what such inclusion should mean. Although some initiatives have met political resistance, the broader shift is now well established across tertiary and school settings. The opposition has often come from those who insist that science is universal only when detached from cultural and metaphysical contexts (Dunlop 2021). Yet the Aotearoa New Zealand debate itself demonstrates the opposite point: science education is never taught in a vacuum, and disputes over what belongs in it are also disputes about what kinds of reality and value a society is willing to acknowledge.

The material taught under and alongside Mātauranga Māori operates on several levels. At one level, courses taught within the science faculty offer historical and philosophical arguments for recognizing Indigenous knowledge traditions as serious sites of observation, experiment, and practical reasoning rather than as prescientific residue (Parke 2024; Moko-Painting 2023). At another, it introduces students to the richness of Māori epistemology and the ways knowledge is situated within community, narrative, and inherited practice (Roberts and Wills 1998). These layers matter because they already widen the conception of what modern science imagines itself to be.

At another level, Māori narratives of origin and *whakapapa* (genealogy) are placed alongside biological and cosmological explanations. In schools, this can include teaching Māori creation narratives alongside more familiar scientific accounts of planetary, stellar, and biological evolution. This opens up a

model of coexistence rather than competition between frames of reference, allowing minds to encompass and be comfortable with multiple explanatory levels. It fosters intellectual comfort with layered explanation and weakens the assumption that meaningful knowledge must always be objective, mechanistic, and disenchanted.

Whakapapa is crucial here because it traces entities through relation, descent, and origin rather than isolating them as discrete objects. An example is Mere Robert's *whakapapa* of the *kumara* (sweet potato). The *whakapapa* "framework," she says, "embraces multiple ontologies concerning how things came to be, each of which is grounded in knowledge of natural science (primarily biological) as well as spiritual knowledge" (Roberts 2013, 93). The *whakapapa* of the *kumara* involves a story of theft from the high heavens, the human birth of the ancestors of terrestrial *kumara*, the banishment of the woman involved to the underground with the rat that still lives on the *kumara*, and the scattering of the first descendants with their *kumara* to far-flung islands (Roberts 2013, 95–96). The plant, its local ecology, and predators are all accounted for, as well as the introduction of theft into the world. Unlike Christian creationism, the Māori narratives are not set up in competition with science; rather, they fill out a wider context, while containing hints of a transcendent aspect to all natural processes.

A related feature is the movement toward holism. Māori knowledge places phenomena within wider ecological, genealogical, and spiritual relations rather than as beginning from isolated units alone (Moko-Painting 2023, 10). Contemporary Western science is certainly capable of ecological and connected thinking, but its dominant habits of analysis have tended to privilege reduction, specialization, and abstraction. By contrast, concepts such as *whakapapa*, *mauri*, and *wairua* encourage a vision of deep interconnectedness. This is one reason Mātauranga Māori resonates so strongly with eco-theological concerns.

Values are equally important. *Pūtaiao* is not imagined as value-neutral inquiry but as knowledge pursued for the flourishing of community and environment (Moko-Painting 2023, 11-12). This does not mean that Western science lacks ethical frameworks, but in Māori contexts, value is not an external restraint placed upon knowledge after the fact. It is part of the rationale for inquiry itself.

Most consequentially, concepts such as *mauri* and *wairua* enter the orbit of scientific discussion, even when they remain contested. Chemistry professor Paul Kilmartin (who has Ngāi Tahu heritage), for example, rejects the claim that *mauri* literally holds matter together, yet the debate itself is revealing, as it marks a boundary that science is now being asked to justify rather than simply assume (Kilmartin 2023). Likewise, work such as Natasha Tassell-Matamua's research on near-death experiences shows that questions of spirit are no longer entirely excluded from serious inquiry (Tassell-Matamua and Lindsay 2016). My claim is not that science has embraced Indigenous metaphysics wholesale, but that it is being pressed into a wider conversation about what counts as reality.

Finally, Mātauranga Māori stresses continuity with ancestral practice: navigation, healing, astronomy, and botanical knowledge are treated not as disconnected curiosities from the past but as living inheritances now being renewed (Whaanga, Harris, and Matamua 2020). Taken together, these developments make it easier to imagine science as capable of layered causality, inherited wisdom, ethical purpose, and even spiritual reference. In that sense, Mātauranga Māori interrupts the secular habit of treating *wairua* as inadmissible from the outset. It does not abolish scientific method. It does, however, challenge the metaphysical narrowness that has often travelled under science's name.

All these influences make it possible to incorporate and integrate the religious and the enchanted into the science story and method. They push the telos of science towards something always in touch with social, spiritual, and environmental wellbeing, and the discourse of science under this transformation becomes more and more attuned to *wairua* rather than in contradiction to it. Multiple levels of causality, telos, and explanation are investigated and allowed.

Mātauranga Māori interrupts the long secular project in which the notion of *wairua* is entirely absent from all discussion of life and scientific law and descriptions of reality. It encourages the idea that the highly specialized and method-focused science of today has its history in the observations, pattern recognition, and applications of Māori and European cultures in the past. This is also seen in the widening of topics under investigation as science. The consideration of unseen realities in Mātauranga within the science narrative opens up the idea of purpose inherent in nature, something banished for over a hundred years in the Western paradigm.

Everyday Ritual and Public Spirituality Reinforce the Power of *Wairua*

The shift is not confined to formal education. If it were only a curricular debate, its metaphysical significance would be limited. What matters is that many New Zealanders now encounter *te ao* Māori in routine civic and social practice. One clear example is the *pepeha* (introduction), or *mihi*. When Māori introduce themselves, they mention their river, mountain, tribe, and the *waka* (canoe) that brought them to Aotearoa many centuries ago, because these are the ecological realities that nourish their being. In that simple act of the introduction is a worldview in a nutshell. Pākehā, too, now commonly speak about their family and connections in an introduction, but without claiming the full connection to land. Even when the inner discourse is about a lack, however, we are brought into an urgent connection with land and people as significant to life, culture, *wairuai*, and meaning (Hoggard Creegan 2026).

Likewise, *kapa haka* (ceremonial welcome) and *karakia* (prayer) now appear in many schools, workplaces, and public institutions. In a more conventionally secular frame, prayer would seem out of place in such settings. Yet *karakia*

has become common in contexts ranging from university governance to local committees. Sometimes these prayers are theologically explicit; sometimes they are more general invocations of blessing, remembrance, or orientation. In either case, they reopen a public space in which spiritual address is no longer confined to churches. These habits nurture more openness to spiritual realities.

Through the rituals of introduction and prayer, and the bonds of *kapa haka*, a connected worldview is formed where people are seen as parts of a story that reaches back to family and tribe in the past, as well as to the creatures, streams, mountains, and waterways of the environment today.

Law and the Living World

The legal sphere provides an even more explicit example. Aotearoa New Zealand was the first country to grant legal personhood to a river, recognizing the Whanganui River as "an indivisible and living whole" that includes both physical and metaphysical elements (Te Awa Tupua Act 2017). Legal personhood for nature is now discussed internationally, but in Aotearoa New Zealand, this development is especially significant because it arises from Māori understandings of relational belonging and has entered the ordinary grammar of public law. The point is not only environmental protection. It is the formal acknowledgement that the natural world may not be adequately described as inert property.

As Simon Day (2017) notes in conversation with Jacinta Ruru, this is a disruptive union of a Western legal device with a Māori worldview that understands the environment as a living entity with its own history and agency. The importance of that disruption is cultural as well as legal. It invites Pākehā publics to imagine a world in which agency, value, and dignity are not restricted to human consciousness alone.

This does not in itself overturn Enlightenment assumptions. It does, however, make them less self-evident. Once rivers can be named in law as living wholes, a strictly disenchanted account of nature no longer appears culturally inevitable.

Stories Also Encourage Re-Enchantment

Public storytelling is another important site of change. Children in Aotearoa New Zealand learn about the gods Papatūānuku and Ranginui and how their son Tāne (the god of the forests) separated his parents, bringing light and life to the world. The public holiday of Matariki in mid-winter, which celebrates the Māori new year and the appearance of the Pleiades star cluster in the morning sky, has further strengthened the collective consciousness of te ao Maori. Matariki embeds reflection, renewal, remembrance, and celestial rhythm within the national calendar. These narratives do more than transmit cultural heritage. They familiarize a secular public with a world in which land, sky, ancestry, and spiritual agency belong together.

The results of this story are multifaceted. One result is that the Indigenous association of the world's natural forces with the mystique and mystery of the gods will spill over into the general "social imaginary." The overall effect is a loosening of a largely fact-based curriculum and the introduction of an idea that *wairua* and nature are intimately linked, even if that does not penetrate deeply in many cases. It is a part of the overall picture and a general movement towards a metaphysical opening, towards what Taylor might label a "re-enchanting."

A Widened Cultural Environment

The case studies mentioned are only representative. Similar developments are visible in politics, media, institutional naming, health, and public policy. In health, for example, Māori-centered models influenced by the work of Mason Durie stress spiritual, familial, mental, and bodily dimensions of wellbeing rather than treating the person as a merely physical unit (Wilson 2021, 3542). Across these fields, *te ao* Māori and *te reo* Māori contribute to a more relational public grammar and a more holistic understanding of human flourishing.

Aotearoa New Zealand's situation is unusual among settler societies for many historical reasons, including the Waitangi Tribunal, the compactness of the country, the resilience of *te reo* Māori, and long histories of cultural contact and intermarriage (Belgrave 2024, 928). The result is not a harmonious synthesis, nor the disappearance of conflict, but a public sphere in which Māori concepts have unusual reach. That reach matters because language, law, ritual, education, and story together make certain visions of reality easier to inhabit.

There is resistance to all of this, and the outcome remains contested. Yet the cumulative effect of these multiple domains is significant. Science, law, ritual, health, media, and public story together help form a new social imaginary in which *wairua*, relation, and the vitality of the natural world are more difficult to exclude. It is from that widening cultural background that the theological implications now emerge.

In the remainder of this article, I examine the repercussions of this metaphysical opening up and flowering of Indigenous culture for churches and, potentially, ecotheology.

How *Te Ao* Māori Changes Theological Reception

These cultural shifts matter for churches because they alter the background conditions in which theological language is heard. For anyone working in science and theology, the changes in Aotearoa New Zealand are especially striking. They reopen questions about evidence, explanation, relation, creatureliness, and the place of *wairua* in public discourse. *Te ao* Māori does not simply support ecological thinking in churches by moral exhortation; it helps recover a wider

imagination of creation, interdependence, and belonging that theological language has often struggled to communicate within a secular frame.

Ecotheology and the Reopened World

This unusual situation in Aotearoa New Zealand coincides with the rise of ecotheology. Over the past half century, Christian thinkers have responded to Lynn White Jr.'s (1967) influential critique of Christianity as the cause of the ecological crisis. White links ecological degradation to technological expansion and capitalist extraction as misplaced examples of dominion in action. White makes a plea for a more Franciscan approach to Christianity. And indeed, more recently, Pope Francis's (2015) *Laudato Si'* has helped normalize Franciscan-inspired theological language about care for creation, integral ecology, and the deep interdependence of life. The A Rocha movement (Arocha.org) is active in Aotearoa New Zealand and in twenty-two countries, including Ghana, India, England, and Portugal, promoting practical church involvement in the guardianship of nature. These theological innovations already resonate strongly with Māori emphases on relation, value, and the living world.

Ecotheology has developed along several lines: rereadings of scripture that highlight the Earth and its creatures, critiques of anthropocentrism, renewed attention to salvation as cosmic rather than merely individual, and ecological accounts of Christ, spirit, and creation as mutually embraced realities (Pattel and Habel 2022; Pattel 2023; Johnson 2015; Wright 2018). Across these developments runs a shared rejection of a narrow theology that concerns only God and humanity while the rest of the natural world remains peripheral. In that respect, ecotheology has already been moving toward a more relational and creaturely vision of faith.

Other emphases note the importance to Christians of seeing the natural world as creation rather than the materialism of Western science (Moltmann 1993; Johnson 2015). The latter is more consistent with the casual dominion-led instrumental reaction to the natural world that White's (1967) critique of Christianity implies. The former allows that nature has its own agency and worth. And, indeed, ecotheology also points to the deep resonance between theology and the natural world before the Enlightenment, extending back to Clement of Alexandria (Doru Costache [2025] summarizes Clement's theology of nature) but extending as far into modernity as Jonathan Edwards ([1765]1989, 540), who famously saw lower forms of love in the symmetries and beauties of nature.

In summary, theology has experienced significant changes over the past fifty years. Ecotheology promotes a broader and more inclusive understanding of God's domain, influence, and concern than was common in late modernity. The past fifty years of Christian theology have seen a notable shift towards nature, with much less of an instrumental approach at the grassroots level.

Ecotheology also highlights the integrity and intelligence of other life forms and the interconnectedness of all living things. Much of this has been carefully argued in both theology and animal and life sciences (see Deane-Drummond 2009, 2017). Incremental progress has been made. There has been a gradual metaphysical expansion, with ideas like panpsychism or idealism replacing traditional materialism (Leidenhag 2020). However, it remains challenging for these theological reflections and advances to have much purchase on the ground.

That purchase is immensely improved when the culture as a whole has partially embraced a more ecological narrative, which allows a deepening of the sense of interconnection and a partial re-enchantment of the world.

Science-Engaged Theology and Mātauranga Māori

The effects are especially visible in the dialogue between science and faith. Both Mātauranga Māori and science-engaged theology resist the idea that modern science is a wholly unprecedented mode of knowing with no meaningful continuity with older practices of observation, discernment, and interpretation (McLeish 2016). Both also question whether objectivity and double-blind trials, valuable as they are, exhaust the range of human knowing. In different ways, each insists that a world open to meaning, spirit, relation, and inherited wisdom need not be a world closed to disciplined inquiry. For that reason, Mātauranga Māori becomes a powerful ally for science-engaged theology. It publicly legitimates the very possibility of layered explanation that theology has long struggled to defend.

Church and Culture in a Widened World

The Mātauranga conversation may help expand the thought-world of theology as well.

Christian faith has long insisted that reality is more than mechanism: that God is present through spirit, sacrament, wisdom, word, liturgy, providence, and creation itself (Moltmann 1993). Yet these affirmations are often difficult to hear within a culture trained to regard them as private or symbolic at best. In *te ao* Māori, Christian theology may find not a substitute for its own tradition but a public environment in which its deeper claims once again sound thinkable.

A Māori theologian once suggested that before missionary contact, Māori could already see the mountain of theology, though it remained mist-covered; after contact, the mist lifted (quoted in Mātenga 2025, 1). Whatever one makes of that image, it can be meaningfully reversed. If Western theology has often focused on the summit—abstract doctrine, isolated propositions, thin liturgical memory—then *te ao* Māori helps bring the mountain's larger body back into view: land, kinship, ancestry, community, and the living environment in which faith is actually embodied. In that sense, *te ao* Māori can provide a richer harmonic

context for themes Christian theology already contains but has often rendered inaccessible to secular publics and even the churches themselves.

Biblical Theology Resonates with *Te Ao* Māori

Biblical language also resonates in striking ways with *te ao* Māori. Christian theology speaks of "being in Christ," of "Christ in us," of light, wisdom, spirit, and the participation of creatures in divine life. Within a reductively material frame, such language can sound opaque or merely metaphorical. Māori concepts of *whakapapa*, relation, and spiritual continuity help reopen a grammar in which such claims become more intelligible. *Whakapapa* traces realities back through layered belonging to an originating source (Marsden 2003, 45). In that sense, it offers a suggestive analogue for thinking about participation, creation, and the relational depth of Christian existence.

Western theology has continued to say these things about sacrament and incarnation, even as the mechanistic grammar of the sciences left less and less space for a faith perspective. Marilynne Robinson (2010, 35) speaks to this when she says: "To a great degree, theology has tended to forget the beauty and strangeness of the individual soul, that is, of the world as perceived in the course of a human life, of the mind as it exists in time. But the beauty and strangeness persist just the same. And theology persists, even when it has absorbed as truth theories and interpretations that could reasonably be expected to kill it off. This suggests that its real life is elsewhere, in a place not reached by these doubts and assaults."

Theology has persisted through modernity, but often under pressure and with diminished cultural resonance. In a world widened by *te ao* Māori, theological speech about creation, spirit, sacrament, and creaturely interdependence may once again breathe more freely.

Conclusion

This article has argued that the resurgence of *te ao* Māori in Aotearoa New Zealand is doing more than reshaping questions of justice, language, and national identity. It is also widening the metaphysical conditions of public life. Through changes in science education, law, ritual, story, and institutional practice, concepts such as *wairua*, *whakapapa*, *mauri*, and more-than-human relation have become more publicly thinkable. That widening does not abolish secularism, nor does it erase colonial injustice. It does, however, loosen the monopoly of reductive materialism and create a cultural environment in which theological and eco-theological claims can be heard differently. In that sense, proximity to *te ao* Māori may be accomplishing something the science-and-theology conversation has rarely achieved on its own: it is helping to make a more relational, spiritually alert, and ecologically charged account of reality publicly plausible.

Notes

[1] An earlier version of this article was presented at the International Society for Science and Religion 2025 Summer Conference in Swindon, UK.

[2] By church, I refer here to the wider collection of churches, not at all unified, but together bearing witness to Christ. The Anglican Church in particular has three *tikanga* (divisions)—Māori, Pākehā, and Polynesian—and three archbishops, together with a heated discussion about the pros and cons of such an arrangement. Churches differ enormously in their ecological commitment, but the established churches are all highly active and engaged. The A Rocha eco-church movement is strong and encourages ecological applications in preaching and liturgy as well as practical creation care work.

Competing Interests

The author declares that they have no competing interests.

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Planetary Thinking in a Time of Crisis: Active Evolution and Fractured Universalism in Cosmic Religions, Past and Present

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This article examines the failure of universalist frameworks and narratives associated with concepts like the Anthropocene and the noosphere and considers the rise of fractured forms of planetary and cosmic orientations, notably in the emergence of nationalist and ethno-nationalist impulses among otherwise planetary ambitions and perspectives promulgated by today's Silicon Valley tech culture. Rather than see these insular, fragmented forms of planetarity as simply secularized versions of Christian apocalypse or doomsday prepping, or perverse distortions of cosmic universalism, I suggest that there are profound levels of meaning and enchantment intrinsic to technological worldviews and their investment in a purposeful cosmic telos. At the same time, this teleological dimension and elements of determinism allow for an evasion of ethical responsibility for the consequences of technological creations and their impact on planetary futures. Tech culture's religious-like teleology, and its entanglement with nationalist and ethno-nationalist agendas, has roots in the blend of science, magic, and religion known as Russian Cosmism, as well as parallel structures with forms of noospheric evolution advanced by cosmic thinkers like Pierre Teilhard de Chardin and his followers. By understanding these religious and spiritual dimensions of today's technocracy, we are better positioned to resist their narratives and forms of enchantment for the sake of a planetary future not foreclosed by cosmic determinism and human exceptionalism.

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Introduction

A quarter of a century ago, the Anthropocene lumbered into our collective consciousness and lexicon, bearing a heavy load of metaphysical baggage. For better or worse, the term has penetrated both scholarly and popular imaginations and spurred ongoing discussion about whether "we" should feel chastened or awestruck by humans' planet-shaping powers.[1] A contingent of scholars in religious studies, environmental humanities, and beyond have framed the Anthropocene in ways that hint at something exciting and even auspicious (Sideris 2016, 2026). On these accounts, the Anthropocene heralds a new planetary stage in which national identities and parochial investments, including religious investments, might give way to collective identity and environmental action. The predicted shift, many hoped, would bring cosmopolitan sensibilities and allegiances, and perhaps even a common commitment to tackling planetary-scale problems.

The word planetary, like the term Anthropocene, has spun off additional terms and debates. Scholars across the humanities and social sciences continue to debate what a planetary perspective entails. Some contrast the "planetary" (and sometimes "planetarity") to the global, where the latter signals (variously) a more human-centric, homogenized, or objectified view of the planet as "seen from nowhere," and the former suggests identification with something beyond (just) the human, with greater emphasis on embodiment and trans-species and transcultural connectedness.[2] A key feature of the hoped-for planetary turn, as I discuss it here, is an awareness of vast temporal and spatial scales, and collective self-awareness of humans' embeddedness within a system that we are now empowered to shape. *Extra*planetary orientations are part of this shift. Understanding Earth as a planet positions humans as creatures within a vast, unfolding cosmic process and community—a microcosm/macrocosm framing often expressed in the idea (popularized in hopeful terms by Carl Sagan) that we humans are the creature in whom the cosmos becomes conscious. This reflexive awareness has the potential to foster the unitive consciousness needed to tackle our collective, planetary-scale crises.

The Anthropocene, understood as a threshold moment that quickened humanity's awareness of our planet-shaping powers, has carried this peculiar whiff of optimism from the start, despite (or because of) its message of warning and collective danger. This upbeat spin is indebted to conceptions of planetary evolution that both preceded and merged with the Anthropocene concept. When Paul Crutzen and Eugene Stoermer (a chemist and an ecologist, respectively) first deployed the term in writing, it was proffered with a somewhat jarring nod to an abstruse entity, namely, the "noosphere" (Crutzen and Stoermer 2000). Crutzen and Stoermer (2000, 18) appraise the Anthropocene as both an exciting and daunting time that will draw upon the "wise application of the knowledge" made available by the noosphere. The task before us, they

concluded at the time, is to develop a "world-wide accepted strategy" to protect Earth and its ecosystems against unprecedented impacts. Soon after, Crutzen (2002) would invoke the noosphere again, this time referencing two of its founders directly: the Russian geochemist Vladimir Vernadsky and the Catholic priest and paleontologist Pierre Teilhard de Chardin.

The noosphere has a religious, or (in some cases) religion-adjacent provenance, having developed out of the broader milieu of late nineteenth- and early twentieth-century Russian Cosmism and its belief in teleologically unfolding and purposeful cosmic evolution (Hagemeister 1997, 185). Russian Cosmism is a broad term for a wide-ranging movement that weaves together aspects of Russian orthodoxy with scientific materialism and occult influences. Its utopian vision blends eschatological elements with technological aspirations to control natural forces, extend human life, defeat death, and colonize space. The figures commonly associated with key aspects of Cosmism are Nikolai Federov (1829–1903); the aforementioned Vernadsky (1863–1945), who originated both the biosphere and noosphere concepts; and Konstantin Tsiolkovsky (1857–1935), a Christian philosopher often described as the founding figure of transhumanist and immortalist movements and an early pioneer of rocketry and aeronautics.

Enthusiasm for "active or self-directed evolution," an effort that is at once "holistic, anthropocentric and teleologically determined" is a thread connecting a broad swath of Cosmists, whether poets, philosophers, theologians, scientists, or artists (Young 2012, 9). The noosphere, too, is central to visions of conscious, progressive evolution. It refers to an evolving layer of planetary mind—literally the *mind*sphere (Greek, *nous*)—emerging from the collective mentation and technological artifacts of human intelligence. The noosphere was understood by those who coined it as "the next level of human development" according to which the Earth's terrestrial envelope, the biosphere, would come under the regulation of human reason "which was itself beginning to appear as a form of energy, as it had the ability to change material processes" (Laruelle 2019, 44). Even for Vernadsky, whose take was more materialist than mystical, the noosphere was no mere contingent occurrence. The very scientific and technological knowledge that manifests as "the geological force creating the noosphere, cannot lead to results contradicting the geological process that created it," Vernadsky insists. "It is not an incidental phenomenon: it is very deeply rooted" (Vernadsky 1999, 95). In Teilhard's philosophy, this non-incidental quality of the noosphere positioned it as a stage predestined by the Creator on the path to the Omega Point, an eschatological climax of sorts that would unify matter and spirit, merging humans with the divine. This culmination of human and (quasi-)divinity is a defining feature of Russian Cosmism as well.

In its anticipation of an emerging planetary consciousness, the noosphere is sometimes regarded as a possible precursor concept to the Anthropocene, even though the dominant "mood" of the two concepts diverges, the latter signaling

warning and crisis and the former, hope and transformation (Shoshitaishvili 2021). While Teilhard and Vernadsky articulate the noosphere in different ways, with Teilhard striking an overtly spiritual tone, both are products of "evolutionary thinking in which civilized Man emerges as a geological force" (Hamilton and Grinevald 2015, 66). The teleological character of the noosphere within planetary or cosmic unfolding confers an air of inexorability to our more recent concept of the Anthropocene as well, as a crucial moment of transformation that is embedded in planetary evolution and yet requires the conscious agency and active evolution of humanity to complete the transition. On these readings, the Anthropocene may appear as a "crisis or pivot point within the fuller"—and often more hopeful—"story of Noosphere formation" (Shoshitaishvili 2021, 7). The Anthropocene as a stage within "noogenesis" generates excitement and optimism at the prospect of a dawning planetary phase in which the complexifying cosmos begins to direct its own future evolution—via humans' newfound agency. Crutzen's and Stoermer's inaugural use of the term gestures in this direction.

A quarter century on, however, no robust "world-wide strategy" or collective planetary consciousness appears to be emerging. Far more evident, I argue, particularly among a subset of humans who are actually positioned to shape the planetary future—namely, tech billionaires and the government officials under their sway—is a merger between the pursuit of planetary-scale technologies and ambitions and nationalist and ethno-nationalist movements, to the neglect of planetary forms of governance and the wellbeing of the planet itself (Shoshitaishvili and Sideris 2025). If indeed a planetary form of nationalism is ascendant, should we understand it as a perversion, perhaps a betrayal, of the unifying, cosmopolitan impulses that animated visions of the noosphere and Anthropocene? Or, on the contrary, is the rise of fractured planetarity, nationalist or otherwise, a continuation, perhaps even a fulfilment, of the cosmic frameworks and philosophies that preceded it? And if, as it appears, the noosphere and the Anthropocene both draw from a wellspring of religious and metaphysical speculation about humanity's cosmic place and purpose, what sort of religious formations accompany the present rise of planetary orientations that eschew cosmopolitan sensibilities?

To explore these questions, I first discuss the ways in which cosmopolitan expectations have failed to manifest, considering how this failure connects to recent events, including the rise of a technocratic elite class with nationalist and ethno-nationalist agendas. I argue that spiritual investments of earlier forms of Cosmism, centered particularly on "active evolution," still animate the dangerously narrow forms of planetary consciousness we are witnessing today. A close examination of the sometimes toxic mix of techno-science and religion that characterizes past and present cosmic orientations reveals an abiding and powerful belief in a progressive, teleological evolutionary

framework. This framework, which drives Silicon Valley technocracy today, encourages perilous expressions of planetarity that blithely justify present harms to human and nonhuman life by subsuming them within the structure of its own enchanted cosmology.

Whither Cosmopolitanism?

Both the Anthropocene and the noosphere concepts have been appropriated for techno-optimistic ends. Some of the most transparently technophilic expressions of Anthropocene enthusiasm are now at least a decade old. For example, *The Ecomodernist Manifesto* and similar forms of Anthropocene boosterism welcome the acceleration of technologies that would enable a "decoupling" of human development and material needs from impacts on nature (Asafu-Adjaye et al. 2015). The "good Anthropocene" envisioned by ecomodernists is presented as an optimistic alternative to "doomsday" environmentalism. If Earth is now "remade by human hands," then knowledge and technology can and should be applied with "wisdom" to enable a "good, or even great, Anthropocene" where growth continues without negative impacts on nature and the future dawns bright and prosperous for (not quite) all (Asafu-Adjaye et al. 2015, 6). Clive Hamilton (2015, 234) has proposed that the "good Anthropocene" framing bears the structure of a theodicy or, more accurately, an "anthropodicy," according to which "human Progress takes the place of God" and climate disruption is revealed as "a treatable side effect of the modernization process—a growing pain that the growth process itself will resolve." Those who suffer the effects of planetary crises are assured that their pain is justified for the greater good. We will see similar tropes appear repeatedly in the context of progressive human–planetary co-evolutionary narratives.

Other Anthropocene narratives are less technophilic in tone, but nevertheless exhibit a telltale teleology—often embracing the noosphere by another name.[3] Many of these draw on Teilhard's cosmology and are known to academic and popular audiences as the Universe Story or the Epic of Evolution. They unspool the wondrous narrative of a self-organizing, animate cosmos, from its origin in the Big Bang to the present day, in a blend of science and spirituality (Sideris 2017). These narratives have been actively promoted for several decades now, if we take the so-called geologian Thomas Berry's call for a "new story" to replace the purportedly dysfunctional traditional religious narratives as the originary event (Berry 1978). Sweeping stories of human and cosmic co-evolution often converge on Anthropocene/noosphere themes of human consciousness awakening to its planetary role and collective task. These narratives serve a mythic function, diagnosing the human condition, and generating prophetic visions of the future unfolding of a planet managed by our species.

Humans are assumed to have a unique role in guiding planetary, and indeed, cosmic, unfolding toward greater complexity and unity. Understanding our

place in the cosmos restores a sense of purpose, direction, and enchantment. Paradoxically, humans' role is simultaneously understood as foreordained—immanent in the cosmos from its very inception—yet requiring activation through our conscious participation in cosmic unfolding (Michelson and Sideris 2025). Universe Story narratives and Russian Cosmism alike exhibit these same discursive habits: an "anthropocentric view of the universe which presupposes a teleologically determined—and thus meaningful—evolution" that is at the same time "dependent on human action to reach its goal" (Hagemeister 1997, 185–86). The similarity is not coincidental, given that the noosphere concept, coined by Vernadsky and Teilhard, is a feature of both cosmologies.

The investment in a noogenic imaginary of humans' progressive co-evolution with Earth has long been implicit in perspectives influenced by Teilhard's cosmology (Thomas Berry imagined the transition to a new "Ecozoic" era as an auspicious evolutionary stage), but some contemporary cosmic storytellers have made their debt to the noosphere explicit. Evolutionary cosmologist Brian Swimme, a chief architect with Berry of the Universe Story, offers an example. Swimme has moved seamlessly from decades of promoting the Universe Story (Swimme and Berry 1992) and more recent advocacy of the *Journey of the Universe* offshoot project (Swimme and Tucker 2011) to championing the noosphere concept as essential to the cultural shift needed to avert planetary crisis (Human Energy, n.d.). Swimme's "new" narrative, detailed in a book titled *The Story of the Noosphere* and under the auspices of something called the Human Energy (n.d.) project—a "catalytic hub for evolving collective consciousness" that takes its name from Teilhard's work—foretells the imminent arrival of a "planetary nervous system" capable of addressing planetary-scale crises and unifying humanity (Swimme and DeRaspe-Bolles 2024; Human Energy, n.d.). Echoing Hamilton's claims about theodicy, the story anticipates "great hardship" to come but urges readers to "stay faithful to the long process that will, over time, unify the antagonistic fragments of humanity" (Swimme and DeRaspe-Bolles 2024, 177). Humans should trust the cosmic process we are also actively shaping.

But why should we trust it? In narratives inspired by Teilhard, as noted, the expectation is that human consciousness will ultimately merge with a divine principle and direction inherent in the universe itself, culminating in a form of superintelligence or super-consciousness. Indeed, Teilhard predicted that the noosphere would mark a profound spiritual transformation, with human-created machines catalyzing an "'etherised' universal consciousness" spanning the entire planet; the explosion of super-consciousness would propel humanity's long-awaited merger with the divine (de Chardin [1959] 2004, 161–62).

It is not difficult to see how the noosphere and Teilhard's Omega Point prefigure ideas of so-called Singularity and technological determinism proposed by transhumanist thinkers like Ray Kurzweil, an AI visionary at Google who

predicts that technological acceleration will effect a merger between human and machine intelligence, or that the latter will simply surpass us, resulting in immortal "spiritual machines" (Kurzweil 1999; Steinhart 2008). Similarities between Teilhard and Kurzweil, which the latter has acknowledged, are so pronounced as to be "uncanny" (O'Gieblyn 2017, 71). If a primary conduit of the noosphere idea to the West as a whole came via (translated) Teilhard, a secularized version reached Silicon Valley and the broader tech industry in large part due to the Kurzweil's inordinate influence on prominent tech figures, including Microsoft cofounder Bill Gates, Tesla CEO and X owner Elon Musk, and OpenAI's Sam Altman, among others (Becker 2025). Singularity appeared in even more respectable garb through the work of Swedish-born philosopher Nick Bostrom. Until recently, Bostrom held a faculty position at Oxford University, where he directed the Future of Humanity Institute, funded in part by Musk. Bostrom produced a stream of academic works on the topic of superintelligence under the institute's auspices prior to its closure in 2024 following numerous scandals and allegations pertaining to racism, sexual harassment, and fraud (Robins-Early 2024).

Currently, this (thinly, if at all) secularized counterpart to the Omega Point—Singularity, superintelligence—attracts many adherents among the Silicon Valley elite and techno-visionary thinkers (Becker 2025; O'Gieblyn 2017). Transhumanists, "Singularitarians," and other techno-utopians, as Meghan O'Gieblyn observes, today enjoy outsized power and influence in Silicon Valley and beyond. "Peter Thiel, Elon Musk, and many venture capitalists identify as adherents" to Singularity and speculative transhumanist ideas that are now being researched and developed at places like Google, Apple, Tesla, and Space X (O'Gieblyn, 2017, 74). These spiritually inflected future projections shape new and emerging technologies that, in turn, impact all our lives, particularly in the current AI boom. As we will see, other esoteric and cosmic philosophies past and present have also made inroads to Silicon Valley (Genovese 2023). Again, common to many such worldviews is a commitment to a progressive, teleological reading of evolution and the cosmos. And yet, for all their investments in planetary-scale technologies, new forms of distributed intelligence, and space-faring endeavors, there is little indication that tech elites, and the government officials with whom they now align, embrace an expansive politics and ethical vision commensurate with planetary aspirations. What happens when enthusiasm for planetary orientations and technologies blends with values contrary to cosmopolitan politics and ethics?

A Retreat to Lifeboat Ethics

At its outset, the COVID-19 pandemic seemed irrefutable evidence of our profound, if shocking, trans-species and planetary entanglement. Initially, there were promising signs of solidarity, even across political party lines. Recall those

frightening but heady days in spring of 2020, when at 7 p.m. each evening, ordinary citizens of New York City under lockdown conditions appeared in doorways and windows to applaud exhausted health care workers, first responders, and other laborers in what were deemed essential services.

The communitarian impulse was short-lived. Although the roots of nationalism and political divisiveness likely began much earlier, the pandemic may well have intensified political polarization, a retreat to hyper-individualism, and a deficit of empathy. Italy was one of the regions first ravaged by COVID-19 in early 2020, but by fall of that year, Pope Francis (2020, para. 11) was already warning from the Vatican that a "myopic, extremist, resentful and aggressive nationalism" was "on the rise"; journalist David Wallace-Wells (2025) hailed the immediate post-pandemic period, and beyond, as a "new age of Social Darwinism."

The connections now seem obvious between the terror of a mysterious worldwide plague and heightened alarm over an encroaching horde of alien others or an "enemy from within," in a Trumpian phrase. Fears about bodily boundaries and bodily permeability readily align with obsessive border control and demonization of those "outside," giving rise to panicked political rhetoric about invasions and the poisoning of a nation's lifeblood. In short, "instead of pulling together in the face of a global disaster," we see a retreat to "lifeboat ethics" (Wallace-Wells 2025), a concept popularized by an environmental ethicist, Garrett Hardin, with unfortunate ties to white nationalist anti-immigrant sentiment and racist pseudo-science (Southern Poverty Law Center, n.d.).

In particular, the pandemic-induced association of health with virtuous behavior expanded into a broader set of beliefs about merit and desert and encouraged ideas about "natural" social hierarchies—and, in turn, set the stage for a ferocious backlash against diversity, equity, and inclusion (DEI). Meanwhile, the "greatest social and technological experiment of our time," namely AI, gleamed, or threatened, on the horizon as "a kind of exit from the realm of human flesh and microbes into one built by code" (Wallace-Wells 2025). As we will see, racially tinged suspicions about unearned merit, preoccupations with social and ethnic hierarchy, and pursuit of high-tech escapist fantasies are integral and interconnected features of the Silicon Valley ethos that now shapes our day-to-day lives. That ethos manifests in eclectic forms of spirituality with roots in and affinities with cosmic philosophies, East and West.

The Rise of Planetary Nationalism

The planetary turn, I suggest, has not produced the hoped-for cosmopolitan politics or unifying sensibilities oriented toward the flourishing of humankind, let alone nonhuman life. Instead, we see a troubling rapprochement between populist-nationalist investments and planetary/extraplanetary technologies

and ambitions (Shoshitaishvili and Sideris 2025). One way to understand these developments is as an emerging form of planetary nationalism—an expanding tendency of nations, regimes, and elites to extend their influence through planetary registers: space forces, AI as a form of distributed planetary intelligence, exoplanetary futures, social media-driven collective intelligence, and blockchain economies (cryptocurrency, for example, is currently proffered by tech giants as the basis for not just a planetary but an *interplanetary* financial system [Puente and Puente 2025]). While planetary techno-sciences and planetary-nationalist politics accelerate, genuine planetary governance—institutions capable of managing shared risks and vulnerabilities—lags drastically behind. Shattering expectations of a cosmopolitan turn, current events appear antithetical to planetary oversight or ethical norms that might rein in and regulate globe-spanning and globe-transcending technocratic projects.

Scholars have examined related formations, sometimes manifesting as far-right environmental movements with nationalist agendas. These include green nationalism, where climate issues drive countries to compete with one another to achieve dominance in arenas like renewable energy or electric vehicles, or forms of ecofascism, where nations weaponize environmental concerns by hardening borders against climate migrants (Moore and Roberts 2022). But the category of planetary nationalism encompasses a broader constellation of developments, including an embrace of, not just strategic responses to, human-caused environmental change (Shoshitaishivili and Sideris 2025). Consider the case of Greenland: rapid climate warming is creating highly lucrative mining opportunities in regions once rendered inaccessible by extreme conditions and prohibitive costs. The island contains a wealth of extractible resources essential to contemporary industrial and technological systems, among them iron ore, lead, zinc, diamonds, gold, oil, uranium, and—especially—large deposits of the rare earth minerals so dear to Silicon Valley.

Both Vice President J. D. Vance and Donald Trump, Jr. paid visits to Greenland in early 2025. Meanwhile, Silicon Valley investors have been eyeing Greenland as a prime spot for constructing a libertarian "freedom city" or "network state," terms for high-tech, deregulated communities for entrepreneurs and other tax-averse elites. In early 2026, Trump escalated his threat to seize Greenland, hinting at military action and imperiling the critical NATO alliance forged in the wake of World War II. Should efforts to control the territory come to fruition, tech magnates such as Mark Zuckerberg and Jeff Bezos—both of whom have invested in a start-up seeking to extract Greenlandic resources for AI-related applications—stand to benefit considerably. Peter Thiel and venture capitalist Marc Andreessen likewise have prospective interests in Greenland and the development of similar high-tech enclaves (Parshley 2025); Greenland, complete with mineral deposits and a very challenging climate, is also being considered as a test site for Musk's fantasy of Mars colonization (Levy and Ulmer

2025). Recognition that climate change is reshaping the planet, combined with a drive to capitalize on newly accessible resources, dovetails with the conviction that such extraction could speed technoscientific advancements envisioned on a planetary scale.

A more straightforward example is Trump's 2020 creation of Space Force as an independent branch of the United States armed services. The previous year, Trump issued an executive order emphatically declaring that the United States does not consider space a global commons, in a reversal of his predecessor's policy and in defiance of statements by other space-faring nations (Silverstein and Panda 2021). Space Force documents unequivocally claim rights to a distinct sphere of influence in space, guaranteeing United States access for purposes of security, commerce, and exploration. As *Space Force 101* explains, "The formative purpose of the Space Force is to achieve space superiority, ensuring freedom of action in space for our forces while denying the same to our adversaries." Space Force personnel—designated "Guardians"—are tasked with "secur[ing] space superiority for the nation" (United States Space Force, n.d.). What stands out is how this mandate extends beyond the defensive protection of satellites to the ambition to control an entire planetary domain. In this respect, Space Force invokes a "Monroe Doctrine for a planetary age"—a nationalist drive toward uncontested dominance within a defined sphere of influence, now consisting of Earth's near-space environment (Shoshitaishvili and Sideris 2025).

On the surface, of course, these lucrative alignments of tech culture with nationalist figures and agendas may be simply that—hugely profitable partnerships. But a broader set of techno-spiritual commitments and prophetic visions of cosmic evolution give both urgency and profound meaning to these endeavors for those engaged in their promotion.

Tech Support from the Broligarchy

When Trump regained the White House, he rode a wave of white Christian ntionalist anti-immigrant sentiment, abetted by obscenely large donations and fawning endorsements from the reigning tech "broligarchy," many of whom had front row seats at his inauguration: Bezos, Zuckerberg, and Musk. The day after the inauguration, Sam Altman joined Trump at the White House to announce the launch of Stargate, a massive AI infrastructure project. Other tech billionaires hold official or unofficial positions in the second administration. These include Thiel, a member of Trump's transition team in 2016, who mentors Vance in theology and bankrolled his political career to the tune of $15 million. Thiel's software and data analytics company, Palantir—named for the magical "seeing stones" in Tolkien's *Lord of the Rings*—partners with United States Immigration and Customs Enforcement to track and deport immigrants (Cameron 2025).[4] Also included is Andreessen (2023), a billionaire venture capitalist and writer of techno-optimistic manifestos ("I am here to bring the

good news") who served as chief architect of the so-called Department of Government Efficiency, or DOGE. David Sacks, a tech investor who assumed the role of Trump's tech "czar," advises him on AI and cryptocurrency. Many of these men have long-standing ties to one another (in 1998, Thiel and Sacks co-authored a book-length anti-diversity screed, taking Stanford University to task for alleged anti-Western zealotry), but their synchronized pivot toward Trump is largely a new development.

For example, Musk's preoccupation with planetary technologies and extraplanetary realms has remained fairly consistent, but his drift toward Trump and embrace of the far right generally (including Germany's far-right AfD party, or Alternative für Deutschland) marks a departure from what seemed a progressive, pro-environmental stance. Some see in Musk's alignment with the political right the imprint of his formative experience growing up in apartheid South Africa (Klein 2025). His attraction to the Great Replacement theory, an ethno-nationalist conspiracy suggesting that white populations are systematically being replaced by mass migration, is evidenced by his amplification of "white genocide" and anti-Semitic conspiracies on social media (Chan 2025). Racist ideologies have captured other Silicon Valley elites, notably, the other members of the so-called PayPal Mafia—Thiel and Sacks—who have similar ties to South Africa (McGreal 2025).

Some in Trump's orbit, particularly Steve Bannon, have criticized the tech titans (Bannon labels them techno-feudalists). Yet Bannon's own populism retains a strong nationalist orientation and an ardent embrace of certain technologies. In an interview in the *New York Times*, Bannon, who previously served as Trump's chief strategist, presents his vision of how MAGA-style movements are changing the world. He invokes Teilhard de Chardin and the noosphere to describe a current state of "unrestricted narrative warfare" in which only one story can prevail. In this narrative battle, he predicts that the noosphere, working through mass media will "so overwhelm evolutionary biology that it will be everything" (Brooks 2024). He advises MAGA foot soldiers to "use your agency . . . The divine providence works through your agency" (Brooks 2024). Here we have an explicit appeal to key planetary concepts by a prominent right-wing nationalist—and a nod to the idea, central to Russian Cosmism and Teilhard's philosophy, of active human agency combining with providential forces to transform evolution.

Although Bannon self-identifies as an economic nationalist and has occasionally ridiculed white nationalist groups, his close ties with the alt-right platform Breitbart News and his enthusiastic endorsement by the Ku Klux Klan and other white supremacist groups cast him in a suspicious light (Childress 2017).[5] Teilhard, whom he references, is likewise controversial. His pronouncements lead some scholars to align him with racist and eugenic movements (Slattery 2017, 2024), and others to defend him vehemently against

such charges (Haught 2019). To be sure, when one reads Teilhard referencing "unprogressive ethnical groups" and inquiring to what extent the "advancing wing of humanity" should "tolerate" them, it is difficult not to find his vision of evolution troubling (Teilhard 1962, 132–33). Whether these sentiments were foundational or peripheral to Teilhard's larger cosmology is a matter of ongoing contention among scholars. I will not attempt to resolve the question. However, for the purposes of the present discussion, it is clear that Teilhard (1962, 127) understood disability and disease as "counter-evolutionary" forces that slow the progression of the noosphere. To maximize what he called hominization, an evolutionary threshold when matter becomes conscious of itself and humanity begins to shape its own evolution, these counter-evolutionary elements would need to be addressed. This threshold of human self-awareness marks a significant step toward the noosphere, and thus it follows in this progressive cosmological scheme—as Teilhard (1951) himself suggests—that gaining control of evolutionary forces, including by way of a "generalized eugenics," facilitates the "maturing" process by which the biosphere transitions to the noosphere.[6]

As unsettling as these aspects of Teilhard's philosophy are, however, they may not be what attracts Bannon to his conception of the noosphere—at least not directly. Both men are interested in the idea of history's directionality, its unfolding in a planet-wide teleology "possessing spiritual dimensions," and both too understand media and communication as powerful and even salvific forces (Shoshitaishvili and Sideris 2024). In the aforementioned *Times* interview, Bannon also invokes the media theorist Marshall McLuhan, whose writings greatly influenced 1960s counterculture and the California tech industry that grew out of it. The result was, and to some extent still is, a distinctly Californian "mish-mash of hippie anarchism and economic liberalism beefed up with lots of technological determinism" (Barbrook and Cameron 1996, 56). And as is often the case with visions of progressive, inevitable advance toward utopia, whether cosmic or technological, this ideology depended upon a "willful blindness" toward less positive features of life on the wealthy West Coast: "[R]acism, poverty and environmental degradation" (Barbrook and Cameron 1996, 45).

As Adrian Daub (2020) similarly observes in *What Tech Calls Thinking*, an incipient messianism and teleology infected the industry early on, encouraging a sense that technology unfolds according to a predetermined plan—a worldview that conveniently insulates tech creators from damaging consequences of their inventions while allowing them to claim the mantle of ingeniously disruptive innovation. McLuhan, whom Bannon admires, "furnished [the tech industry] with a narrative of historical inevitability, a technological determinism that they could now call on to negate the consequences of their inventions—if it was fated to happen anyway, is it really their fault?" (Daub 2020).[7] McLuhan, we should note, was himself a Teilhard enthusiast. Teilhard's noosphere and his

vision of a single, worldwide civilization became McLuhan's "seamless web of experience" and "global village" concepts, respectively (Wolfe 2004, 22). In tech's recurring theme of inevitability—and the ease with which it justifies "progress" for some at the expense of others—we can discern one of the intriguing threads connecting the spirituality of Silicon Valley with cosmic philosophies and theologies from a century (or more) prior. In this teleology, as I argue, a certain magic dwells. By analyzing its religious dimensions and antecedents, we might begin to demystify it.

Religious Formations of Fractured Planetarity

For the remainder of this article, I explore in greater depth how narrow nationalist and ethno-nationalist expressions of the planetary intersect with, are driven by, or are driving religious and spiritual commitments—again, keeping in mind features of the "planetary" I previously outlined, and which here encompass developments and forms of awareness that are planetary in orientation or impact. These include but also extend beyond climate change, such as the distributed intelligence of AI, to space-faring endeavors and colonization.

Some scholars have analyzed the religious dimensions of recent trends in tech culture, often with particular attention to extraplanetary ambitions. Much of this analysis circulated around Musk and his aerospace company Space X in the period prior to Trump and Musk's tumultuous and widely publicized on-again, off-again relationship and before Musk emerged as the president's chainsaw-wielding "Dark MAGA" sidekick. These critiques, and those of tech journalists who track the spiritual milieu of Silicon Valley, often focus on apocalyptic dimensions of techno-futurism and space colonization in particular. As Sarah McFarland Taylor (2022, 2024) observes, Musk's thinly veiled apocalypticism tracks a set of recognizable marketing schemes like fabricated urgency and perceived obsolescence—Earth's own obsolescence—calculated to attract adherents to his end-times predictions and self-presentation as the messianic genius the world needs. Mary-Jane Rubenstein critiques the "weird religion" of the new corporate space race, what she calls "NewSpace," as a retooled Christian ideology of colonization, expansionism, and extraction. Channeling Nietzsche, she argues that the "very nihilism that characterized imperial Christianity now characterizes modern science," particularly as seen in these corporate and dominionistic endeavors (Rubenstein 2022, 35). Our tech overlords offer a world-destroying "utopianism without the utopia" (Rubenstein 2022, 18).

Meanwhile, building on apocalyptic themes of planet destruction, Naomi Klein and Astra Taylor, in an essay that is at times stunningly bleak, diagnose the reigning technocracy "less as old-school imperialism than super-sized prepping, at the level of the national state. Gone are the old colonial fig leaves of spreading democracy or God's word—when Trump covetously scans the globe, he is stockpiling for civilizational collapse" (Klein and Taylor 2025).

They suggest that what links tech billionaires to Trump-style politics and its base of evangelicals, white Christian nationalists or Zionist Christians (think Pete Hegseth) is a shared end-times vision where only a subset of humans will escape. Some in this "millenarian mashup" straddle both camps, notably Thiel, who lately delivered a series of high-profile, closed-door lectures on the Antichrist, a figure symbolizing global unity and therefore, to Thiel, unspeakable evil (Bullard 2025). For tech elites, corporate-ruled "startup countries" and outer space present possible escape routes; for the right-wing Christian contingent, the Biblical rapture beckons. In the meantime, an immediate priority for these Armageddon bedfellows is hardening national borders against all enemies, foreign, domestic, ethnic, or theological.

Klein and Taylor's analysis reveals a quasi-religious constellation of Silicon Valley ideologies that has received less attention from religion scholars than one might expect. These include an eccentric cluster of movements that, I argue, cannot be fully grasped apart from their investment in active, progressive evolution: effective accelerationism, longtermism, as well as the aforementioned promise (or threat) of Singularity.[8] Accelerationism in the tech world is associated with reaching Singularity, the point at which human and machine intelligence merge and an intelligence explosion transforms human and cosmic history. Effective accelerationism seeks to hasten the arrival of Singularity by means of unrestricted technological progress. Unobstructed development of AI or, more accurately, AGI (artificial general intelligence, the point when AI reaches or exceeds human levels of intelligence) will facilitate the spread of consciousness throughout the universe.

Effective accelerationists draw from the utopian optimism of effective altruists, a utilitarian philosophy originating from the philosopher Peter Singer that endorses funneling money and resources in precisely calculated, data-driven, and cost-effective ways, achieving the most good for the most people (disgraced entrepreneur Sam Bankman-Fried was a high-profile advocate). Blending effective altruism with the claim that vast temporal distances should not negatively influence assessments of which humans "count" refocuses moral attention on generations existing well into the future, a view called longtermism. Blending these ideologies, in turn, with urgent appeals to speed up technological progress results in a position, increasingly influential in tech culture, called effective accelerationism or "e/acc." Silicon Valley figures associated with e/acc (or technological accelerationism generally) include, minimally, Musk, Andreessen, Altman, Bostrom, and Kurzweil, the latter of whom formulated a Law of Accelerating Returns (more on that later). The accelerationist camp focuses on speculative, far-future scenarios, believing that future lives (which vastly outnumber humans alive today) take clear moral priority. This group positions itself against those it perceives as *de*celerationists or doomers who worry about

the existential risks, such as AGI misalignment with "our" values. In a move that will by now sound familiar, longtermism enables proponents to gloss over present harms caused by technology—algorithmic discrimination, exploitation of workers, widespread unemployment, environmental degradation—for the sake of abundant future life.

Were longtermism merely about safeguarding future generations, climate activists might readily get on board. But, crucially, it is also about "maximizing the probability that there are as many lives of those generations as possible" (Becker 2025: 15). These future lives include digital people, uploaded brains living in computer simulations, or space-colonizing transhumanist creations. Longtermists envision futures spanning billions or even trillions of years from now. Failing to enable these incalculably numerous future digital or posthuman lives by decelerating technological progress would be an unthinkable moral dereliction. In the tech world, stagnation *is* the apocalypse. Moreover, wealthy countries have more to contribute to the future than poorer ones, owing to worker productivity and innovation, some longtermists argue. To maximize the possibility of future lives, we need rapidly accelerating technology, even though—as some longtermists admit—these powerful technologies present grave risks. But the sooner superintelligence emerges, the sooner technology will transform us into cognitively and morally enhanced posthumans (Damiani 2025). Moreover, its emergence is auspicious, for while it poses huge existential risks, it marks the next logical stage in evolution. Thus, on this account, even catastrophic climate change would be a minor setback, a rounding error, in the totalizing tally of "greater good" represented by trillions of years of future intelligent life.

While accelerationists rebuke the pessimism of doomers, their far-future orientation presents an odd sort of optimism that assumes the likelihood of disasters but judges them negligible in the long, long run (needless to say, the value of myriad nonhuman lives currently inhabiting Earth—remember them?—do not register in these calculations at all). These "ethical" frameworks explain in part why a growing chorus of concern about energy-hogging AI data centers that exacerbate climate change and destroy communities are met with a shrug by tech moguls, some of whom previously spoke in grandiose terms about saving the planet.

Klein and Taylor stress the destructive nihilism of these worldviews, in contrast to previous forms of fascism that at least anticipated some golden era to come. Meanwhile, Christian nationalists or Zionists who find common cause with the broligarchy do believe something awaits, and perhaps they assume that the tech bros believe it too. But for tech entrepreneurs, Klein and Taylor suggest, it is enough that Christianity has the right apocalyptic mix to get its faithful on board with accelerationism.

Note, however, that there are many different accelerationist creeds, spanning the entire political spectrum and with historic roots, on some accounts, extending to Marxist and Nietzschian philosophies. As mentioned, many effective accelerationists pit themselves against "decel" doomers (thus, characterizing the former as preppers, as Klein and Taylor do, seems to miss something). The closest thing to a common denominator among accelerationist philosophies is the belief that radical change can be created through intentionally speeding up processes that shape society, including technologies that generate many of society's problems. Yet Klein and Taylor's analysis leans heavily on an association of accelerationism with apocalyptic fatalism, and therefore with a secular(ish) rapture narrative that revels in sheer destruction. Illuminating as they are, then, these analyses center darkly apocalyptic and millenarian imaginaries to such a degree that important parts of the picture fall outside the frame. To be sure, certain bizarre Silicon Valley tenets of faith link up with prophecies of all-out destruction. But the apocalypse frame falls short of grasping how their techno-utopian character is rooted in an embrace of progressive evolution and human capacities to quicken its pace. My point is not to defend tech billionaires against charges of fascism or bad faith. It is rather to argue that focusing on end-times fatalism and annihilatory agendas—what Rubenstein (2022, 34) sees as big tech's Christianity-shaped "will-toward-nothing"—obscures the profoundly, if also darkly, magical elements of tech spirituality. These future visions are not simply secular or "pseudo" versions of Christian apocalyptic fever. They have their own distinct religious genealogies and forms of enchantment.

Cosmism Revisited

To pull back the curtain on the religious enchantments shaping tech culture, including in its planetary nationalist tendencies, we need to return once more to earlier cosmic philosophies and theologies that are structurally similar to Silicon Valley spirituality.

Especially key here is Russian Cosmism, a wide-ranging and eclectic movement that has generated a number of successive waves over the past century or so, with some still influential in Russia today (Bernstein 2019). Leading scholar of Cosmism George Young (2012, 4) summarizes the central features, many of which are relevant to contemporary techno-elites:

> [T]he active human role in human and cosmic evolution; the creation of new life forms, including a new level of humanity; the unlimited extension of human longevity to a state of practical immortality; the physical resurrection of the dead; serious scientific research into matters long considered subjects fit only for science fiction, occult, and esoteric literature; the exploration and colonization of the entire cosmos; the emergence on our biosphere of a new sphere of human thought called the "noosphere"; and other far-reaching

> "projects," some of which may no longer seem as impossible or crazy as they did when first proposed in the late nineteenth and early twentieth centuries.

For Russian Cosmists, the stuff of the universe has a latent spirituality or soul. Collaboration with the vital, quasi-divinity inherent in the universe results in the active evolution of humans and the cosmos. Federov, bent on resurrection and immortalism, saw a universe filled with the dust of the ancestors, waiting to be reawakened. Tsiolkovsky, the aeronautics pioneer, understood the cosmos as rationally ordered into hierarchies, with the lowest forms of matter containing dormant spirits and higher forms being spiritually alive—all moving toward a more perfect state. For Tsiolkovsky, the cosmos possesses an absolute will of its own, while humans are endowed with a "conditional will" that must be actively exerted (Smith 2018). This cosmic telos reveals the deeper meaning of the universe and the place and purpose of technologically advancing humans within it. Even Vernadsky, perhaps the least mystical of the major cosmic thinkers, was beholden to ideas of creative evolution, an élan vital or dynamic force driving evolution, as promulgated by Henri Bergson (and developed by Teilhard). For many Cosmists, the relationship between humans and the universe is one of microcosm–macrocosm, with the same principles guiding both, and with human purpose manifesting in active participation in cosmic evolution. Here, traditional supernatural powers "are replaced by physical laws, cosmic energies, vibrations, extra-terrestrial beings, and human intellect that render the world a meaningful, interconnected, and controllable place" (Terbish 2020, 767). The movement offers an alternative to conventional religion by conferring meaning to the superconnected universe, notably in the form of our species' capacity to "upgrade" to immortal godlike status—a vision stamped with the imprimatur of techno-science and bearing traces of Orthodox belief in theosis, according to which God created humans that they might progress to godlikeness. In short, Cosmism was always a "techno-religion in the making" (Terbish 2020, 769)

Rather than dismiss the movement as pseudoscience or pseudotheology, then, it is important to understand Cosmism as "a crossover area between science and magic," the mingling of thaumaturgy—the realm of wonder and miracles—with academic knowledge and pursuits (Young 2012, 9). Significantly, this cosmic orientation always contained a kernel of Slavophilic nationalism, a chauvinistic tendency that persists alongside "the international, interplanetary, intergalactic scope of their vision" (Young 2012, 9). Federov, for example, was invested in "complex theories about the 'manifest destiny' of Russia in Eurasia" (Bernstein 2014). Nationalist/ethno-nationalist strains of Cosmism have often surfaced as Eurasianism or Neo-Eurasianism, a form of Cosmism oriented toward nationalist ends (Terbish 2020; Laruelle 2019; Smith 2018) and driven by a "right-wing occult theory which espouses that certain cosmic events will

dictate the strengths and weaknesses of different races" (Genovese 2023, 164). And like contemporary tech culture's self-identification as the cognitive elite, some Cosmists believed leadership by geniuses like themselves was critical to moving the masses toward evolutionary stages associated with higher beings.

A universal orientation mingled with ethno-nationalist and autocratic tendencies led some Cosmists to posit the need for specifically Russian "strongman" figures to oversee the task of immortality, a "godman to direct the masses" (Terbish 2020). Similarly, in the proto-transhumanism of Federov passed down in modified form to today's tech elites, we see how visions of an extraplanetary, transhumanist future for all are narrowed significantly to become an "ethnocultural claim upon outer space and upon the technologies to arrive there" (Smith 2018). For the space travel-obsessed Tsiolkovsky, the process of perfectibility by which humans ultimately merge with cosmic energy meant that lifeforms deemed defective—human, animal, or plant—would have to be weeded out (Young 2012, 152). The purported universalism of the Cosmists' vision, in other words, has often been reframed, not least by some of the movement's key figures, to advance nationalist agendas and claims of ethnic superiority.

Parallels with this parochial and ethno-nationalist planetary turn are evident in tech culture today. Musk, for example, believes that inferior sectors of humanity, propped up by DEI programs, are inhibiting progress toward colonizing outer space. General concerns among tech giants about demographic, policy, and economic impacts of falling birthrates conceal a deeper preoccupation with "social engineering and the idea that the best people are being replaced" (Swisher 2025). The alignment of tech entrepreneurs with pronatalism—policies promoting reproduction—is another outgrowth of ethno-nationalist, techno-eugenic enthusiasm. Anita Say Chan (2025, 26) documents the rise of "contemporary strains of techno-eugenics among leading voices in Silicon Valley, who project the risk of Western technology stagnation as rooted in an undervaluing of the innovative capacity of the cognitive elite." This agenda dovetails with other articles of Silicon Valley faith, like longtermism, which, as discussed, prioritizes humans who will live in the (possibly quite distant) future—a superior stock of humanoid pioneers of extraplanetary existence.

Meaningful Evolution and the Manufacture of Inevitability

On the whole, as I have argued, cosmic thinkers, whether Russian, Teihardian, or those more broadly influenced by noospheric frameworks and "good" Anthropocene expectations, often imagine a universe that is self-organizing and yet dependent upon the agentic participation of (some) humans in evolutionary processes to propel it forward. The idea that humans can participate in and transform the system in which we find ourselves, a system whose deep meaning and direction is revealed through our own active engagement, creates a profound

sense of purpose. It is also this teleological investment, particularly when combined with other Silicon Valley creeds, that enables the evasion of negative impacts and social justice concerns. To say this is not, however, to declare these cosmic prophecies nihilistic. What remains somewhat underappreciated, and what comparisons with cosmic philosophies bring into view, is how these visions are animated by broader investment in active evolution. Moreover, in attending to the numinous quality of this underlying teleology, common to cosmist philosophies and Silicon Valley alike, we can better appreciate that escape and exit are not simply geographical but structural—that is, less about securing a safe bunker somewhere (on Earth or beyond) than escaping ethical consequences and responsibilities, both in the short term and in the (very) long-term balance sheet of the universe itself. Built into melioristic evolution is the assumption that some will advance at the expense of those left behind. While a teleological worldview can elevate ethics, it can also "divorce us from the present" for the sake of future payoff (Rushkoff 2019, 157). All else is simply fuel, energy, and resources to be extracted.

In the worldview of tech elites, cosmic teleology allows for a justificatory and normative strain of technological determinism that decouples technology from culpability, rendering technology "opaque and beyond political intervention and control" (Wyatt 2007, 175–76). To be sure, teleology and determinism are not the same thing, since the former implies some degree of openness, an effort of seeking or directing actions toward a goal (a possibility that thoroughgoing determinism would foreclose). Yet, both are means of banishing chance and randomness. In Silicon Valley narratives that combine the two, an inherently progressive trajectory simultaneously requires human participation (or rather, the participation of a coterie of ingenious seers who perceive futures unavailable to others). At the same time, in its justificatory mode, technological determinism functions as a rhetorical strategy, invoking narratives of progress and inevitability to legitimize decisions and foreclose debate.[9] In this cluster of ideologies, then, the agency of the cognitive elite is preserved, even as culpability is evaded. Put differently, cosmic agency becomes the purview of tech innovators, a privilege denied to inferior others forced to live in the worlds, real or virtual, that elites choose to create, without our consent.

In-depth analyses of the Silicon Valley ethos converge, intriguingly, on the frequency with which tech entrepreneurs dispense a "rhetoric of inevitability" (O'Sullivan 2025; Becker 2025, 87). Through rhetorical repetition, "speculative scenarios acquire the weight of destiny. This process—the manufacture of inevitability—reveals how power operates through prophecy" (O'Sullivan 2025). In this way, AI/AGI comes to seem a "natural force" rather than something created consciously by humans. Tech executives who once pored over "quarterly earnings and user growth began speaking like mystics about humanity's cosmic destiny" (O'Sullivan 2025). The mystical, prophetic framing

makes the arrival of superintelligence seem like the "inevitable next rung on the ladder" (O'Sullivan 2025). The teleological premise, enshrined in the intrinsic directionality of evolution or in the law-bound exponential progress of AI development—the two trajectories ultimately merge in these prophecies—effectively justifies collateral damage to the planet and less fortunate humans. It obscures the reality that technological development and its acceleration are choices humans make.

Belief in a deeply purposeful structure of the universe connects what Taylor Genovese calls the "affective ontologies" of Silicon Valley to other cosmic thinkers. For Musk, Thiel, Bezos, and others, "the essence of the universe is *informational*, and the teleological, intrinsic value of that base information will always naturally organize itself into *intelligence*" (Genovese 2022, 162). I would argue, for example, that this constellation of creeds is evident in Andreessen's manifesto. While he repeats optimistic mantras about a wide-open future (declaring his position neither apocalyptic nor utopian), he delineates a purposeful role for "humans" in fulfilling goals inherent in the larger order of things. In affirming a steadfast allegiance to lawlike accelerationism, he cites tech prophet Kurzweil:

> Ray Kurzweil defines his Law of Accelerating Returns: Technological advances tend to feed on themselves, increasing the rate of further advance. We believe in accelerationism—the conscious and deliberate propulsion of technological development—to ensure the fulfillment of the Law of Accelerating Returns. To ensure the techno-capital upward spiral continues forever . . . We believe in competition, because we believe in evolution. We believe in evolution, because we believe in life. (Andreessen 2023)

We believe in evolution. Kurzweil's vision of Singularity, technological growth, and progress depends upon cherry-picking certain milestones both in technological and human evolution, suggesting, in Teilhardian fashion, a trend and direction that culminates in complexly conscious humans, as if our species "is the ultimate goal of evolution." Kurzweil "is inferring a kind of teleology, a purpose and trend, where none exists" (Becker 2025, 59–60).[10] Here we see a techno-meliorist faith according to which the universe, propelled forward (even against its own entropic forces) by exponential growth in intelligence, grants a transcendent purpose to human effort.

American Cosmism

Silicon Valley today presents a recognizable but somewhat distorted version of earlier Cosmist philosophies. The same "enchanted logics" of these earlier thinkers are evident in efforts to achieve greater longevity and defeat death, to accelerate "life" toward transcendent states, and in repeated refrains about

the urgency of making "humanity" a multi-planetary species (Genovese 2023, 162). At the same time, we discern a narrowing of cosmic universalism to nationalist fervor, along the lines of the nationalist/ethno-nationalist impulses displayed in some strains of Russian Cosmism and embodied in the emergence of planetary nationalism, outlined previously. Genovese (2023) identifies a distinctly American variant of Cosmism, a modified but recognizable version of the Russian variety. A highly influential figure in this context is Aleksandr Dugin, whose ideas have also inspired idealogues in the United States, including Bannon, alt-right figures, Thiel, and others in Trump's orbit (and Putin's in Russia).[11] Dugin himself absorbed nationalist influences via Russian thinkers drawn to Vernadsky, notably Lev Gumilyov, a historian who sought to direct Cosmist ideals toward "nationalist ends" by promoting ethnogenetic and Eurasianist theories (Genovese 2023, 165). Vernadsky's contention that nature and humanity were fused—an assumption embodied in the noosphere —was appropriated by Gumilyov to advance arguments that distinct ethnic categories arise deterministically from the physical environments in which they were embedded. As transmitted to Dugin, and thence to contemporary tech figures including Thiel, these ideas have congealed into the spiritually inflected planetary nationalist politics we are seeing enacted today.

A critical question, then: Are these resemblances between Cosmist philosophies and Silicon Valley merely that—a convergent, parallel evolution? While they remain somewhat speculative, historical lines of influence can be traced between the two, particularly in the context of the uniquely Californian blend of New Age spirituality with the libertarian, capitalist ethos of the burgeoning tech industry (Barbrook and Cameron 1996). A key hub for the transmission of various strands of esoteric and New Age thought to Silicon Valley was the Esalen Institute, a New Age center located in Big Sur, California, founded in 1962 by two Stanford graduates, Michael Murphy and Richard Price (Kripal 2007; Rushkoff 2022).

Around 1980, the Esalen Soviet-American Exchange program, later named the Russian-American Center, or Track Two, initiated a citizen diplomacy program. It was at Esalen that Silicon Valley capitalists came into direct contact with Cosmic thought and its offshoots. Key figures at Esalen like Murphy were taken with mystical musings of Russian Orthodox theologians influenced by Cosmism (Cosmism was experiencing a resurgence in the Soviet Union). Among these was Vladimir Solovyov, who shared Federov's interest in immortality and bodily resurrection. "A type of esoteric Christianity with its own unique enlightenment of the body," Jeffrey Kripal observes, "was an intimate part of the cultural landscape" of Esalen (2007, 320). A lesser known genealogy indicates that Russian Cosmists were themselves drawn into the Theosophical writings of Madame Blavatsky (1831–91), whose blend of science and religion emphasized spiritual progression through active, stadial evolution in ways consonant with the orthogenetic—directional—evolutionary

progress popularized by the Social Darwinist Herbert Spencer (Terbish 2020; Mühlematter 2023) and with striking parallels to the multi-stage evolutionary scheme proposed by Kurzweil.

This esoteric, evolutionary blend resonated strongly with a cluster of initiatives central to Esalen philosophy. Known collectively as the human potential movement, it emphasized self-actualization through a mix of counterculture and New Age spiritualities, psychedelics, humanist psychology, and Eastern philosophies and spiritual disciplines. The ambition of liberating oneself from mental and physical constraints to achieve one's highest potential aligned with the interests of Russian Cosmists in transcending physical limits, both bodily and planetary, and perfecting human consciousness. We hear echoes of these ideas today when Musk promotes Neuralink, a neurotechnology company piloting implantable brain–computer interfaces, as "unlock[ing] new dimensions of human potential." Even where precise historical ties are harder to establish definitively, the affinities of Cosmism with tech spirituality are remarkable (Genovese 2023).

Narrative Warfare

We can conclude this lengthy analysis by returning to a set of questions posed at the outset. Are these trends toward greater insularity—nationalism and ethno-nationalism—perversions of planetary mindsets and cosmic orientations as they have come down to us through concepts like the noosphere and the (good) Anthropocene? Or were such darker tendencies always present, perhaps latently? Some have suggested that contemporary tech billionaires, as well as officials in Putin's orbit, have "weaponized" planetary concepts like the noosphere; whereas Vernadsky and Teilhard envisioned universal awakening, global unity, and shared knowledge—an "open, cooperative, and transcendent" noosphere—tech elites twist such concepts into tools of "surveillance, fragmentation, and control" (Trippi 2025).

I am not fully persuaded by such claims. Weaponization (perhaps literally) of planetary concepts and creations is one of the dangers of planetary nationalism. And yet it is not the case that cosmic philosophies generally, or the noosphere concept in particular, were originally devoid of sinister elements. We have seen that Teilhard's vision of cosmic evolution raises concern in some circles about his entanglement with eugenic theories and predictions. More generally, Russian Cosmism was, and is still in its contemporary expressions, entangled with ethno-nationalist worldviews (Laruelle 2019, 201). For its own part, tech visionaries are repeatedly mired in plausible accusations of xenophobia, ableism, sexism, and racism (Gebru and Torres 2024). That racism, eugenics, ethnic hierarchies, and nationalist zeal surface again and again in these expressions of cosmic worldviews is surely not coincidental. Put differently, the combination of "planetary" and "nationalism" seems less an aberration of an otherwise benevolent universalism

than a matter of emphasis. Melioristic views of evolution as leading toward a perfecting climax almost invariably coincide with racial hierarchy and eugenics, as these ideas have long been shaped by colonial encounters and the attendant ranking of different cultures and ethnic groups. The very idea of a leading edge, an "advancing wing" of humans and their artifacts, is integral to progressivist accounts of evolution. No such vision—particularly one encompassing all of humanity and the cosmos—is possible without perceived benchmarks and anticipated thresholds. Meanwhile, as I have argued, perception of a cosmic telos combined with purposeful human effort (we might call it merit) subsumes all harms under a banner of inexorable growth.

Klein and Taylor argue that we can resist the techno-fascist juggernaut by telling different stories—narratives of interdependence and collective survival, stories of better times, rather than end-times. But have "we" not been telling such stories? Tales of universalism and collective consciousness, as I suggested at the outset, have been disseminated widely for decades or more, perhaps nowhere more earnestly than in discourse on religions, science, and ecology. Yet perhaps they remain too mired in meliorist evolutionary frameworks that are both their source and ultimate undoing. Maybe the fracturing we are witnessing is, to borrow a phrase from the tech industry, not so much a bug as a feature of the universalizing impulse of the noospheric/Anthropocenic imaginary. Stories of cosmic solidarity, past or present, have not proven victorious in the narrative warfare the technocracy is waging. By all means, we need better, more humane, and more inclusive stories. But for such narratives to succeed, whatever they might look like, we must first comprehend and confront the deeply rooted forms of enchantment and meaning that possess the narrative warriors—those traitors to the Earth, as Klein and Taylor aptly dub them—who are now positioned to dictate the course of our planetary future.

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Notes

[1] The sweeping Anthropocene "we" has rightly been criticized by a number of scholars, as the term conveniently covers over the uneven culpability for the planetary conditions typically associated with the term and obscures the deeply rooted colonial dimensions of these developments.

[2] See, for example, Gayatri Spivak's 2003 *Death of a Discipline*, Dipesh Chakrabarty's 2021 *The Climate of History in a Planetary Age*, and Ursula Heise's 2008 *Sense of Place and Sense of Planet: The Environmental Imagination of the Global*, among others.

[3] Some authors of the *Ecomodernist Manifesto* understand humans' planetary management not as something currently emerging or a later stage of planetary evolution but a process that has gone on, incrementally, for thousands of years, sometimes referred to as a "long Anthropocene" view.

[4] As I write, additional partnerships are being forged between the United States military and tech companies, inaugurating an AI-powered form of warfare in the conflict with Iran that began in March 2026.

[5] Bannon's political theology is complex and highly eclectic. He also subscribes to an esoteric spirituality called Traditionalism, which, while it strongly supports nationalist and anti-immigrant agendas, sees nationalism as a first stage in a multi-stage historical process that will usher in a new spiritual elite, defeat modern liberalism, and return the world to progress (see Teitelbaum 2021). Bannon's interest in Traditionalism links him to a Russian figure in Putin's circle, Aleksandr Dugin, whose nationalist—specifically, Eurasianist—beliefs have a direct line to Russian Cosmism (Genovese 2023).

[6] Teilhard's style of writing is abstruse and his meaning sometimes hard to discern or pithily summarize. Whether or not active evolution in the form of eugenics was central to his cosmology as a whole, I believe it is fair to say that his interest in the potential of eugenics and his commentary on less advanced groups are intimately tied to his idea of the noosphere. Vernadsky's articulation of the concept appears less susceptible to these entanglements.

[7] Interestingly, Daub suggests that tech culture appropriated McLuhan's famous aphorism, "the medium is the message," with an odd and convenient twist, such that tech creators were not responsible for the *content* of their ingenuous platforms and were thus off the hook for any harms caused to users. Here we see another example of how ethical evasion is built into determinist frameworks.

[8] Timnet Gebru and Émile P. Torres have coined the acronym TESCREAL to describe this bundle of doctrines that infuses Silicon Valley: Transhumanism, Extropianism, Singularitarianism, Cosmism, Rationalism, Effective Altruism, and Longtermism (Gebru and Torres 2024).

[9] Talk of rhetoric and strategy prompts one to ask whether tech elites *believe* the narratives they dispense, a question also raised in O'Sullivan's (2025) treatment of superintelligence rhetoric and the "perfecting" of rhetorical stances. My view is that their actions—acting on the narratives and spiritual frameworks I have discussed here—commit them to these values, whatever they might "really" believe.

[10] Becker impressively deconstructs these claims about exponential growth and evolution.

[11] During Trump's first administration, Bannon and Thiel, influenced by anti-democracy ideologue Curtis Yarvin, began engaging with Dugin's Eurasianist, ultranationalist philosophy. In 2025, Dugin, sometimes referred to as "Putin's brain," enthusiastically endorsed Trump's policies.

Competing Interests

This author declares that they have no competing interests.

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Does Science Need Theology? Looking Back and Looking Forward

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Science now appears to be doing quite well without theology. Yet in the past, it was a different story. This article shows how at the time of its birth in the seventeenth century, experimental science originally depended on theological ideas both for its logical foundations (such as the concept of invariable laws of nature grounded in the will of God) and its social legitimacy (through religiously framed justifications of scientific inquiry as a form of charity, worship, and recovery of Adamic dominion). While this theological indebtedness is now largely overlooked, arguably, contemporary science continues to depend on unacknowledged theological presuppositions for its rational coherence and cultural authority. The article concludes with speculations about whether the explicit relationship between science and theology that characterized its formative period might be revisited in some form in the future.

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Does science need theology? The question brings to mind Irina Dunn's quip that "a woman needs a man like a fish needs a bicycle." It is relevant that Dunn's well-known observation was derived from an earlier bon mot from American psychologist Charles S. Harris, who remarked that "[a] man without faith is like a fish without a bicycle." The modern scientifically informed individual, on Harris's account, has no need for the questionable comforts of religious faith. As it relates to our question, it might seem that the natural sciences, as currently conducted, are managing quite well without any input from theology. Indeed, the almost universal adoption in the sciences of "methodological naturalism"—the principle that science should be conducted without reference to supernatural entities or powers—could be taken to imply that not only is theology unnecessary for science, its invocation is inimical to it. If this is true, it is not just a matter of theology being irrelevant to science, as ballet is generally thought irrelevant to physics, but that theological ways of thinking are actively opposed to a scientific frame of mind.

That said, it is important to clarify at the outset that the claim "theology is in some sense necessary for science" is not quite the same thing as insisting that "theological *explanations* need to play a role in science." There are various ways in which theology might be "necessary" to the natural sciences that do not involve the invocation of supernatural causes. Here are four: first, theology might provide tacit presuppositions necessary for scientific claims to be fully rational; second, theology might contribute to the social legitimacy of the natural sciences, providing background reasons for supporting scientific endeavors and valuing scientific expertise; third, theology might provide motivating reasons for at least some individuals to pursue science; fourth, for those with religious convictions, theology might be necessary to place science within a broader framework that offers an overarching account of the cosmos and how our lives can have meaning within it. None of these relations necessarily contravene the principle of methodological naturalism. They also raise the further qualifying question: For whom might it be the case that science needs theology?

The last two examples suggest that there are at least some for whom theology is necessary to science—those who belong to religious communities. But what about the first two examples, which go to questions of the metaphysical foundations of the sciences and the issue of their social license? Certainly, it is no longer obvious how theology might play those roles. However, as I argue, it did in the past, when scientific practice was embedded within a religious culture—that is, when virtually everyone belonged to a religious community. This raises questions of whether, with the secularization of religious culture, science now rests on different logical foundations, and whether science no longer requires the sanction of religious values. Alternatively, it might be that we have simply forgotten or repressed the role played by theological considerations in grounding and legitimating science, in which case, the sciences do need theology, but do not realize it.

In this article, I outline historical instances of science needing theology and then offer brief reflections on the extent to which those historical precedents might still have implications for the present. Both examples are taken from the early modern period—roughly, the long seventeenth century, when a distinctively modern, experimental science first took shape. The first case involves the way in which theology provided the theoretical presuppositions upon which science rested; the second highlights the role of theology in lending social legitimacy to the new scientific practices. (It would be possible to offer further case studies, for example, that speak to the way in which theological anthropology informed experimental methods [Harrison 2007], but the two instances under consideration should be sufficient to establish the principles I am interested in articulating.) The two examples might be regarded as concerning the logical and normative foundations of science, respectively. (By "normative," I simply mean our reasons for valuing science, for thinking it is a "good thing.") My overall proposal is that we have become habituated to the features of science that originally had theological premises, not realizing the extent to which, in their original early modern context, they were culturally and historically novel. This leads to the question of whether key elements of these original theological factors are still operative, albeit at a covert level.

Theology and the Laws of Nature

Much of contemporary physics assumes the existence of laws of nature, and many classic discoveries are couched in those terms: Newton's laws of motion, ideal gas laws, laws of thermodynamics, and so on. The idea that there are laws of nature at all, however, emerged historically late, in seventeenth-century Europe. To be sure, before this, no one doubted that there were regularities to the operations of nature. But these regularities were not understood in terms of invariable laws. According to the Aristotelian philosophy that prevailed in the premodern West, for example, changes in the natural world were to be understood in terms of the intrinsic virtues and qualities of natural things. In practice, the operation of these internally located properties gave rise to an order that was regular "for the most part" (to use the formulation of Aristotle and Thomas Aquinas) (Aquinas 2018, 3/99 201).[1] The distinctive feature of modern laws of nature, when they were first conceptualized in the seventeenth century, was that they were understood very differently as the external imposition of the will and power of God, which moved inert particles of matter that had no inherent motive powers. These laws were invariable and universal. At its inception, then, the idea of laws of nature had a theological foundation.

French philosopher René Descartes played a key role in introducing this idea (Henry 2004; Harrison 2008a). Descartes proposed that nature be understood in terms of particles of matter in motion. The fact that we observe regularities in the way things move, he insisted, owes to the fact that God moves them according to regularities he has willed. "God has established these laws,"

Descartes (1985, 1:91, 97) explained, and he alone "is the author of all the motions in the world in so far as they exist and in so far as they are rectilinear." "Law of nature," on this understanding, was not a mere metaphor but conveyed the fact that the regularities in the natural world resulted from the decrees of a law-giver—God. Descartes (1985, 1:90–1, 93–6) proposed that laws of nature derive their immutability and universality from their divine author, who is likewise unchangeable and omnipresent.

This understanding of laws of nature became fundamental to the new scientific worldview of the seventeenth century (although thinkers differed about how the laws were to be derived or discovered) (Harrison 2013). The English experimental philosopher Robert Boyle (1999–2000, 11:111, 302), for example, insisted that God had established the laws of motion and that their regularity was guaranteed by his ongoing creative activity in sustaining them. Isaac Newton adopted a similar view of laws of nature. The preface to the second edition of his *Principia mathematica*, arguably the most celebrated scientific work of all time, states forthrightly that the laws of nature originate in "the perfectly free will of God, who provides and governs all things" (Newton [1713] 1999, 397). The Newtonian philosopher and theologian Samuel Clarke (1738, 2:697–98), who vigorously defended the Newtonian worldview against the German philosopher G. W. Leibniz, summed up the core of this approach: "The course of nature, truly and properly speaking, is nothing else but the will of God producing certain effects in a continued, regular, constant, and uniform manner; which course or manner of acting, being in every moment perfectly arbitrary, is as easy to be altered at any time as to be preserved."

This view of laws of nature, which provided a justification for inductive inferences, persisted well into the nineteenth century. (David Hume's well-known identification of the problem of induction, incidentally, stems in part from his adoption of a weaker conception of laws of nature.) Late in that century, however, in one of the great ironies of history, the inviolability of laws of nature began to be used as evidence *against* God's involvement in the natural world. This resulted from a habituation to the idea of laws of nature and a convenient amnesia about its origins. What had once been understood as constant divine creative activity was now simply accommodated to a "nature" whose laws were presumed to require no further explanation. Thus was born modern scientific naturalism and, along with it, the misconception that theological commitments were somehow incompatible with genuine science (Harrison 2024, 242–53). The emergence of naturalism necessitated the tacit repudiation of the role played by theological considerations in the history of science. Its birth accordingly coincided with the invention of the dubious science–religion conflict narrative, the refutation of which has kept historians of science busy for several decades (Numbers 2010; Hardin, Numbers, and Binzley 2018; Lightman 2019).

It remains to be asked, notwithstanding the theological *origins* of the concept of laws of nature, whether science remains logically indebted to theology. Some have argued that it does (Foster 2004; Swinburne 2010; see also Koperski 2023). But there are ways to avoid this conclusion. One would be to abandon the traditional conception of laws of nature. The distinguished philosopher of science Nancy Cartwright (2005), for example, has espoused the principle "no God, no laws," arguing that "the concept of a law does not make sense without the supposition of a law-giver." But her conclusion is that this gives us reasons to abandon the idea that nature is governed by natural laws (Cartwright 1983, 1993; also Giere 1999). Cartwright's position notwithstanding, we can still conclude that it is inconsistent to espouse a strong naturalism while at the same time affirming that the universe really is governed by laws of nature. To the topic at hand, the "no God, no laws" principle implies that certain widely held understandings of science (if not its uncritical practice) do implicitly require theology.

Another way of evading the force of the "no God, no laws" principle would be to seek recourse to a weaker, "Humean" understanding of laws of nature, according to which laws are not features of reality but more like conditional generalizations based on human experience. But this approach has well-known difficulties of its own (van Fraassen 1989, 40–64; Carroll 1990; Berenstain and Ladyman 2012). "Laws" thus understood do not support counterfactuals (which is something that most of those who harbor a realist conception of science usually need it to do); it allows for trivially true "laws"; it does not allow that there is something necessary about how events transpire; it makes the problem of induction more acute. Most scientists, and not a few philosophers, have accordingly found the Humean solution too weak a formulation to sustain their intuitions about how nature operates. An apparent dilemma here is also that a weaker understanding of laws of nature seems to vitiate the claims of naturalism over against theistic readings of nature. (I say "apparent" because it involves a failure to realize that the strong version of laws of nature arguably relies upon an implicit theology.)

In sum, practitioners and philosophers of science cannot hold to both naturalism and a robust conception of laws of nature. Any view of science that is predicated on a notion of inviolable natural laws owes some commitment to the theological premise that makes that conception rational.

Theology and the Social Legitimacy of Science

A second historical case of theological dependence concerns the social legitimacy of science. In order to appreciate the significance of the legitimacy question, it is important to understand that there is nothing natural or intuitive about the approach of experimental science. Nor is it obvious that the pursuit

of scientific knowledge should occupy a prominent place in the activities of a society. From a historical and cross-cultural perspective, the general rule is that most cultures have not developed practices that look much like modern experimental science. In those that have, their version has not come to assume the prominence and epistemic prestige science currently enjoys in the West. Generally, societies do not develop into what historian Stephen Gaukroger (2006) refers to as "a scientific culture" like ours. Cases in point would be ancient Greece, China, India, and medieval Islamic cultures. We might say that the normal course of scientific development, when it happens at all, conforms to a "boom-bust" pattern characterized by bursts of scientific activity followed by periods of relative stasis when societies turn their attention to other priorities (Ben-David 1971; Cohen 2010). Scientific development then stalls. What makes for a scientific culture is a set of values that leads a society to prioritize scientific activity and propel it to the center of the culture. In the early modern West, this singular process of consolidation was accomplished by appeals to specific values, and theological values were central.

There are two reasons we now tend to take the question "why prioritize science?" for granted. One is that the manifest material benefits science confers seem obvious; the other is that we rank those material benefits more highly than other things, such as cultivation of the arts or the individual pursuit of wisdom and virtue. Again, however, for most societies—and indeed in the West before modern science got underway in earnest—the answer to this question was less obvious. Moreover, it was not immediately clear that experimental science could deliver much by way of material benefits. Initially, the practical payoffs of the new scientific approach were meagre. More importantly, very few thought the pursuit of practical utility was an appropriate goal for serious intellects. The cultivation of moral and intellectual virtues was regarded as the highest intellectual pursuit. While it may seem surprising to us now, the new scientific approaches of the seventeenth century attracted widespread criticisms about their social value. The new science was thought to focus on undignified objects of investigation, seemed crassly utilitarian, and often fell short of accomplishing its own underwhelming goals (Purver 1967, 7; Benedict 2001, 46–51; Gaukroger 2006, 36–8; Harrison 2008b). As one articulate critic of the new science expressed it: "Those men therefore, who have applied themselves by their writings to promote vertue and godliness, in their kind . . . were generally thought to have deserved of mankind, as well (if not better) as the most renowned inventours, or promoters of useful Arts or Trades. Had Aristotle never written any thing but his *Ethicks*, . . . he deserved the thanks of all ages" (Casaubon 1669, 6). Aristotle's emphasis on ethics was much preferred to messy experiments and bloody dissections. Even if the latter did eventually yield a few modest, practical outcomes, these might still not be considered worthy of serious intellectual investment.

In the face of such disapprobation, advocates for the new sciences appealed to religious values to establish the social legitimacy of their endeavours. There were three main avenues of appeal. Francis Bacon argued that the material benefits science promised to confer could be understood as a form of Christian charity in action. For Bacon (1857–74, 2:153), the goal of science was "the relief of the human estate." In so far as it accomplished this, it was to be understood as an embodiment of charity, the most elevated of the Chrisitian virtues (Bacon 1857–74, 3:221f, 3:294, 4:20f; Harrison 2001). This line of justification admittedly called for some adjustment of how the virtues themselves were conceptualized, and to a degree, Bacon played a role in the momentous transition in moral thinking away from traditional conceptions of virtue towards something like utiliarianism (MacIntyre 1981). In Bacon's case, charity, in its relation to the pursuit of knowledge, aimed at external works directed towards pratical ends, in addition to contributing to the process of individual sanctification (Bacon 1857–74, 4:20f.; Gaukroger 2001, 221). Over time, however, elements of moral formation tended to fall away from justifications of the pursuit of scientific knowledge.

Another theological justification for practicing science was that it conferred knowledge of God through the study of his creatures. The importance of contemplating nature had long been a theme in the Christian West, as reflected in the venerable notion of the "two books," the book of scripture and the book of nature. Apologists for the new science allowed that a general sense of God's wisdom and power could be deduced from even a casual acquaintance with nature's operations. But they argued that a more profound appreciation of the nature of God came from the detailed understanding of nature that only experimental science could provide (Boyle 1999–2000, 3:220, 235.) Boyle (1999–2000, 3:238, 278–79) expanded on this principle to argue that experimental science is essentially "reasonable worship of God" and natural philosophers are priests of nature.

These two themes were often combined in the early modern period to shore up justifications for scientific pursuits. In essence, the argument was that "science" is a way of fulfilling the double injunction: love your God and love your neighbor. As Boyle (1999–2000, 3:192) expressed it:

> By the one, sound notions are proposed to the reader's apprehension from the contemplation of God's creation and the governance of the world, and thereby good matter is suggested to his affections for the advancement of his devotion: by the other, there are divers things delivered, which may tend to enlarge mans power of doing good: by them, in the whole, both honour to God, and our charity to our neighbours may be assisted: in which two, the substantial part of all the most noble, not only human, by Christian virtues, both speculative and practical, are certainly contained.

Claims that the conduct of science was a means of operationalizing both piety and practical virtue became important themes for defenders of the new natural philosophy (Glanvill 1676, 5, 25; Sprat 1667, 322f.; Edwards 1696, pt. 1:206–14, pt. 2:150).

A third element of the theological legitimation of science came from the proposal that scientific practice is a means of recapturing a dominion over nature that had been lost in the wake of the Fall. A common reading of the Genesis narratives was that in his state of prelapsarian perfection, Adam had enjoyed a comprehensive scientific knowledge of nature and complete dominion over it. Following his rebellion against God, however, he lost this knowledge and his mastery of the creatures. Oversimplifying somewhat, we can say that medieval readings of Genesis tended to emphasize the moral rather than material losses that resulted from Adam's primeval transgression. Accordingly, reversal of those losses involved the quest to recover a lost mastery of disordered desires, with "the beasts" being allegorized as passions that needed to be brought under control (Harrison 1998). More literal interpretations of Genesis, characteristic of the early modern period, stressed instead a literal mastery of the natural world. Science was thus understood as the means by which the curse of the Fall could be partially redressed.

This idea of science as a redemptive enterprise became central to establishing its social legitimacy during its infancy. Bacon (1857–74, 8:350) wrote in 1620 that "man by the fall fell at the same time from this state of innocency and from his dominion over creation. Both of these losses however can even in this life be in some part repaired; the former by religion and faith, the latter by arts and sciences." Science, he insisted, could restore "the sovereignty and power" Adam had enjoyed "in his first state of creation" (Bacon 1857–74, 3:220; 4:7). This would become a familiar theme in defenses of the Royal Society, founded in 1660. Robert Hooke (1665, preface), the first curator of experiments at the Royal Society contended that experimental science was a means of disciplining human knowledge seeking and a palliative to "the mischiefs, and imperfection, mankind has drawn upon it self." These restorative ideals also found their way into contemporary culture, easing the birth of a new scientific approach that was regarded with suspicion in certain quarters (Harrison 2007, 183).

It must be conceded that little, if anything, is left of these theological arguments for the value of science. No one today thinks that science derives its legitimacy from a Christian Fall–Redemption narrative or that it is an expression of the double imperative to love God and love your neighbor. Accordingly, it may seem reasonable to conclude that whatever insecurities attended the birth of modern science, science no longer needs recourse to theology to secure its social legitimacy. Yet the history of early modern science points to the facts that science is not self-authenticating and that its social license rests upon a capacity to appeal to the value system of the society in which it

operates. Although we rarely reflect upon this, the legitimacy of science still ultimately rests on appealing to certain values. (Why do we value the specific outcomes science delivers? This question takes us to the realm of values, not facts). If there is anything to the argument that the West's value system remains essentially Christian, in terms of its historical origin and normative content (see, e.g., Siedentop 2014, Spencer 2015, Holland 2019), even if that reliance is no longer widely acknowledged, it could be argued that the ongoing legitimacy of science still rests upon a covert theological foundation. This situation would parallel, in certain respects, the reliance of some contemporary understandings of science on a covert theological conception of the order of nature discussed in the first section.

It is also the case that while the social prestige of the sciences remains relatively high, in recent years it has faced a number of challenges (Etsy 2025; Mann and Hotez 2025; Plümper and Neumayer 2026). Questioning of the authority of science has been linked to the COVID-19 pandemic, the replication crisis, growing awareness of scientific fraud and misconduct, and the rise, in certain quarters, of science-hostile governments. These unfortunate developments serve as a stark reminder that the issue of the social legitimacy of science has never really gone away. Returning to our core question, then, it might be argued that science still needs if not theology then something like it to provide the necessary normative grounding that gives it a social license. Without such a moral grounding, it remains vulnerable to a range of ideologically motivated attacks. Accordingly, it is not implausible to argue that the present vulnerability of science is owing in part to the gradual, and largely unnoticed, expiration of its original theological warrant. If science does not need theology, at the very least, it may need something that can play the legitimating role theology once did.

Conclusion: Does Secular Modernity Need Theology?

Ernst-Wolfgang Böckenförde (1976, 60) was a twentieth-century German judge and legal philosopher known for a dictum of political philosophy: "The liberal secularized state is nourished by presuppositions that it cannot itself guarantee."[2] Böckenförde was essentially proposing that the liberal state rests upon foundational assumptions about human beings and what constitutes their common good that it is unable to justify on the basis of its own moral resources. What is required for such a guarantee is, in fact, a set of religious commitments that come from "outside". On this account, to state it baldly, liberalism, in spite of its apparently secular ethos, "needs theology." The twenty-first century has witnessed increasing attacks on liberalism, from both left and right. These can be plausibly linked to the incapacity of liberalism to defend itself by relying only on the meagre arsenal of its own secular values.

In this article, I have set out an analogous argument for secular science. Despite the overt naturalism of science, we might think of it as resting upon presuppositions that have been tacitly carried over from the Christian culture in which it was first nurtured. Science might accordingly be regarded as living on the borrowed credit of these original theological foundations. This, I have suggested, may be true in two senses: in relation to the logic of laws of nature and in relation to the values that have lent it social legitimacy. Clearly, the unreflective practice of science does not presently require the overt profession of any theology. But it can be argued that science nonetheless "needs" theology if it is to provide a coherent account of its logical foundations and secure its moral legitimacy.

Two closing reflections. As the Böckenförde dictum suggests, the question of science's ongoing reliance upon unacknowledged theological principles can be regarded as a subset of a broader question concerning the general indebtedness of secular modernity to hidden theological considerations. Opinion is divided on this question, with some arguing that key secular institutions of Western modernity derive their content and ultimate legitimacy from the Christian ethos in which they originated (Löwith 1949; Becker 1932). Others maintain that secular modernity, in spite of its historical trajectory, is legitimate in its own right (Blumenberg 1985).[3] This is not place to attempt a resolution of that question. My own view is that some aspects of some present institutions, including the sciences, do indeed seem to rely upon unstated religious premises or values (Harrison 2023).

A second issue worth pondering concerns not the past relation of science and theology but its future. For most of Western history, the formal study of nature was intimately connected to theology—notwithstanding the prevalence, since the late nineteenth century, of dubious narratives suggesting otherwise. This prompts the question of the future of science–theology relations and whether the years to come might see some new rapprochement with theology. What this might look like is not altogether clear, and prevailing models (such as intelligent design) are not auspicious, just as prominent admixtures of theology and politics—witness Christian nationalism—are deeply disturbing. But these unfortunate realities need not constitute a barrier to envisioning new, creative, and edifying modes of thinking. A good starting point for a new way forward would be an acknowledgment of the positive role played by theology in the genesis of modern science and an abandonment of the tired story of the inevitability of science–theology conflict.

Notes

[1] Some earlier Islamic thinkers had already rejected Aristotle's view that nature had an independent intrinsic agency. Avicenna, for example, spoke of externally imposed laws of nature. Even before this, Asharite philosophers adopted a voluntaristic view of nature's operations that was similar in some respects to the position later adopted during the scientific revolution (Brown 1972; Moad 2005).

[2] Translated by Peter E. Gordon (2013). To some degree, as students of political theology will be aware, this dictum echoes the sentiment of another, notorious, German jurist, Carl Schmitt (2005, 41), who wrote along similar lines that "[a]ll significant concepts of the theory of the state are secularized theological concepts." More generally, on the legitimacy of aspects of modernity that appear to rest upon theological premises, see Gordon (2019a) and Harrison (2023).

[3] For discussions of this general question, see Gordon (2019b), Harrison (2024), and Smith (2025).

Competing Interests

The author declares that they have no competing interests.

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On Not Looking a Gift Horse in the Mouth: Theological Advice to Quantum Fundamentalists

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In this article, I answer the guiding question of "does science need theology?" in three ways, pointing especially to the theological roots of scientific method. In my third answer, I argue in the affirmative, pointing out that scientific method can be seen as rooted in theological motifs concerning the giftedness of creation and of theological participation. Recognition of these motifs is helpful, I suggest, when facing some of the notoriously difficult metaphysical debates thrown up by modern science. I focus especially on quantum interpretation and make a theological argument to ground the ordinary scientist's working instrumentalism, which is so often coupled with a vague but aspirational realism. This coupling, I suggest, is effective as a professional acceptance of the giftedness of creation, and it respects Thomas F. Torrance's "theological warrant" of empirical enquiry. In the words of my title, I want to teach quantum fundamentalists how not to look a gift horse in the mouth.

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Introduction

"Does science need theology?" is my guiding question throughout this article. I can think of at least three answers, what I will call my first-, second-, and third-order answers, since they ascend a ladder of subtlety. I sketch out my first- and second-order answers in this introduction, and then spend the remainder of the article on the third-order answer, illustrating it with an example in the contested interpretation of quantum theory. My point is that theology is able to remind scientists—theistic scientists, at least—of the gifts that have been endowed to them as specialized recipients of the wider gift of creation.

My first-order answer: yes, of course. In much the same way that asking whether science needs philosophy is to pose a philosophical question about the scope of philosophy (Rovelli 2018), so too is asking whether science needs theology to pose a theological question about the scope of theology. And a well-informed discussion will accept that both philosophy and theology have totalizing tendencies born out of their subject matter. Just as it is possible to construe philosophy as the love of all wisdom—which includes all scientific reason and knowledge—so is it possible to construe theology as concerned with all that is created by the uncreated Source, which obviously includes every scientific interest there ever has been or ever will be. Therefore, we could answer, "Yes, of course science needs theology, since theology tells us about the Source of all creation." But I regard this as a rather trivial answer. It evades the challenge of addressing the nature and scope of science by telling us about the nature and scope of theology instead. My first-order answer is, therefore, my least subtle.

More interesting are what I call my second- and third-order answers; more interesting because they engage with science as science, that is, with how and why science works as a family of knowledge-seeking enterprises and how it might continue to work as science.

My second-order answer ("no") will not come as a surprise in this day and age, but my reasoning might. For, on the one hand, today's general public and working scientist alike widely assume that religious faith is, at best, an irrelevance to scientific practice and, at worst, a hindrance. Indeed, modern scientific method assumes a working naturalism, whereby the supernatural and its possible influence on the natural is, by definition, excluded from scientific enquiry. But it was not ever thus. For, and on the other hand, the historian of science tells us that, until the mid-nineteenth century (approximately), scientific work was often steeped in theological language and thought; natural philosophers and natural historians were not shy of weaving theological claims into what they were discovering about the natural world, nor of justifying their discoveries in theological terms (e.g., Funkenstein 2018). We also learn that, in those crucial seventeenth and eighteenth centuries of early modern science, scientific practice relied heavily on theistic working assumptions concerning, for

instance, the uniformity, intelligibility, and parsimony of nature, which in turn supported key scientific concepts such as the lawfulness of nature (itself with a venerable theistic history).[1] Not only is it difficult to disentangle scientific from theological claims in much of this early work, but the practitioners themselves would sometimes use terms such as "physico-theology" and "natural theology" to signal that their scientific objectives were part of a wider theological vision. As this language implies, two potentially independent perspectives—natural enquiry and divine revelation—were being combined into a unitary synthesis (Gaukroger 2006, 493), which might, for instance, search for evidence of divine design in nature, present scientific arguments in support of biblical miracles, or, further, justify new scientific theories by calling upon the nature of the Creator God.

Although the terminologies of physico-theology and natural theology have fallen out of use in modern scientific discourse, the aspiration they signal has not: that a singular truth may be sought through the merging of scientific and theological perspectives, even if that latter perspective has become tacit or invisible today. In case of point, Peter Harrison (2024) argues that the modern worldview of scientific naturalism is the inheritor of exactly such a unifying aspiration, merging scientific and theistic understandings of the laws of nature into the metaphysical entity of "nature," which is itself defined in terms of a hard nature/supernature dualism. I myself have made a similar argument, reflecting upon the varied history of calls upon naturalism and natural theology (Harris 2018, 1058): "[T]here is no sharp or uncontested boundary between naturalism and natural theology: not only do they overlap, but there is a sense in which they can become the very same thing, depending upon how one construes the metaphysical foundations of the natural sciences." If this line of argument is correct—that scientific naturalism is entangled with natural theology—then "nature" (the arena of natural lawfulness) is effectively a theological construct, since it is reliant on theological conceptions of "supernature" and of the laws of nature. David Hume's famous 1748 definition of a miracle as a violation of a law of nature by the Deity is clearly influential in this regard, effectively providing a tacit theology of nature for our modern times (Hume 2007, 79–95).

Modern scientists rarely reflect upon the theological genesis of their laws, but modern science still relies on assumptions about the universality, intelligibility, and reality of natural regularities just the same; the theism that once undergirded those assumptions is largely forgotten now, or, arguably, tacit (Harrison 2008, 30). My point is that while it might be widely assumed in secular society that the theism of early modern science is quaintly outmoded and quite unnecessary in today's science, the modern theistic scientist is still able to take a richly theological view of her scientific methods and their grounding assumptions, inspired by the foundational arguments of her early modern forebears. Therefore, my

second-order answer is: "No, science does not need theology, because science is already theological after a fashion, albeit tacitly so in this day and age."

And now for my third-order answer. I will argue a definite "yes," following on directly from my claim at the end of the previous paragraph that to the theistic scientist, science is richly theological. It is possible that this point may shed light on some of the notoriously difficult metaphysical questions thrown up by modern science. For, and not to put too fine a point on it, in certain areas of fundamental physics, the theory has advanced far beyond what is testable by experiment, at least for the foreseeable future, but perhaps even in principle. This mismatch between theory and experiment has prompted a virtual existential crisis in the fundamental areas of particle physics and cosmology. The problem is that key theoretical convictions regarding, for instance, the importance of supersymmetry and naturalness in particle physics, or the questions of string theory and universe origin in cosmology, cannot be established experimentally—probably even in principle—but must be justified by appeal to the grounding principles of scientific method mentioned in my second-order answer, many of which originally arose from theistic arguments. A number of critical voices working in and around physics, by no means theologians,[2] suggest that theoretical physics has become so speculative in these areas, so detached from what is empirically testable, and so extravagant in its ontological claims that it is no longer clear that it still counts as scientific. Perhaps, but I suggest that in such areas, theological commentary might make all the difference to the way the science is perceived and interpreted, if not the actual doing of the science itself.

By way of illustration, I turn to a related problem in the interpretation of quantum theory, looking at one of the ways in which theology can contribute towards the longstanding question of how to interpret quantum mechanics (QM). Again, there is a mismatch between theory and experiment. As is well known, there are numerous conceptual interpretations of QM, most of which ontologically conflict with each other, and all of which introduce strange and counterintuitive views of reality, but that are nevertheless empirically equivalent (as far as we can tell in the present state of the quantum science). The consequence is that we currently have no empirical way of telling the interpretations apart, even though we would dearly like to know which of these unpalatable visions of nature is closest to the truth. There is still reason to hope for enlightenment yet: it is possible that nonscientific methodologies could shed light where the empirical science cannot, and indeed, philosophy has already proven its worth here in the quantum foundations area. I have suggested that yet more might be gained by introducing (reintroducing?) theology to the conversation (Harris 2024), and in this article, I outline some theological considerations around the Christian doctrine of creation that might help guide further interpretation of the quantum science. Specifically, I expand on three closely connected theological themes: giftedness, contingency, and participation.

My point is that, if the quantum world is to be affirmed as creation—and if the quantum is truly fundamental—then the quantum comes to us as gift, mandating an attitude of grateful reception in the theistic scientist. Her training in empirical enquiry is a further part of the gift, a divine "warrant" (Torrance 1981). Receiving the gift in all its theological (and, indeed, Trinitarian) fullness therefore entails a participatory realism that nevertheless urges caution towards speculation beyond what her best empirical science can establish (founded on tacit theistic assumptions of intelligibility, uniformity, and parsimony, as I said). The giftedness theme therefore supports her emphasis on empirical enquiry, manifest in her working instrumentalism, which is coupled with what I refer to as a vague but aspirational quantum realism.

My Third-Order Answer, or: Why Quantum Science Is a Miracle

The Giftedness of Creation

Ever since I first read the great quantum theorist Eugene Wigner's (1902–55) article on scientific method ("The Unreasonable Effectiveness of Mathematics in the Natural Sciences," Wigner 1960), I have been enthralled by his closing paragraphs. Having spent most of his article describing some of the great successes of mathematical physics to date, and having explained repeatedly that we do not know the deeper reasons why our physical theories in particular—and our mathematics in general—seem to work so well in describing the physical world, Wigner poses a troubling dilemma for future science. Wigner (1960, 13–14) points out that, despite the many successes of our mathematically framed physical theories to date, it is entirely possible that they may end up conflicting with future advances in biology, such as, for instance, an explanation for consciousness. In such a scenario, he says, we physicists would experience "a deep sense of frustration" as we interrogated "our faith in our theories" and their concepts (Wigner 1960, 13–14). We would question everything the physical sciences had told us so far in our search for truth. And the precise reason such a troubling dilemma is feasible is because, "fundamentally, we do not know why our theories work so well. Hence their accuracy may not prove their truth and consistency" (Wigner 1960, 14). In other words, and to emphasize the force of Wigner's argument: since we do not know the reason why the physical sciences have been successful so far, it is entirely possible that they may fail spectacularly in the future as our wider scientific knowledge (beyond physics) advances, despite the apparent accuracy of our physical methodology in the present day.

Wigner has got to the heart of the matter. In explaining scientific methodology, we always emphasize that every scientific theory is provisional, destined to be revised or discarded by future science. But Wigner is reaching for a still deeper and more sobering truth: our confidence in the scientific methodology itself (or, at least, our reliance on the immense power of mathematics) is provisional and may collapse one day. We simply cannot be certain, because of the basic

problem that we do not understand why our theories work in the first place; from that point of view, our mathematical methodology is, effectively, a black box. As the title of Wigner's article makes clear: the scientific effectiveness of mathematics is "unreasonable."

But there is more. I often tell my students that the title of the article captures the whole argument, but that is only true up to this point in the article. The next (and final) paragraph changes the complexion considerably (Wigner 1960, 14):

> Let me end on a more cheerful note. 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. We should be grateful for it and hope that it will remain valid in future research and that it will extend, for better or for worse, to our pleasure even though perhaps also to our bafflement, to wide branches of learning.

Despite the potential devastation of the previous paragraph, there are grounds for optimism in our scientific methodology, Wigner thinks, since our reliance on mathematics is "a wonderful gift." And here, Wigner is just as theological in referring to the scientific appropriateness of mathematics as was Galileo in his own way: it is a "miracle . . . a wonderful gift which we neither understand nor deserve." Wigner does not say who is the giver of the gift, but his use of the term "miracle" is highly suggestive of the divine Giver, beyond nature. If this were the only instance of such theological language ("miracle") in the article, we might pass it off as a closing rhetorical flourish. But Wigner uses the word miracle repeatedly throughout the article to refer to the unreasonableness of scientific methodology. It is therefore reasonable to conclude, I suggest, that Wigner is implying a very serious theological message about the source of our scientific successes: those successes are providential—as if from above—and they should be received as such in an attitude of humility and gratitude to the Giver of the gift.

If my reading of Wigner is correct—and if he himself is correct about the unreasonableness of scientific methodology—then we clearly have a significant further reason to acknowledge the fundamentally theistic basis to science: the giftedness of creation.

That creation is God's gift to the creatures is a venerable theme in Judeo–Christian tradition, stretching from the Hebrew Bible (e.g., Psalm 139) to the present day (e.g., current theological discussions around environmental care and sustainability; Boulding 2025; Laracy 2025). Indeed, the theme of "gift" has been much discussed in recent years—it is "almost mantric in its repetition in recent continental and North American theology" (Coakley 2008)—and for good reasons, such is its efficacy. When seen in light of the *creatio ex nihilo*

doctrine, that theme includes the very gift of being itself to every creature: the Creator created every thing from no thing as a purposeful act of love and grace, giving the creatures purpose, structure, and value. Creation need not be what it is in any respect, except by the free decision of its Creator; creation is therefore entirely contingent on the Creator for its past, present, and future as much as for its very form and function. And neither was the gift limited to the initial moment of creation, but it is continuous, free, and ongoing. God continues to sustain creation at every moment from falling back into nothingness.

Moreover, in Christian theology the giftedness of creation flows from the very being of the Trinitarian God. Augustine famously describes the innermost dynamic of the Father, Son, and Holy Spirit in terms of both "love" and "gift" (*De Trinitate* 15). Both love and gift are to be identified with the Holy Spirit, who proceeds from the Father and the Son and is their "common Gift," providing for distinction within the "inseparable Trinity" (*De Trinitate* 15.29). Therefore, the giftedness of creation is made possible by—and is a token of—the inner dynamic of God the Holy Trinity.

Finally, the giftedness of creation is effective at capturing the theological relationship between the natural sciences and creation, especially if we reflect on the theme of contingency, which flows from the fact of giftedness. The science–theology discussion has focused extensively on the contingency of creation, considerably more so than on its giftedness (e.g., Mascall 1956, 93–96; Torrance 1981; Pannenberg 1988; Russell 1988; Barbour 1997, 211–14, Schwöbel 2004, 164; Jaeger 2018). The point here is that the form, structure, and dynamics of creation—including its supposed lawfulness—cannot be second guessed or predicted from first (logical) principles, since the *ex nihilo* doctrine indicates that creation's form, structure, and dynamics are entirely contingent upon the Creator's will in giving the gift. Therefore, the natural sciences can only gain understanding of nature by means of a grateful acceptance of the gift of creation in whatever form it comes to us, testing and probing it patiently by empirical means. Indeed, the contingency of the created cosmos is the very reason that the natural sciences are able to develop their own "autonomous modes of investigation" in the first place, according to Thomas F. Torrance (1981, 86); there is "theological warrant" for the empirical method of science, and, in fact, scientific investigation is "a duty toward God laid upon us by his work of creation." In short, once we begin to explore the giftedness—and especially contingency—of creation, science becomes abundantly theological.

In case the reader is wondering at this point how I have advanced beyond my second-order answer, suspecting that I am merely arguing (again) that science is tacitly theological, I will now develop the themes of contingency and giftedness further by looking at a third theme—participation—before applying them to a live controversy in quantum science.

Participation

Andrew Davison has set out a detailed theological account of participation in his 2019 book, *Participation in God*. His opening sentences are especially helpful (Davison 2019, 1):

> Approaching the world in terms of sharing and receiving should be the bedrock of a Christian understanding of reality, and of Christian doctrine . . . The heart of that perspective, which often goes by the name of "participation," rests in perceiving all things in relation to God, not only as their source but also as their goal, and as the origin of all form and character. In that way, notions of likeness and exemplarity lie close at hand, and an inclination to celebrate the variegated particularity of things, as a creaturely expression of the goodness and beauty of God.

The participation motif recognizes that all is God's gift, but it goes further in expressing a mindset of "sharing and receiving": a relational view that is able to "celebrate the variegated particularity of things." Davison does not say so, at least not here, but such a mindset is well suited to a theistic construal of science. And, of particular relevance to my focus on quantum science, Davison (2019, 1) goes on immediately to point out that "people who think in these terms tend to be objective, or 'realist' over how we know things . . . their epistemology and ethics, that is to say, tend to be worked out in terms of recognition and reception rather than invention or projection." The reason I am repeating Davison's words here is that the categories of relationality, participation, objectivity, and realism are relevant to a major contention in quantum interpretation. Now, in the final subsection, I want to use these categories to provide theological advice to scientists caught up in the quantum realism/antirealism debate.

A Working Instrumentalism Coupled with a Vague but Aspirational Quantum Realism

It is important to remember why the quantum realism/antirealism debate is so significant in science in the first place. Scientific realists are those individuals who tend to believe that our current best theories provide true (or approximately true) pictures of nature as it really is (e.g., Maudlin 2019, xii). Scientific antirealists, on the other hand, prefer to exercise caution or agnosticism towards claims concerning the ability of our theories to reveal the true ontology and properties of nature. Instead, such scientific antirealists often prefer forms of instrumentalism, where scientific theories are held to be effective "black boxes" rather than more-or-less true representations of nature's deep ontology. The debate over quantum interpretation introduces a particularly sharp version of the realist/antirealist distinction, focused especially upon the significance of measurement; hence the infamous quantum "measurement problem."

In classical (i.e., pre-quantum) physics, we were able to assume—in fairly realist terms, calling upon the success of our best physical theories before the quantum revolution of the early twentieth century—that a physical entity such as a particle possesses definite properties such as energy, position, and momentum quite apart from whether or not it is being observed; that is, that an observer is able to measure such properties "objectively." But the measurement problem of QM puts much of this objectivity into question. As Philip Ball (2019, 11) puts it so effectively, "quantum mechanics doesn't say *anything* about 'how things are'. It tells us what to expect when we conduct particular experiments." Therefore, if we want to go beyond the quantum formalism to make claims about the reality of the unexamined quantum state, we must apply a metaphysical interpretation. But there are many of these, and they all treat the measurement problem in different ways. Some interpretations—those typically referred to as "antirealist" interpretations—refuse to grant objectivity to the quantum state until it is observed, at which point determinate physical properties will be measured. The so-called Copenhagen interpretation is the prime example of such a view, but others, such as QBism and quantum pragmatism, are often classified as antirealist (Wallace 2020, 78). In each case, emphasis is placed on the act of measurement for establishing the reality of the quantum state. Other interpretations—those typically referred to as "realist"—downplay the role of measurement by granting full objectivity to the quantum state and its properties, quite apart from whether an observation has been made. This move requires ontological commitments to be made that go beyond the "antirealist" interpretations. Thus, while the three main realist interpretations—de Broglie-Bohm, Hugh Everett's "Many-Worlds Interpretation," and objective collapse—all understand the ontology of the quantum state differently from each other, they nevertheless all maintain that the quantum state has an ontology of some sort, and that it possesses a basic objectivity independently of measurement.[3]

Significantly for this article, the debate over the role of the observer in determining the reality of the quantum state can be translated into participatory language. Seen in light of the theistic underpinnings of the history of science mentioned in my second-order answer, the secret of classical science's success was its ability to bracket off all participatory influences on an entity (a creature)—including those of its Creator—so that those influences could be neglected. Hence, classical science was able to operate, as I argued in my second-order answer, without reference to the theism that informed its working presuppositions, and it was able to isolate its objects of enquiry in order to determine their properties "objectively." But in quantum science, we now find that the participatory framework cannot be so easily neglected, since that framework represents the observer and the supposed "object" of her measurement, the quantum state. Observer and object are now bound together in a quantum participatory framework that cannot be neglected as easily as in classical physics.

The quantum interpretations—whether realist or antirealist—can now be seen as different metaphysical accounts of the participatory framework, and with different physical ontologies. I will say more about this participatory angle on quantum interpretation towards the end of this section.

For now, it is important to point out that there is no widespread agreement in physics generally, nor in the quantum foundations area particularly, over which is the correct quantum interpretation; the fact that the empirical science cannot distinguish between the interpretations does not help matters. And yet there is widespread agreement in physics that the quantum science is revelatory of true fundamentals of our cosmos and that even though our future science will continue to evolve, it will most likely be thoroughly quantum.

I have already explored the mindset of quantum fundamentalism at some length (Harris 2023, 2024) and have introduced some of its theological challenges and opportunities. Recall that quantum fundamentalism is the belief—widespread in the physical sciences—that the quantum, including all its strangeness and the vastly open questions it introduces about the nature of reality, captures that which is most fundamental about our physical world. Also recall that quantum fundamentalism cannot be established on empirical grounds; it is a worldview, which moves in the same cognitive territory as a theistic belief, and indeed is constructed on those same theistic grounding principles of science I mentioned in my second-order answer, such as the uniformity of nature, along with the universality, parsimony, and coherence of our best mathematical descriptions of the physical world. In light of the analysis I have developed in this article, I suggest that quantum fundamentalism is tacitly theological and may therefore be informed and critiqued by wider theological perspectives such as those I have outlined regarding giftedness, contingency, and participation and will develop further shortly. Likewise, if quantum fundamentalism is of theological merit in its own right—if it faithfully captures something of the Creator's mind for our cosmos—then the theologian has need of reflection on it. I will say more shortly.

In previous work, I have described the position in which most ordinary working physicists like myself find ourselves with regards quantum interpretation (Harris 2023, 188–93). In the very large subdisciplines of particle physics and condensed matter physics (my own)—those disciplines that are numerically dominant in physics, involve a close relationship between theory and experiment, and are thoroughly reliant on quantum theory—there is rarely much need to ask "what is really going on" in the unobserved quantum world. There is an old joke that, when a new student asks what is really going on, they are told by their professor to "shut up and calculate!" After all, the mathematical quantum formalism is exceptionally powerful in addressing our empirical problems of interest and guiding new avenues of concrete research. We little need to ask in general terms why the formalism works when its predictive power is so dazzling at the level of

our particular interests. This leads to a highly pragmatic attitude in the ordinary quantum physicist that is, in effect, a kind of working instrumentalism. This instrumentalism respects the authority of the Copenhagen interpretation most of us are taught as students,[4] but it does not buy into Copenhagen's stricter forms of antirealism. In fact, our instrumentalism is rather half-hearted, since we tend to think of ourselves as scientific realists overall.[5] Indeed, we ordinary physicists would be horrified if you branded us "antirealists" merely on account of our working instrumentalism; most of us assume that the quantum world is somehow real—it is a "world", after all—while remembering that we are duty bound not to claim too much about that world in its unobserved state. For all that, our realism is also rather half-hearted, insofar as we do not commit to any particular realist quantum interpretation on account of their baroque and unpalatable ontologies and/or their hidden and untestable additions. For, despite the attractions of scientific realism in general for the working scientist, the particulars of each realist quantum interpretation are, frankly, deeply unattractive when seen from the perspective of everyday human experience. The upshot is that the ordinary working scientist—while exercising a deep-felt conviction towards realism in her heart of hearts—is simply not convinced by any single interpretation, especially not the realist interpretations. The everyday world is strange, we say—the quantum world admittedly much more so—but surely not that strange. Hence, in the spirit of pragmatism, we retain our working instrumentalism for now, while nurturing what I refer to as a vague but aspirational quantum realism, assuming that deeper clarity will emerge in time.[6]

The quantum foundations area of research, on the other hand, engages with the realist interpretations themselves, enthusiastically and in every particularity. There has been a definite turn towards realism in quantum interpretation (French and Saatsi 2020, 1), to such an extent that philosophers in the area are not unknown to articulate a deep-felt exasperation with the tacit instrumentalism of mainstream physicists and with our deference to the authority of the Copenhagen interpretation, even if, as I indicated in the previous paragraph, that instrumentalism/deference is only skin deep. Here is a selection of comments from philosophers critical of the dominance of Copenhagen instrumentalism in mainstream physics. Tim Maudlin (2019, x-xi, 2–5) lambasts the Copenhagen position. It cannot qualify as a physical theory since it does not address either the ontology or the dynamics of the physical world; Copenhagen is more a "quantum recipe" for making observational predictions. Worse still, Copenhagen stifles the scientific imagination: "The contemporary Copenhagen Interpretation is just an attitude: the refusal to ask, much less attempt to answer, foundational questions about quantum theory" (Maudlin 2018, 954). Travis Norsen (2017, 305) is even more forthright: Copenhagen is "increasingly recognised as . . . a lot of vague and philosophical hand-waving" which covers up for a failure to explain the physical world. Jeffrey A. Barrett (2019, 3) is more measured but still

sees the standard approach adopted by working physicists as a serious mistake: "[T]he standard theory is either incomplete in an empirically significant way on the most charitable reading or logically inconsistent on an uncharitable but natural reading."

Clearly, we have a major difference in attitude towards quantum interpretation between two different kinds of expert. One (the ordinary working physicist) is reluctant to commit to any of the realist quantum interpretations: on the face of it, she appears antirealist/instrumentalist, but in her heart of hearts, she maintains a vague but aspirational quantum realism that is repelled by the distinct particularities of each realist interpretation. The other (the philosopher working in quantum foundations) insists that the metaphysics matters, and must be explored in all its gory detail, no matter how unpalatable it might be. To the philosopher, the scientist's realism is simply not realist enough.[7]

How should the theologian adjudicate? Considering what I have developed so far in this article, we can make some headway. I am speaking now as a scientist with theistic beliefs to other scientists with similar beliefs and theologians with interests in scientific practice. An emphasis on the theological giftedness and contingency of creation indicates, I suggest, that we (all of us) should favor a realist attitude, as theologically aware scientists (and scientifically aware theologians), towards the gift of the physical world. We receive the gift from the Giver as it is given, in whatever form it comes to us. Strong antirealism in QM, on the other hand, emphasises the role of the observer in determining reality. The very givenness of creation would seem to weigh against such an approach and favor quantum realism instead. Does that mean we are obliged to face up to the strongly realist quantum interpretations and commit to one of them, such as Everett or de Broglie–Bohm, in all their technicolor strangeness? Not necessarily, I say. When we consider the gift of the physical world to us as scientists, we must remember that the empirical scientific method is our primary means of receiving the gift; that method is, in its own way, a gift to us. Or better, we must remember that to exercise the empirical method is our vocation; it is both our "theological warrant" and our "duty toward God" (Torrance 1981, 86). Therefore, in this particular case of quantum interpretation—when conceptual interpretation of the gift is massively underdetermined by the empirical science and significantly troubling to boot—speculation above what the empirical science can establish would seem to go beyond our warrant. Christoph Schwöbel (2004, 164) made a similar point in his discussion of the giftedness of creation: the "'givenness' [of the world] is a challenge to deal with it as far as we can and to adopt a fatalistic attitude to those aspects we cannot deal with: the characteristic marks of a 'naturalistic' understanding of the world." His point is that the gift is a challenge to us scientists. We do not know what it contains, nor its scope. We must exercise restraint in receiving it: we must explore what we can within our means and let go what we cannot, since that is beyond science. This is a

method—it is the "'naturalistic' understanding of the world"; that is, it is the empirical scientific method, which is itself learnt from theology's reflection on the givenness of the world. It is a powerful method, but it is a limited method: restrained and cautious. Often referred to as "methodological naturalism," the theistic scientist might better understand her working restraint more as a kind of "methodological gratitude."

All of this is to say that there are sound theological reasons for the working physicist's caution in committing to metaphysical speculation while she maintains a vague but aspirational quantum realism in her continued focus on concrete and particular physical problems. But there is more to be said when we return to the participation theme.

As I mentioned earlier in this subsection, the realism/antirealism debate in quantum interpretation can be recast in participatory terms. Ali Barzegar and Daniele Oriti (2024) have done just that, exploring the ontological commitments of what they refer to as the "epistemic–pragmatist" interpretations, those that do not posit any hidden variables or extra mechanisms beyond the basic quantum formalism, nor countenance the possibility of an objective quantum state beyond the observer. These are commonly referred to as the "antirealist" interpretations, and they include the classic Copenhagen position and the mainstream approach I described earlier: a pragmatic/tacit instrumentalism coupled with a vague but aspirational realism. Significantly, Barzegar and Oriti (2024, 4–8) point to the "weak realism" that arises within this family of interpretations once we acknowledge their relational emphasis. All of these interpretations share three commitments, they say, that form a wider epistemic–pragmatist framework when combined. These commitments are first, an epistemic (rather than ontic) view of the quantum state—which means that the interpretations do not postulate hidden structures or extra detail beyond the bare quantum formalism; second, a metaphysics of participatory realism—which means that reality is not objectively "out there" waiting to be discovered but is, in effect, created by the interaction and relations between two physical systems (e.g., the observer and observed); third, an epistemology of perspectival objectivity—that is, a weak objectivity where facts (about a physical system) are related to the perspective of a relating system.

Barzegar and Oriti's study contains a great deal of theological potential, I suggest. In particular, their analysis of the "weak realism" in the so-called "antirealist" quantum interpretations shares the same kind of metaphysical commitment as that which arises from the giftedness of creation, namely, a participatory commitment. Quantum interpretation, of course, looks to relationality on the physical level alone, while the giftedness theme is theological. But since the giftedness theme concerns all creatures and all of creation, it embraces all manifestations of participation, including the physical. Barzegar and Oriti's epistemic–pragmatist framework for quantum interpretations

therefore chimes with the participatory metaphysics that arises from theological treatments of giftedness and relationality. The ordinary working scientist with Christian beliefs can take encouragement in her own professional embrace of a working instrumentalism (for the present) with a vague but aspirational quantum realism (for what is to come), seeing the combination as falling within the context of a theological account of participatory realism that reflects the giftedness of creation, and, ultimately, the innermost being of the Trinitarian God. This may not be a vision of reality that chimes with the harder kind of realism pursued by many (especially philosophers) who work in the quantum foundations area; nevertheless, it is a faithful and faith-enriching Christian vision that informs the scientist's vocational "warrant" using the tools and assumptions of scientific method, many of which, as I pointed out in my second-order answer, are tacitly theistic anyway.

There is also a possible avenue here for further theological work. Theology provides many reasons to take relationality and participation seriously, offering a sophisticated view of reality that might enrich the quantum participatory view. Of course, theologians have long invoked particular quantum themes—indeterminism, complementarity, and entanglement—as metaphors to explore divine mysteries, but they have done little in reverse mode, using theology to shed light on the quantum science. Hence, not only may theologians find that Barzegar and Oriti's participatory quantum metaphysics provides a new set of quantum themes to apply to divine mysteries, but those theologians may also be able to shed theological light on the metaphysics itself.

My third-order answer to my guiding question then is an enthusiastic "yes," especially if it looks as though theologians are able to provide support for the working hunches of physicists and guide them into the richer metaphysical implications of their scientific work. Quantum science is a gift, I suggest, and if we take Wigner's words to heart, it is a miracle too. As physicists, we do not know why it works, but perhaps theology can help.

Conclusions

I have addressed my guiding question of "does science need theology?" in three ways, with increasingly complex answers. Throughout, I have been concerned to expose the theistic roots of modern science, roots that are by no means obsolete (at least for the scientist who herself has theistic beliefs), but that come to the surface in certain areas of fundamental physics. In my third-order answer, I have tried to go further in order to support the subtle metaphysical hunches displayed by working physicists towards their quantum science. As I have explained, ordinary working scientists in mainstream physics take a distinctively cautious view to quantum interpretation, which is surprising given the enthusiasm shown in the quantum foundations field for strong quantum realism. I have provided theological reasons to support the stance of ordinary

working physicists, especially those physicists who, like me, see their science as a manifestation of their religious faith. My point is that if the scientist affirms the quantum world as creation—and if she also maintains that the quantum is truly fundamental—then the quantum comes to her as gift, which implies that a degree of grateful and trusting realism should be exercised instead of untestable metaphysical speculation beyond what our best empirical science can establish. Such a realism provides "theological warrant" for the vague but aspirational quantum realism of many working scientists who are also theists, allowing them to take their "duty toward God" seriously (to echo Torrance) by prioritizing empirical research over metaphysical distraction. This cautious restraint, I suggest, is the scientist's most effective professional and faithful response to the gift of creation. In the words of the main title of this article, I want to support theistic quantum fundamentalists in not looking a gift horse in the mouth.

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Notes

[1] For further reading, Joshua M. Moritz (2017) provides a comprehensive survey of many of the ways in which the foundational assumptions of scientific method can be shown to derive from Judeo–Christian theism.

[2] It is sufficient merely to register the titles of some of the book-length critiques of modern theoretical physics to see that what is at issue here concerns the very nature of science: *The Trouble with Physics: The Rise of String Theory, The Fall of a Science and What Comes Next* (Smolin 2008); *Higher Speculations: Grand Theories and Failed Revolutions in Physics and Cosmology* (Kragh 2011); *Fashion, Faith, and Fantasy in the New Physics of the Universe* (Penrose 2016); *Lost in Math: How Beauty Leads Physics Astray* (Hossenfelder 2018); *The Dream Universe: How Fundamental Physics Lost Its Way* (Lindley 2020).

[3] Excellent accounts of the quantum interpretations—and of the intricacies of the measurement problem more generally—can be found in a number of introductions; for instance, Travis Norsen (2017), Adam Becker (2018), and Jeffrey A. Barrett (2019).

[4] The reader will recall that the Copenhagen interpretation is usually categorised as an antirealist interpretation, since it emphasizes the observer's role in determining reality, or at least our inability to pronounce on the unobserved properties of the quantum state.

[5] A belief borne out by a recent survey of physicists as compared with philosophers, which found the former to tend towards belief in scientific realism, more so than the latter (Henne et al. 2024).

[6] David Deutsch (1997, 329) makes a similar observation about the "typical physicist," pointing out that we have given up on quantum interpretation and adopted a "pragmatic instrumentalism" instead. We use the phenomenal predictive power of QM as a "black box" in our everyday work, but we do not rely upon what its various interpretations tell us about the reality (or otherwise) of our quantum states.

[7] Note that Hasok Chang (2022) makes a similar distinction, pointing out that philosophy of physics has a tendency to promote an impossibly elevated form of scientific realism compared with that of scientific practitioners. His point is that philosophers often do not take account of how scientific practice informs the realism of an ordinary scientist. Chang himself endorses a form of pragmatism not unlike my account of the everyday quantum physicist's working instrumentalism coupled with a vague but aspirational quantum realism.

Competing Interests

The author declares that they have no competing interests.

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Why Does Scientific Culture Need Theological Engagement?

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This article argues that contemporary scientific culture stands to benefit socially, epistemically, and morally from thoughtful theological engagement. Rejecting both the conflict thesis and the exclusion of theology through strict methodological naturalism, I contend that silencing theological reflection risks alienating religious believers, undermining trust in scientific institutions, and weakening science's democratic and cultural foundations. Drawing on sociological research, I show how many Christians experience scientific culture as inhospitable, leading to epistemic injustice and reduced participation in scientific life. I then advance a theological argument for why Christians require theology to discern when theological claims are inappropriate within scientific enquiry, particularly in relation to appeals to special divine action. While ordinary scientific practice rarely requires theological input, I maintain that theology plays a crucial role in clarifying the boundaries of legitimate explanation, addressing moral questions raised by scientific advancement, and sustaining the cultural conditions under which science flourishes. Ultimately, the article proposes a theology-engaged science as a more inclusive and intellectually responsible alternative.

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Science does not unfold in a vacuum, detached from the rest of human life. It is carried out by people whose thinking is shaped by their broader beliefs, and it can only survive within communities that regard it as valuable. Were we to live in a society that universally despised science, it would not exist at all. Its very possibility depends on cultural attitudes that affirm its worth.

History reminds us that scientific practice has often been obstructed, distorted, or even discredited by those who misuse it, whether through destructive agendas or poor practice. This is especially evident in the early days of science, when it was dominated by men. So, one could easily construct a narrative about how men, as a group, have been bad for science. In a prejudiced world, such a narrative could easily take hold and be weaponized to justify excluding men altogether from scientific practice. Science would, of course, still endure, enriched by the contributions of brilliant women, yet it would likely be diminished as a result of being less competitive. Strictly speaking, science does not require men, and one might even be able to imagine certain benefits from their absence. However, excluding half the human population would inevitably weaken its vitality. If men have historically posed distinctive problems for the scientific enterprise, a more constructive response would not be exclusion but transformation: helping men to unlearn or resist any problematic tendencies. This is precisely the rationale behind equality, diversity, and inclusion training in workplaces, which aims to confront entrenched patterns of behavior, often linked to particular identities, in order to cultivate healthier, more inclusive practices moving forward.

We find a comparable situation in relation to Christians in the scientific world. Because specific Christian theological views have, at times, hindered scientific progress, there is an enduring perception of conflict between science and Christianity.[1] While this has not led to the exclusion of Christians from the sciences, it has led to a silencing of theological reflection. To guard against religious interference, science is often coupled with approaches like methodological naturalism, which rules out theological consideration entirely. While intended to protect scientific progress, this exclusion signals to religious believers that their deepest convictions must be checked at the door, leading them to "practice a *closeted faith*" (Ecklund 2010, 6).

I contend that a better alternative to banning theology entirely is to help Christians discern which specific theological tendencies obstruct scientific work, so they can learn why they should be resisted. Theological engagement can help Christians discern which theological commitments genuinely support scientific enquiry and which risk distorting it. Rather than simply declaring "science says no" to theology, it is more constructive to recognize that theology, when engaged well, can actively enrich a Christian's scientific vocation by clarifying its foundations, shaping its moral parameters, and enabling Christians to participate in science with integrity and confidence. At the same time, such engagement

helps Christians recognize why certain theological appeals are inappropriate within scientific contexts. In short, the abuse of theology should not take away its use (*abusus non tollit usum*).

Theological engagement offers many advantages for the sciences. First, it can challenge the popular conflict narrative by demonstrating that science does not need to distance itself from theology in order to thrive. Second, theology can help Christians delineate the boundaries between their theological beliefs and scientific practice. Unlike purely secular approaches to science, theology can clarify these parameters by defining the inherent limits of both scientific enquiry and theological reflection. This, in turn, minimizes the risk of confusion or improper overlap. Third, theology can encourage Christians to see their scientific work as an expression of a broader vocation, easing any internal tension that can come from compartmentalizing between science and faith. Fourth, theology can help justify certain assumptions on which scientists rely but cannot prove without theological (or perhaps philosophical) grounding, such as the intelligibility of the natural world. Finally, theological engagement invites reflection on the moral parameters that should guide scientific research. When science invests in studies that are morally compromised or foster moral decay, its legitimacy is undermined.

In this article, I elaborate on these reasons why scientific culture stands to benefit from theological engagement. I begin by laying out the social context in which science and Christianity interact, showing how scientific practice depends not only on methods and evidence but also on the social trust, participation, and support of the communities in which it is embedded. In societies where many people interpret the world through a theological lens, theology can help make the scientific world more hospitable to Christians and other religious believers. It can do this by offering interpretive frameworks that allow them to understand scientific enquiry in ways that resonate with their faith. This kind of engagement has real social value: it encourages Christians to be more open to, supportive of, and actively involved in scientific work, thereby strengthening the social environment in which science thrives.

Having offered a sociological motivation for my argument, I then turn to make a more explicitly theological argument. That is, I contend that theology is needed to help Christians discern when and why particular theological beliefs should not be brought into scientific investigation. By clarifying the boundaries between ordinary scientific explanations and appeals to special divine action, theology can prevent forms of religious reasoning that risk impeding scientific progress—especially those approaches that invoke God prematurely to account for unexplained phenomena. A theological account of why such appeals are generally (though not always) inappropriate within scientific contexts enables Christians to affirm the integrity of science's methods without adopting

philosophical frameworks, such as atheistic naturalism, that conflict with their faith. In this way, the article argues that theology both strengthens the social conditions under which science flourishes and clarifies the epistemic conditions under which Christians can engage in science in a faithful and responsible manner.

While this article focuses specifically on a Christian form of theology-engaged science, some of its insights may hold broader relevance.[2] Readers from other religious or philosophical traditions may recognize how similar approaches might be developed in relation to their own worldviews. They may also see that, rather than isolating science from other dimensions of life, there is profound value in integrating scientific enquiry with the intellectual and existential frameworks that give coherence and meaning to human life. This is because scientific enquiry is never wholly free from values, perspectives, or social influences. No scientist is the embodiment of a purely objective science. Rather, science is carried out by individuals and communities whose judgments are shaped (whether consciously or not) by (a)religious and philosophical commitments.[3] Acknowledging this reality is crucial for cultivating a more honest, inclusive, global, and intellectually responsible scientific culture.

The Social Context in Which Science and Christianity Relate

The relationship between science and Christianity extends far beyond debates about the facts, theories, and methods of science and theology. Understanding this relationship also requires a recognition that science is deeply embedded in the social contexts that shape how communities, institutions, and individuals interpret and engage with scientific work. It exists within a web of cultural expectations, educational systems, funding structures, and moral narratives—all marked by underlying (a)religious and philosophical commitments. So, when science becomes disengaged or entirely detached from theology, it risks losing not only its metaphysical footing but also the investment of religious communities who may come to view the culture surrounding science as alien, or even antagonistic, to their deepest convictions.

One of the leading scholars to explore this sociological terrain is Elaine Howard Ecklund.[4] Her book, *Religion vs. Science: What Religious People Really Think*, coauthored with Christopher Scheitle, surveys over 10,000 Americans on this topic. Their research found that most religious respondents have no problem with science itself. Instead, they interpret science through cognitive frameworks shaped by their beliefs about God's activity in the world and the world's relationship to God. These frameworks represent a form of faith-based reasoning rooted in a desire to see scientific inquiry find genuine harmony with their religious worldview. So, any tension these religious believers experience with the scientific world stems not from science itself, as they understand it, but from what they perceive as a scientific culture that privileges secular materialism, dismisses divine purpose, and belittles belief in a personal God who acts

in history—a God who sometimes acts in ways that go beyond naturalistic expectations. As one "very religious" biology major told Scheitle, pursuing graduate study in biology "would be like feeding myself to the sharks," which captures just how hostile the culture of the scientific world can seem to devout believers (Ecklund and Scheitle 2018, 2).

Such perceptions of hostility are corroborated by Ecklund's earlier research, which shows that religious scientists often anticipate (or experience) negative reactions to their beliefs. Therefore, as noted in the introduction, many "practice a *closeted faith*" (Ecklund 2010, 6; see also 47, 154; Ecklund and Scheitle 2018, 67; Ecklund et al. 2019, 71, 204).[5] Her findings reveal that a majority of "scientists believe that religion has no legitimate place in the modern American academy; 54 per cent mentioned the dangers that religion could bring to universities (in particular, to science) when it goes wrong" (Ecklund 2010, 92, 128–29). The resulting pressure on religious scientists to conceal their faith for fear of professional stigma sends an implicit message that scientific credibility requires silence about God. This dynamic fuels antagonism towards religion and contributes, in particular, to an underrepresentation of "evangelicals among scientists at top research universities when compared to the proportion of evangelicals in the general population" (Ecklund and Scheitle 2018, 34). In turn, this imbalance reinforces the perception that science is inherently secular,[6] deepening distrust between scientists and devout believers, who feel expected to keep their faith private in professional settings.[7]

A related concern among Christians centers on the moral trajectory of science when it becomes detached from theological reflection. When a theological moral framework is excluded from scientific discourse, science can appear to develop within a culture of technical brilliance that lacks adequate ethical constraints. Ecklund highlights this point by summarizing a historian of the modern university, Julie Reuben, who argues that:

> efforts to create a scientific objectivity that was value neutral ultimately failed, leading instead to a complete separation of facts and values. This means that fields like science, considered completely based on fact, are separated from more humanistic fields such as English and history. Scientists are left, then, with little vocabulary for thinking about the moral implications of science or what kind of public translation of science works well. (Ecklund 2010, 89, summarizing Reuben 1996)

Ecklund and Scheitle's surveys show that while most religious believers recognize science's capacity to improve human life, some worry that "unfettered scientific advancement" can lead to an "ethical slippery slope," with people trying to play God (Ecklund and Scheitle 2018, 22–24; referencing Evans 2002). Many Christians believe scientists need to grapple with the moral questions

raised by human embryonic stem cell research, which involves the destruction of fertilized embryos. This research, they note, "forces religious individuals to weigh the sanctity of human life against their responsibility to alleviate suffering" (Ecklund and Scheitle 2018, 9). Similar concerns arise in debates over reproductive genetics, cloning, transhumanism, and abortion (Ecklund 2010, 8). These reactions are not antiscientific; they are theological responses to a scientific culture that can treat moral boundaries as impediments to progress. Wherever Christians stand on these issues, there is, at least, a widespread recognition that morally ambiguous research requires theological reflection, and that such reflection should be integrated into scientific enquiry rather than cordoned off from it.

Another social area where science can benefit from theological engagement is vaccine hesitancy. Muhammad Haaris Tiwana and Julia Smith's recent review shows how religious meaning and scientific culture intersect to shape public health attitudes. They note that "when religion is uniformly regarded as the sole determinant of vaccine hesitancy, it consistently emerges as a significant factor in contributing to vaccine hesitancy" (Tiwana and Smith 2024, 7). Among some conservative Christians, for example, vaccine resistance stems not from ignorance but from theological reasoning, especially the belief that health outcomes ultimately lie in God's hands. One study's participant put it this way: "I know for sure that God cares for me. And that the things He sends me, that may also be disease, that He will help me cope with it" (Tiwana and Smith 2024, 5, citing Ruijs et al. 2012, 1–11). This perspective reflects a theology of health care that can sit uneasily alongside the technocratic assumptions underlying many public health campaigns. Tiwana and Smith (2024, 7) stress that one's religion "serves as a major unifying force in the lives of billions" and that "neglecting this connection or isolating science and religion as entirely distinct realms could hinder our ability to comprehend and influence people's sentiments regarding scientific matters."

Yet Tiwana and Smith also offer a more nuanced account. When religiosity is analyzed alongside other social factors—such as education, income, gender, race or ethnicity, and age—it appears to lose its independent statistical significance. Vaccine hesitancy, they observe, tends to emerge from intersecting forms of marginalization, including economic insecurity, racial inequality, political polarization, and distrust in institutions. Even so, faith remains a key interpretive lens through which many communities make sense of their skepticism toward health advice. Consequently, faith can lock believers into their hesitancy by giving them theological reasons for it. This is precisely why vaccine hesitancy cannot be addressed through sociological analysis or public health messaging alone. Since many believers understand their skepticism through theological categories, any attempt to persuade them must also engage those categories from within their own framework. One study, for example, found that some religious

communities viewed the government's messaging on vaccines to be disparaging, complaining that officials "put an ill connotation" on their decisions (Tiwana and Smith 2024, 5, referencing Capurro et al. 2022, 7280–87). Such perceptions of condescension can themselves become stumbling blocks for religious believers, deepening their estrangement from public health authorities. For Tiwana and Smith, these findings highlight the need for theologically sensitive engagement that treats religion not as an obstacle to scientific progress but as a persistent social force that shapes public interactions with medical science.

Another recurring area of tension concerns miracles and divine action. As Ecklund and Scheitle (2018*,* 6) observe, the way many religious believers "view science and the natural world is influenced by their desire to maintain an active role for God." Ecklund and Scheitle (2018*,* 6) found that 60 per cent of evangelicals agreed that "scientists should be open to considering miracles in their theories and explanations." As one respondent put it, "Once you posit an omniscient God, then I don't have any trouble with miracles" (Ecklund and Scheitle 2018*,* 6). Such statements show how disorienting it can be when scientific culture treats miracles, which are at the core of the Christian faith, as intellectually suspect or irrelevant.

What these sociological studies illustrate overall is that the social circumstances in which science and faith relate are shaped by competing worldviews. Addressing this tension requires more than better scientific communication. It requires us to create genuine space for theology-engaged science—space that enables the scientific domain to become a safe(r) place in which religious believers can interpret scientific enquiry in ways that remain faithful to their core beliefs. Such engagement, when done well, can also show nonreligious believers that faith need not impede scientific research, even if we still need to recognize that confusion about science and faith can sometimes generate real conflict. Only then, as Ecklund and Scheitle (2018, 139) put it, can science and faith move beyond myths and stereotypes to a dialogical relationship grounded in a shared humility and purpose.

Although the "conflict thesis"—that science and religion are fundamentally at odds—has been widely dismissed by academic theologians and philosophers of science, it remains a felt reality for many Christians and other religious believers. The gap between academic consensus and popular perception reflects not simply intellectual misunderstanding but social and moral alienation. As Helen De Cruz (2024, 170) observes, drawing on the work of John Evans, many believers experience science not as a neutral search for truth but as a community with its own "moral agenda that runs counter to Christian conservative values." For such Christians, the perceived conflict lies not with scientific findings themselves but in the cultural ethos that often accompanies them.

When scientific institutions become culturally inhospitable to religious believers, they foster distrust and weaken science's standing in democratic

societies where religion plays a prominent role. Addressing these fractures requires us to consider how epistemic norms, cultural expectations, and identity-shaping narratives contribute to the impression that science and Christianity conflict. It is to these epistemic divisions, and how they might be repaired, that I now turn.

Addressing Epistemic Divisions between the Cultures of Science and Christianity

Based on their analysis of these social circumstances, De Cruz views the alienation that some Christians, especially evangelical Christians, experience towards scientific culture as a matter of epistemic injustice. Building on Lani Watson's (2021) account of epistemic rights, De Cruz (2024, 171) argues that evangelical Christians are not merely underrepresented in science but wronged in their capacity as knowers. When distrust of scientists and exclusion from mainstream scientific discourse prevent religious believers (as religious believers) from participating in or benefiting from collective inquiry, their epistemic rights (their rights to form true beliefs, avoid false ones, and understand the world) are compromised. De Cruz stresses that this tension between evangelical and scientific culture is not simply a matter of individual ignorance but of systemic failure: political polarization and media caricatures have created an epistemic environment in which many evangelicals no longer recognize scientists as benevolent or trustworthy interlocutors. The resulting suspicion becomes self-reinforcing, diminishing both the scientific literacy of evangelicals and their confidence in expert communities.

Such exclusion, De Cruz (2024, 171, citing Dewey 1927) insists, ultimately harms science itself. When large segments of society feel estranged from scientific culture, the pursuit of science loses some of its democratic character. Science cannot function as a genuinely collective enterprise if it systematically marginalizes certain religious communities. Instead, it risks becoming an intellectual tribe. At times, scientific culture becomes shaped by tendencies within elite Western institutions that are determined to keep religion out, even as a different kind of religiosity, scientism, can subtly creep into the culture surrounding science.[8] Under these circumstances, tensions between science and Christianity arise less from clashes between their respective truth claims (although this still matters) and more from social questions of trust, identity, and belonging. Again, many Christians feel uneasy about science not because they reject its findings but because they are wary of the naturalistic worldview often associated with them—a worldview that, in their eyes, overlooks or dismisses their belief that God makes a fundamental difference to how we understand the empirical world.

A common way of responding to this tension is to claim that, while science operates with a methodological naturalism, scientists are not required to embrace

a metaphysical naturalism. So, outside the scientific workplace, scientists are entirely free to hold a theistic worldview. I explore the problems with this approach in more detail elsewhere (Torrance 2017, 2018). Briefly, however, one of the major difficulties with this approach is the impression it can create that scientific practice requires believers to resist or bracket out a theistic worldview. For Christians who view science as a pursuit of truth, this can seem deeply troubling. If scientific culture demands that Christians suspend what they believe to be fundamentally true about the world, it is hardly surprising that it would contribute to the kind of social tension we have been considering. A further concern is that methodological naturalism can be interpreted as removing God's meaningful engagement with the world from the empirical domain, thereby conflicting with Christian beliefs about God's intervention, particularly in the case of miracles. While I can understand the motivation behind methodological naturalism—namely, to prevent theological claims from obstructing scientific progress—I maintain that a theology-engaged approach to science offers a more constructive way forward.

Later in this article, I provide an example of how this approach can be applied in practice, particularly when addressing the question of miracles. I will show that a theology-engaged approach can help Christians see how their theological convictions can shape the parameters of scientific enquiry. In so doing, it can address many of the concerns that motivate methodological naturalism, while also allowing Christians to reimagine science in ways that align with their fundamental commitments. The result could be a scientific culture that is more hospitable to believers and more genuinely inclusive in its pursuit of understanding.

There is fertile ground for this kind of approach. Ecklund and Scheitle's (2018, 7) research shows that 48 per cent of evangelicals, and an even higher 73 per cent of evangelical scientists, view science and religion as potentially collaborative rather than competitive.[9] They contend that the core challenge is less about reconciling different ways of understanding and more about cultivating spaces of mutual trust. Religious leaders, they suggest, can play a vital mediating role. Since many Christians turn first to pastors, rather than scientists, when faced with scientific questions, equipping clergy with an accurate scientific understanding, accompanied by a theological grasp of it, can reshape how congregations perceive and engage with science. When pastors affirm that studying the natural world can be a form of worship, they can help believers see scientific curiosity not as a threat to faith but an expression of it (Ecklund and Scheitle 2018, 10).

De Cruz also provides support for this kind of strategy. They argue that repairing tensions between scientists and Christians requires confronting not only misinformation but the deeper fractures of trust that underlie it. Through education, outreach, and the involvement of "benevolent testifiers (e.g., people

who self-identify as Evangelical Christians, and who are supportive of science)," De Cruz (2024, 171) reframes the conflict not as an inevitable clash between faith and science, but as a remediable injustice within the social ecology of knowledge. For De Cruz, healing this divide requires a humanizing of the conversation; it involves restoring moral and intellectual trust between religious and scientific communities that have become estranged by mutual caricature.

I would add that a key element of the social approach proposed by Ecklund, Scheitle, and De Cruz is not only the training of faith leaders to develop a deeper scientific understanding but also the encouragement of scientists, and those interested in science, to become theologically engaged. Up to this point, I have focused on why scientific culture stands to benefit socially from such theological engagement. Shortly, I shall offer a more explicit theological reason why science, in rare cases, may even require theology for the sake of explanatory completeness. Before doing so, however, let me offer an initial caveat.

The Scope and Limits of Theological Engagement in Science

If we were to survey the highly specialized work undertaken in science today, we would be unlikely to find many instances where a particular scientific investigation is directly hindered by a lack of explicit theological engagement. Most scientific work proceeds successfully without it. If theology poses a practical problem for science, it is less likely to be through its absence than through its improper presence, that is, when implicit theological assumptions are smuggled into scientific reasoning. This can happen in subtle ways: shaping what counts as evidence, what counts as a legitimate research subject, or which scientific goals are worth pursuing. Careful theological reflection can help identify and critically examine such assumptions before they distort scientific inquiry.

Yet the broader question remains: Does science as a whole need theology? To make a case that it does, I must identify at least one instance in which theology is not merely relevant but necessary for explaining a phenomenon that finds itself within the domain of scientific research. By pointing to certain miracles that are essential to Christian orthodoxy, I contend that there is more than one.

By considering such cases, I aim to show that science—understood broadly as the pursuit of an accurate understanding of empirical reality—sometimes depends on theological insight to offer a complete explanation. At the same time, I acknowledge that such dependence arises only in relation to exceptional, miraculous events. Routine scientific practice is exceedingly unlikely to require theological input, and introducing it, in most cases, would be entirely inappropriate.

Nevertheless, reflecting on why science needs theology can help ease social tensions by giving Christians a constructive way to understand how science can operate without asking them to set aside their faith. It can also clarify how theology can support scientific progress by explaining why Christians should

not treat the possibility of miracles as a reason to halt scientific investigation by invoking divine action prematurely—for example, by endorsing a "god-of-the-gaps" approach.

What I shall now argue is that one of theology's primary contributions lies not in directing scientists how to conduct their research but in helping Christians understand why contemporary scientists should not employ theological explanations in the context of ordinary scientific work.

Miracles and the Observable Phenomena That Accompany Them

There are numerous references to miracles throughout Christian scripture. A Christian may reasonably adopt a critical stance toward some miracle accounts without departing from Nicene orthodoxy. For example, one could remain firmly in line with Christian orthodoxy, grounded in the beliefs of the Nicene Creed, while regarding the parting of the Red Sea (Exodus 14), Balaam's talking donkey (Numbers 22:28–30), or the resurrection of the saints at Jesus's death (Matthew 27:52–53) as mythical symbols that never actually happened without abandoning the faith. While it is certainly possible that these events occurred, and they would be a cakewalk for the creator of heaven and earth, doubting their literal historicity need not undermine one's Christian faith.

Yet some miracles are not so easily set aside by Christians. Belief in God's creation of all (non-divine) things, the incarnation (by the Holy Spirit and of the Virgin Mary), the resurrection, and Jesus's ascension are all miracles foundational to Christian orthodoxy, as affirmed in the Nicene Creed. These events are especially significant for our purposes because they are associated with observable phenomena that invite scientific as well as theological reflection. Any theory that either dismisses such phenomena as errors without serious investigation or assumes that a non-theological account must be exhaustive in principle risks overlooking important dimensions of what is being examined. This is not to suggest that non-theological inquiry into such phenomena is wholly inappropriate; such inquiry may prove illuminating in some respects. Rather, the point is that, in these particular cases, a fully adequate account cannot ignore the theological claims that are constitutive of the phenomena themselves. If science is genuinely committed to truth-seeking, it should remain open to engaging forms of explanation that may be necessary for a fuller understanding of the realities under investigation.

The Christian belief in miracles points to a wider horizon of phenomenological understanding, within which certain historical events are interpreted as exceeding purely naturalistic description. The occurrence of miracles that stand at the heart of Christian orthodoxy suggests that theology can, at least in certain cases, meaningfully contribute to explaining observable phenomena. When such events occur within the empirical world, scientific enquiry stands to benefit from

theological input to make sense of them. A theological account can show that these phenomena are utterly unique and should therefore be treated differently from phenomena that conform to the regular patterns of the natural order. Nonetheless, reaching such a conclusion still requires theological insight.

Negotiating Some Risks That Come with Allowing for Theological Explanation

But there is a real danger here. Recognizing that God sometimes acts in uniquely miraculous ways, which should shape how we interpret certain observable events, may tempt some Christians to attribute divine intervention too quickly to other phenomena that remain unexplained.

For instance, a Christian psychologist might feel drawn to employ natural theology to explore the concept of human consciousness as a divine miracle. Given their belief that God occasionally intervenes in surprising ways, it might seem plausible to theorize that consciousness could be the result of special divine action. They might theorize, for example, that at a formative stage in human development, God intervened to implant a "seed" of consciousness.

Were this to happen, the Christian would be engaging in a form of natural theology that, I contend, has no place in the scientific world—a form of reasoning akin to that found in intelligent design or god-of-the-gaps arguments. The approach is flawed because it treats consciousness, a continuing natural phenomenon, the same way it treats singular historical events like the incarnation or resurrection. While Christian orthodoxy affirms these specific historical miracles as unique acts of God, it allows for the possibility that consciousness arises through natural processes. By carelessly invoking special divine action, without solid theological justification, the Christian researcher risks impeding a proper scientific and theological understanding of consciousness.[10]

But let me be clear here. In highlighting the problems with such an approach, I am not denying that theology has an important role to play in helping Christian scientists make sense of consciousness. Secular scientific reasoning, by its very nature, cannot adequately explain why a Christian should refrain from invoking special divine action to account for consciousness. From a Christian perspective, dismissing theological insights simply because science is "secular" or "naturalistic" by definition would seem arbitrary—at least without offering a further rationale. Such a dismissal could simply be seen to reflect the secular world's blindness to God, and, in particular, God's living engagement with creation. Moreover, such secular constraints may seem especially unwarranted to Christians, since a purely secular approach is less capable than a theology-engaged one of accounting for all observable phenomena—including those associated with the incarnation, resurrection, and ascension.

Theological reasoning, therefore, is needed to clarify why the occurrence of uniquely miraculous events does not entitle scientists to appeal to special divine

action whenever they encounter phenomena that remain, for the time being, unexplained. By thinking theologically, a Christian scientist can distinguish between occasional miraculous phenomena central to Christian orthodoxy, which rightly call for a special theological explanation, and other mysterious phenomena that do not. The latter, while puzzling, cannot be identified as uniquely miraculous solely on the basis of natural theology. Why? It is because natural theology lacks the criteria to discern particular instances of divine action with reliability.

In sum, science, as an endeavor undertaken by scientists, needs theology to help clarify for Christians why references to special divine action are generally inappropriate in the scientific realm, even though Christians know that certain observable phenomena do require such reference.

Conclusion

This article began with a simple but easily overlooked point: there is no science without scientists, and scientists can never operate as purely objective scientific instruments. Scientific enquiry is always carried out by humans who are shaped by broader commitments, and it can only flourish in communities that recognize its worth. In societies where many people interpret the world through a theological lens, it is shortsighted for scientific culture to become antagonistic toward religion in the way that it has done, either implicitly or explicitly. Such hostility risks discouraging believers from entering scientific fields, thereby weakening the competitiveness and diversity of the scientific workforce. It also risks alienating communities whose moral, financial, and intellectual support has been and continues to be vital for sustaining scientific institutions. A scientific culture that treats theological reflection with suspicion risks diminishing the very social ecosystem on which science depends.

This is why I have argued that science needs a thoughtful and well-defined form of theological engagement. My point is not that scientific research requires constant theological input in every experiment and research program; it does not. Most scientific work proceeds perfectly well without it. Nonetheless, as a human enterprise, science stands to benefit when the wider culture of science engages seriously and respectfully with the theological convictions that shape the lives of many people across the world.

On a sociological level, theological engagement helps address the epistemic tensions that some Christians experience when they perceive scientific culture as implicitly secular, morally indifferent, or dismissive of belief in God who acts in history. By creating intellectual space for Christians to interpret scientific research in harmony with their faith, theology can make the scientific world more hospitable, more inclusive, and ultimately more robust.

Theologically speaking, such engagement also helps Christians understand why their faith supports, rather than threatens, the integrity of scientific

practice. Theology can clarify why certain theological appeals—especially appeals to special divine action—are inappropriate in ordinary scientific contexts, while still affirming that some utterly unique events (i.e., creation, incarnation, resurrection, and ascension) will require theological explanation. In doing so, it addresses, at least in outline, each of the five advantages identified at the outset: it challenges the conflict narrative by presenting theology and science as mutually hospitable; it clarifies the boundaries between theological and scientific explanation; it frames scientific work as a genuine expression of Christian vocation; it provides theological grounding for assumptions—such as the intelligibility and orderliness of the world—that science presupposes but cannot itself justify; and it brings moral seriousness to bear on a scientific culture that can otherwise lack the resources to evaluate its own ethical trajectory. Theology, therefore, protects science both from an overly restrictive naturalism that refuses to consider God at all and an overconfident natural theology that inserts God into empirical gaps without sufficient justification.

In short, science needs theology because science needs scientists—real people, embedded in communities, shaped by convictions about what the world ultimately is and why it is worth understanding. When scientific culture acknowledges this and enters into meaningful dialogue with theology, it can better flourish as a human pursuit: one that seeks truth with intellectual humility, moral seriousness, global reach, and a more democratic vision of the world in which many find that faith and scientific inquiry belong together.

Notes

[1] The two episodes perhaps most commonly invoked in support of the "conflict thesis" are the Roman Catholic condemnation of Copernican heliocentrism in the early seventeenth century and Christian resistance to Darwinian evolutionary theory following the publication of *On the Origin of Species* (1859). Both episodes, however, are historically more complex than popular "science versus religion" narratives often suggest. In the Galileo affair, the dispute involved not only doctrinal concerns but also ecclesiastical politics, institutional authority, and Galileo's own polemical style. Moreover, several Catholic clergy and theologians were sympathetic to Copernicanism (see Hedley Brooke 1991, 82–116; Fantoli 1994). Likewise, Christian responses to Darwinian evolution were never monolithic: many theologians and clergy accommodated evolutionary theory relatively quickly, while sustained resistance emerged primarily within particular theological traditions, especially those committed to biblical literalism (see Numbers 2006; Bowler 2001).

[2] A reviewer helpfully raised the question of whether the proposal advanced here is more properly associated with a "theology of science" than "theology-engaged science." As Joanna Leidenhag explains in her entry on "Science-Engaged Theology" in the *St Andrews Encyclopaedia of Theology*, theology of science and theology-engaged science are related but distinct enterprises. A theology of science involves second-order theological reflection upon the sciences themselves and their methods, assumptions, practices, and implicit metaphysical commitments. Theology-engaged science, by contrast, concerns scientific enquiry undertaken in explicit dialogue with, and sometimes shaped by, theological commitments (Leidenhag 2024, section 4.1–4.2; citing Harris 2024). The reviewer is correct that this article operates primarily at the level of a theology of science. However, the theological account of science developed here is intended to support a theology-engaged science by helping Christian scientists approach their work with greater theological awareness and integration. Whether "theology-engaged science" should refer only to the scientist's own practice, or also to the wider theological work that helps make such practice possible, remains an open question, though the distinction is still a helpful one.

[3] For example, Angela Potochnik (2017, 46) argues that science does not aim at a perfectly accurate representation of reality but at understanding achieved through models and idealizations that often distort in order to illuminate. Such judgments about relevance and explanatory power inevitably draw on broader cultural and philosophical commitments. Thinkers such as Michael Polanyi (1962) and Thomas Kuhn (1962) further remind us that science is not a purely objective accumulation of facts but a practice shaped by paradigms, tacit commitments, and judgments of plausibility.

[4] For a more global perspective, see Ecklund et al. (2019).

[5] The systemic pressure to conceal one's religious identity highlights a stark institutional double standard within contemporary higher education. In the United Kingdom, for instance, "religion or belief" is legally codified as a protected characteristic on equal footing with eight others, including age, disability, race, sex, and sexual orientation (Equality Act 2010, ss. 4, 10). While an institutional culture that implicitly pressured individuals to conceal an identity tied to any of these other characteristics would prompt immediate scrutiny and be recognized as a failure of an organization's duty of care, the pressure on religious scientists to suppress their faith is frequently met with indifference. It is this selective application of equality, diversity, and inclusion principles that makes this problem not merely a matter of personal discomfort but a structural failure by the academy to apply its own professed standards of inclusion to religious believers.

[6] Ecklund et al. (2019, 46; see also 81) note that, for United States scientists, "[s]cience is considered a secular institution, and to maintain its authority and power, religion can be derogated and religious expression suppressed—and religious scientists who deviate from these norms can be stigmatized."

[7] "A culture of professionalism is another factor that motivates separation between science and religion among US religious scientists" (Ecklund et al. 2019, 38).

[8] As a religion, scientism can be understood as a set of claims and commitments according to which the methods of the natural sciences are elevated into a comprehensive metaphysical

doctrine: namely, that only what can be directly observed, measured, or quantified is truly real. By assuming a closed, exclusively quantifiable picture of reality, scientism rules out in advance any forms of understanding that lie beyond its methodological reach. In so doing, it treats empirical measurability as the ultimate standard of epistemic legitimacy. From this perspective, science no longer functions merely as a powerful investigative tool but is instead positioned as an ultimate explanatory authority, claiming the ability to settle questions of meaning, value, and purpose. In this way, the empirical method takes on a (quasi-)religious role by providing an overarching account of reality, a normative framework for knowledge, and an existential orientation that displaces any appeal to a transcendent source of meaning.

[9] Although "[o]nly 12 percent of scientists in the United States believe science and religion can be used to help support each other" (Ecklund et al. 2019, 36).

[10] Such reference to divine action would function as a "science stopper." See Alvin Plantinga's (1996, 177–222) response to concern about such science stoppers.

Competing Interests

The author declares that they have no competing interests.

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Modern Science Thrives with the Right Theology

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If "science" is the distributed efforts and structuring ideas of scientists, then science needs theology to sustain its long-term health and vitality. Science needs theology to ground its epistemology, motivate and guide its use, inspire the interpersonal virtues that will ensure its health, and motivate the investment of resources in it. Theology may also play a critical role in the application of science in technologies and interventions, which fuels investment in the sciences. Nonetheless, not all theology is equally supportive of science, with some theology holding potential to undermine scientific inquiry. What is critical is a theology that includes elements supporting methodological providentialism and science stewardship. It does not follow that all scientists must have or value theological commitments to be able contributors to scientific inquiry. How prominent theology must be in scientists or in science-supporting publics are open, empirical questions.

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Does science need theology? Such a big question requires the usual and rhetorically unfortunate offer of some clarifying definitions before giving a (hopefully) persuasive answer. My view is that under some fairly common definitions of science, theology, and need, the answer is yes.

My focus is specifically on modern science as it grew from natural philosophy in the sixteenth and seventeenth centuries into the sort of thing that English speakers commonly mean by "science" today. I do not intend my argument to apply to any and all careful studies of the natural world that have appeared throughout history and around the globe. I also do not mean science in the broader sense of general academic inquiry.

"Science" is also inseparable from what it is people known as scientists do. It is characterized by the distributed efforts of scientists, including the institutions and artifacts that support and structure their work. Science also includes the ideas that a critical mass of scientists in any given domain regard as having positive epistemic status. These ideas may include commitments about research methods, theories, and frameworks, and various claims regarding empirical findings. What matters here is that these ideas are only part of "science" by virtue of being represented and affirmed as good-to-hold by a number of individuals who are engaged in scientific inquiry. My use of the term science for this argument, then, emphasizes shared beliefs and practices sustained across a community.

By "theology," I mean the reflective, intellectual study of the sacred or divine and how all things relate to divinity, including their nature, purpose, and flourishing. Humans count among "all things." And so, theology is intellectual thought about the nature of God (or gods), humans, and commendable values, attitudes, thoughts, relations, and behaviors—lives lived well.

By "need," I have in mind something short of logical entailment or even strict causal necessity. "Need" is that which makes for a good, strong, and enduring version of something, in this case, science. This sense of need is like plants needing soil. As hydroponic gardeners know, it is possible to grow plants without soil, but then you need to artificially and carefully add nutrients. In soil, plants just grow. But even with soil, plants still need the soil to be of the right sort or plants will not grow or not grow well. A plant needing soil is not a logical relationship but a functional and teleological relationship.[1]

With these thumbnail definitions in place, in what follows, I argue that modern science needs grounding, motivating, and guiding commitments that come from outside of science proper in order to thrive. To thrive means growing toward a thing's best version or purpose (Barrett and King 2021). To ask whether science needs something or other amounts to asking whether that something is needed for some community of scientists to do what it is they do or to hold the ideas they hold relevant to those efforts. Science needs theology in the sense that theology, of the right sort, will help scientists to persist doing their inquiry in a productive, rightly aimed manner. A theology

of the right sort may be the most satisfactory source for these commitments, even if some non-theological philosophical commitments may do similar work. Science needs theology to ground its truth-seeking efforts, motivate and guide its use, inspire the interpersonal virtues that will ensure its health, and motivate the investment of resources in it. Theology may also play a critical role in the application of science in technologies and interventions, which fuels investment in the sciences. Nonetheless, not all theology is equally supportive of science, with some theology holding potential to undermine scientific inquiry. Science may be able to get by with some substitutes for the nutritional properties of a suitable theology, and not just any theology will do, but science will find its most ready and reliable home in an appropriate theology.

Theologies that support the sciences well must generate two clusters of commitments or values. First, methodological providentialism involves viewing the world as generally stable across time and place, law-like, knowable to people who are part of creation not above it, and good to know about in particular ways because a divine creator and sustainer (or similar agents) makes it so. The possibility that a divine creator and sustainer has made the world and humans with such properties may encourage inquiry toward divinely endowed aims. This last aspect of methodological providentialism suggests the second cluster of commitments. Science stewardship is a set of values and virtues concerning why and how to invest in the sciences, including how to treat scientific colleagues and publics.

It does not follow that scientists must have or value theological commitments to be able contributors to scientific inquiry. Rather, this argument suggests some open empirical questions. What degree of reflective adherence to methodological providentialism and science stewardship is needed in a population of scientists or a public that supports science (or not)? To what extent does the health of science require that this adherence occurs within worldviews that cohere well with these?

Science Does Not Come Easily

As philosophers of science are quick to point out, defining what is meant by (modern) science is not simple or without controversy. Yet, whatever it is, it is something done by scientists working in interaction with each other. That is, people do it—individually and collectively—and not just any people but people trained and (usually) paid to do it. This banal observation is connected to another one: whatever modern science is, it did not exist prior to several hundred years ago, even if some features of modern science have appeared in many times and places. To refer to, say, Aristotelian study of the natural world as science in the sense that we use the word now is anachronistic (Harrison 2015). The careful study of nature has always been with us, but the particular way in which modern scientists go about trying to understand the features

and dynamics of the natural world through quantification, controlled studies, peer-review of findings, and publicly available reporting of those findings is a historically recent development.

Furthermore, science is relatively expensive. As the philosopher of science Robert McCauley (2011, 275) observes:

> Science is expensive. Sustaining worldwide communities of teams of scientific researchers and all of the institutional arrangements necessary for disseminating information and for policing malfeasance requires dedication, honesty, and lots of hard work by lots of highly educated people. These things do not come cheaply. And this tally does not include the resources it takes to produce suitable conditions for experimentation.

McCauley makes these points for a similar reason that I raise them here. Doing science, sustaining it, and its very existence as part of culture are not easy givens. Even focusing on a single child's personal and professional development, becoming a scientist takes a degree of talent, lots of motivation and hard work, and lots of social and institutional support. Becoming a scientist and then doing it is no one's path of least resistance.

Because science does not come easily for individuals or societies, special support or scaffolding is needed. These needs were historically met by certain theological commitments and remain conducive to well-aimed and healthy scientific inquiry. More specifically, scientists need intellectual support, motivational support, and directional support. These three kinds of support interact.

Intellectual Support

What I am calling intellectual support comes in many varieties. How we understand and experience our own reasoning abilities and how we conceptualize aspects of the world around us must be understood in particular ways in order for scientific work to merit the cognitive and material expense of it.

Cognitive Unnaturalness of Science

As McCauley explains at length, practicing science is far from doing what ordinary human minds are inclined to do on their own. Some ways of thinking are easier than others because they suit the kinds of minds humans have. We make assumptions about how the world is, the properties of physical objects, the nature of living things, and how each other think and feel in large part because certain ways of thinking are how our minds usually do what they do. These conceptual tendencies may have arisen because they were adaptive for our ancestors.

Further, we appear to have a host of domain-general reasoning biases and heuristics that help us solve problems pretty well most of the time. Nonetheless, these reasoning abilities also have some weaknesses. Some of these weaknesses are so pervasive that we take them for granted. For instance, none of us match the mathematical computational fluency of a 1980 Texas Instruments pocket calculator, even if that machine pales in comparison to the processing power of our brains in so many other domains. As statistics and research methods instructors are painfully aware, we also are pretty shoddy at paying sufficient attention to base-rate probabilities or attending to disconfirming cases. Similarly, introductory logic teachers may resonate with McCauley's (2011, 55) observation:

> In dozens of previous studies of a familiar reasoning problem in the psychological literature (namely, the Wason selection task) experimenters had found that people generally do not do well in carrying out some basic logical inferences when they involve statements about conditions between propositions.

Doing science requires being able to surmount these natural limitations as well as knowing when and how to override or improve upon our reasoning biases and heuristics.

The discoveries of the sciences also commonly run counter to our more domain-specific ways of understanding physical objects, living things, and human minds. For instance, the ideas that solid physical objects are mostly space or that there are no clear and fixed boundaries between species of animals appear to run counter to naive physics and naive biology, respectively (e.g., Sperber, Premack, and Premack 1996, pts. II and IV). This counterintuitiveness of many scientific claims, and the need to effortfully override reasoning biases and heuristics, means that doing science is rarely or never characterized by the fluency, automaticity, and ease of cognitively natural activities such as using language or recognizing faces.

What McCauley has called the relative cognitive "unnaturalness" of science entails a need for extra cultural support for scientists to do what they do. In contrast to, for instance, gossip or engaging in play, modern science does not simply emerge in essentially any cultural environment by virtue of people with ordinary biological and psychological endowments doing what they ordinarily do together. To do science, we need special instructional efforts, institutions, and artifacts.

How to Seek Knowledge of the Natural World

Recognition of basic cognitive limitations implies that we need effortful correctives to improve our conceptual fidelity. If I cannot simply rely on my intuitions and straightforward perceptions of the world around me, what should

I do to improve? Scientific approaches to the study of the natural world appear to be impressive improvements over reliance only on folk wisdom, testimony, personal experience, intuition, and careful observation. Something extra has been added to our toolkit for learning and discovering. More accurately, a number of somethings have been added to our toolkit.

Commonly, teachers of science research methods and philosophers of science point to numerous features of modern science as useful for drawing stronger inferences: experimental methods; careful or controlled observation, counting, quantification, and mathematical modeling; generating and testing falsifiable predictions; specification of data collection and analysis methods so that others may inspect them; replicability; representative or random sampling; and a host of other techniques and considerations. Scientists also share with other scholarly pursuits general ways of seeking knowledge such as intuition, application of deductive and inductive logic, personal experience, and the testimony of others. But the "add-ons" that characterize modern science were very rare in the study of the natural world that preceded its emergence, and remain rare outside the sciences.

Does science need some kind of theology to ground the use of these intellectual techniques? In a logical sense, perhaps not. But functionally, perhaps so. Historical and philosophical analyses gesture toward an affirmative answer. Approaching the topic historically, Peter Harrison (2021, 1) writes regarding "the scientific revolution" of the sixteenth and seventeenth centuries in Europe that though "it must be acknowledged that there was science (or something like it) well before this and in places other than Europe," what we want to explain is how different commitments, motivations, and techniques for learning about the natural world congealed as they did to make something importantly different. "So, it is important to establish at the outset what, if anything, was distinctive about the scientific culture that arose in early modern Europe" (Harrison 2021, 1).

Instead of merely providing and explaining a list of characteristic features of modern science, Harrison (2021, 2) identifies a smaller number of features of this new natural philosophy that arose, at least in part, due to Christian theological considerations in Europe in the early modern era: "[T]hree features of modern science—laws of nature, mathematical and mechanical models, and experimental method—are indebted to religious considerations [i.e., theology]." Harrison (2021, 2) argues that a critical intellectual shift that gave rise to modern science was away from the Aristotelian notion "that nature was ordered according to the intrinsic properties of natural things" and toward "the idea that nature was governed by laws imposed upon it by God." Pioneered by the likes of René Descartes and Robert Boyle, this move arose from theological considerations. "The specific theological impulse for this shift was a renewed emphasis, most conspicuous in the theology of the Protestant reformers, on the sovereignty of God and the primacy of the divine will" (Harrison 2021, 2–3).

Regarding the use of mathematics, there was a shift from thinking of mathematical models as useful fictions to tracking reality. "Advocates of the new mathematical astronomy . . . argued that God had stamped mathematical relations onto the natural order and that these mathematical relations were not simply human constructions" (Harrison 2021, 3). Consistent with its law-likeness, "nature was increasingly thought of as analogous to a machine, rather than as self-organised and goal-directed living thing" (Harrison 2021, 4). After all, "a direct implication of the Christian doctrine of creation was that the world, in an important sense, was an artificial creation"; that is, "God made the world, and therefore it was analogous to an artifact" (Harrison 2021, 4).

Even more important to the basic epistemological assumptions of modern science was a shift away from the Aristotelian notion that humans are "rational animals" that can more or less reliably perceive and comprehend the world. The trend was toward a greater pessimism concerning human will and intellect, a pessimism arising from the Reformation emphasis on the "fallen condition of human minds and senses, and because the world itself had deteriorated since its original creation" (Harrison 2021, 4). The sinful condition of humans and a fallen creation more resistant to detecting God's law-like order and purposes required something new:

> What was now called for were repeated sets of painstaking observations, conducted under experimental conditions. As for fallen human senses, these now had to be augmented through the use of artificial instruments such as the telescope and microscope. Whereas in the past scientific knowledge could be attained by the wise few, now it was understood the call for the labours of many individuals carried out over long periods of time. Science would necessarily be corporate and cumulative. (Harrison 2021, 5)

As McCauley (2011, 139) observes, this socially distributed dimension of science remains one of its critical features for overcoming the individual conceptual and motivational errors that often are a product of cognitively natural dispositions:

> Nonetheless, however poor scientists may prove to be as critics of their own views and of views that they favor, the history of science supplies compelling testimony about their abilities as critics of other scientist' views and views that they oppose. Scientists may suffer from an all-too-human penchant to confirm the proposals they prefer, but they suffer from no such failing when it comes to assessing competing positions.

Harrison's historical analysis is complemented by Alvin Plantinga's (2011) philosophical one. Plantinga too offers a list of ways in which Christian theology provides intellectual support for doing modern science. In many cases, he

suggests that theology, especially Christian theology, provides better intellectual scaffolding for doing science than a naturalist worldview. The topics he includes in his analysis are an intellect that fits the world, induction and learning from experience, the reliability and regularity of the world, the law-likeness and constancy of the world, the astounding efficacy of mathematics to track what appear to be deep truths about how the world really is, and the contingency of the natural world. A review of all of these topics would exceed the scope of this article. I raise them primarily to demonstrate that, together with Harrison's historical analysis, theological considerations may provide strong intellectual support for doing modern science. That is, it would be assuring for scientists and their supporters if the scientific enterprise seemed to be based upon good enough intellectual grounds. Coming from theology, such assurances go part of the way towards overcoming the expense and unnaturalness of science.

Objection. It appears that a particular cluster of theological commitments helped give rise to and may continue to provide substantial intellectual support for modern scientific inquiry. Do such theological commitments remain valuable, let alone needed, for contemporary scientists, scientific institutions, and their efforts? Even if these various positions are consistent with theological claims and arose out of theological reflections, it does not follow that theological foundations are needed to hold these assumptions about how the world is, how human minds work, and how knowledge is formed about the natural world as a consequence. Even more strongly, it may be that, similar to how early modern thought supplanted more Aristotelian medieval thought, leading to an improvement in how to learn about the natural world, scientific efforts were further improved by divorcing the metaphysical grounds of modern science from their theological foundations.

Response. If it remains true that thought about one or more gods is broadly natural for humans living in communities, as many cognitive and evolutionary scientists of religion have argued, (e.g., see Boyer 2001; McCauley 2011), and if the existence of gods and similar "ultimate concerns" are deeply motivating for individuals and their communities, as psychologists of religion have argued (e.g., Emmons 1999), then theological reflections are likely to remain important resources to fortify the intellectual grounds for investing in and doing science. Though many contemporary scientists may not see a need to locate their intellectual foundations about human minds and the world within a theological framework, it does not follow that theological sources are not continuing to form the cultural backdrop that make confidence in the sciences seem more intuitive than it may actually be.

My central thesis is not that science needs one particular theology, such as that held by the pioneers in the sixteenth and seventeenth centuries. It may be that other theological perspectives and commitments serve to intellectually support scientific inquiry as well or even better. What Harrison's analysis

suggests is that if the theological moorings change substantially enough (e.g., from an Aristotelian-inflected theology to a more Reformed theology), the resulting systematic study of nature changes from one sort of thing to another. Premodern science changed, over time, into what we now recognize as science. If the theological or philosophical moorings change substantially enough again, we may have something different still. I have no position regarding whether postmodern "science" or post-scientific exploration of the natural world needs theology. More importantly, it is not clear whether such repositioning—such as adopting methodological naturalism—actually constitutes an improvement in learning about the natural world (Harris 2026). We cannot know with certainty, because the sciences have continued their work in societies importantly shaped by theologically derived values and populated by people holding theological commitments.[2]

Nonetheless, Plantinga plausibly argues that many of the foundational assumptions of contemporary science do not merely find their historical roots in theology but are more coherent when situated within certain theologies. For instance, concerning the fit between the world and our cognitive faculties, Plantinga (2011, 269–70) observes (with the help of the pioneering cognitive scientist and linguist Noam Chomsky):

> [T]here is a match between our cognitive or intellectual faculties and reality, thought of as including whatever exists, a match that enables us to know something, indeed a great deal, about the world—and also about ourselves and God himself. According to Noam Chomsky, "This partial congruence between the truth about the world and what the human science-forming capacity produced at a given moment yields science. Notice that it is just blind luck if the human science-forming capacity, a particular component of the human biological endowment, happens to yield a result that conforms more or less to the truth about the world." From the point of view of theistic religion, this is not blind luck. It is only to be expected.

Plantinga (and Chomsky, it seems) take for granted a sort of intelligibility regarding the natural world when it comes to science. That is, we may take for granted that the world exists independently of our thoughts about it, and yet, out thoughts can grasp, however imperfectly, truths about that reality. Plantinga can locate this intelligibility in a creation theology.[3] Chomsky can only regard it as a happy accident. It seems plausible that a creation theology is a more secure support for science than counting on blind luck.

Though coherence is not strictly necessary from a psychological perspective, blatant incoherence in an intellectual domain is unlikely to be helpful. Plantinga argues that many of the foundational assumptions of modern science sit as or more comfortably in some kind of theistic framework than others. Perhaps

most famously, he argues that one particular assumption—that human reason of the sort that generates scientific theories is generally truth aimed—is not just coherent with theism but inconsistent with naturalism when combined with contemporary evolutionary theory. He argues that naturalism coupled with human evolution by natural selection does not yield confidence that our reasoning faculties can be trusted to be largely truth aimed. To simplify the argument, without some notion of a creator God who brought about humans with truth-aimed reasoning faculties, natural selection provides no solid grounds for thinking that our reasoning faculties are truth aimed, only fitness enhancing. After all, natural selection is blind to conceptual states; it only cares about adaptive behaviors. Even if we grant the contentious claim that conscious, reflective conceptual states are causally potent, plenty of evidence exists for a decoupling of truth-aimed mental states—particularly, higher-order reasoning—and adaptive behaviors. For instance, reasoning could be tuned to avoid catastrophic behavioral mistakes instead, known as "error management," which may include tuning toward false, but not maladaptive, beliefs (McKay and Dennett 2009). Or it may have evolved primarily to persuade others and generate consensus (Mercier and Sperber 2017). Even if the naturalist can construct a compelling argument that in order for reflective reasoning about mundane aspects of life to be evolutionarily adaptive, it must be at least somewhat truth aimed, it does not follow that the abstracted reasoning of philosophers and scientists need be adaptive. Indeed, McCauley's point about the cognitive unnaturalness of science is that it supplants or improves upon cognitive systems that, apparently, lead us to less trustworthy belief states because those cognitive mechanisms were designed by natural selection for other purposes. Consequently, under natural selection without God, we have little reason to trust our abstract, scientific reasoning, including our reasoning that led to a belief in natural selection (Barrett 2018, 162–64).

Objection. Even setting aside Plantinga's particular argument regarding evolution and our reasoning faculty, suppose that Plantinga is correct, following Alfred North Whitehead, that "[f]or science to be successful, the world must display a high degree of regularity and predictability" (Plantinga 2011, 271) and, "[f]urthermore, science requires more than regularity: it also requires our implicitly *believing* or *assuming* that the world is regular in this way" (Plantinga 271–72). Could it be that this assumption, and many others Plantinga points to as critical for doing science, are ordinary tacit assumptions that people make as part of just being humans? If so, it may seem that we do not need theology to provide us with these assumptions. It could be that as long as scientists do not too critically question their science-supporting assumptions or find inconsistencies or tensions with their broader belief and value systems, all is well.

Indeed, the sciences could ride the momentum of their intellectual ancestry for as long as certain assumptions and values remain part of the cultural fabric that produces scientists and supports scientific enterprises. If these viewpoints

are part of ordinary human cognition—independent of the reflections of philosophers and theologians—all the better. Some of the foundational assumptions Plantinga points to seem to be of this sort. We need reasons to think the world is not real, cannot really be grasped (at least to some extent) by human reason, and is unreliable or irregular rather than reasons to think these things. Even if, strictly speaking, such positions would benefit from a broader metaphysical framework in which they are nurtured, practically speaking, scientists can just keep doing what they do.

Response. Or can they? The truth of the matter is likely to be complex. Some of these assumptions will be safe when not explicitly challenged (e.g., that there is a real world we can at least begin to understand), but others may not be part of "natural" cognition at all. They may seem natural but are instead the product of a certain modern enculturation that itself is historically peculiar and open to change. For instance, the idea that the mathematical patterns derived from experiments in one time and place safely generalize because of the stability and predictability of the world is almost certainly the sort of thing that needs to be taught or acquired through enculturation. These have not been universally held perspectives, nor easily derived from common interactions with the world.

It may be natural and intuitive to think that yesterday, today, and tomorrow are similar to each other and that what is true about how things go in my neighborhood is also true on the other side of the village, but these uniformity, stability, and predictability assumptions may fail to apply beyond very local extensions. Why not assume that the world is basically chaotic and changing with islands of stability instead of the other way around? Stories about how things used to be (but are not now), unpredictable calamities, chaos in weather, wild variation in the success of hunts or harvests, and the oddities of distant peoples are the ordinary stuff of human existence and evidence that we do not simply take broad uniformity for granted. It is easy to be impressed with the variability, unpredictability, and seemingly chaotic nature of the behavior of humans, animals, weather systems, and ecological dynamics. Outside temporally, physically, and culturally local environments, uniformity is not at all obvious. We seek to find uniformity in natural patterns hidden behind apparent complexity, change, and chaos when motivated and tutored to do so. The idea that a divine being providentially holds back the chaos or has created the cosmos with deep regularities that may be hard to see may be fruitful support.

In this vein, McCauley's point about modern science is that even though it does make use of some natural cognitive inclinations, as a whole, it is radically unnatural and characterized by counterintuitive ways of thinking. Its operating assumptions require at least periodic refreshment from thinkers who are trying to preserve and fortify its strengths and are committed to its wellbeing. Learning to be a scientist requires special training, including reflections upon why scientists do what they do and think how they think. If this training has shaky intellectual grounds, it will be less persuasive and more subject to competition from non- or anti-scientific

pursuits. It is not hard to find thoughtful, educated people in universities around the world who are far from impressed with modern science, in part because they reject many of the assumptions that seem necessary to its character.

Methodological Naturalism and Methodological Providentialism

Though not an essential feature of modern science, one McCauley (2011) identifies as pushing modern science in the direction of being cognitively "unnatural" is a growing resistance against explanations that appeal to design, purpose, and especially intentions of minded agents. From early in childhood, people readily make sense of the world around them through appeals to the aims, desires, perceptions, beliefs, and actions of intentional beings, including humans, many animals, and gods (Barrett 2012). Resisting such intuitive explanatory strategies requires motivation and diligence. In contemporary sciences, this effort is fortified by the doctrine of methodological naturalism (MN).

Plantinga, following Bas van Fraassen, identifies three features of MN. First, the scope or model of the data to be explained relevant to scientific inquiry will not include supernatural agents (including God) "or employ what one knows or thinks one knows by way of revelation" (Plantinga 2011, 172). Second, an explanatory scientific theory should "not to include reference to God or any other supernatural agents . . . and the theory, like the data set, also can't employ what one knows or things one knows by way of revelation" (Plantinga 2011, 172). Third, the evidence base that can be drawn upon to decide whether a theory or explanation is plausible "will not contain propositions obviously entailing the existence of God (or other supernatural beings); nor will it include propositions one knows or thinks one knows by way of revelation" (Plantinga 2011, 173). Plantinga goes on to note that there are stronger and weaker forms of MN. The weaker form is simply silent about supernatural entities; the stronger form includes the denial of their existence for the sake of the scientific enterprise.

In the broad sense that I have been using the term "theology" here, MN amounts to a theological position. To guide scientific inquiry, MN must specify what constitutes the natural and distinguish that from the non- or supernatural. If I do not have a theory about the supernatural, I cannot identify when and where it is causally potent and relevant for a particular question. This theorizing is theological in that it concerns the supernatural, divinity, and the like in relation to the rest of the world. In practice, MN amounts to the proposition that our understanding of the world is best done by presuming that, for the sake of generating sufficient explanations, the activity of God or other divinities or supernatural beings and forces are causally irrelevant. They do not generate relevant data, nor help account (enough) for patterns observed. If theology includes how all things—including their nature, purpose, and flourishing—relate to divinity, then the claim that divinity is explanatorily irrelevant to the nature,

purpose, and flourishing of the material stuff of this world is a theological claim. Similarly, judging that God or gods exists or not or that they are causally inert or irrelevant are (a)theological judgments.[4]

As much as many contemporary scientists might recoil at founders of modern science finding intellectual support in theology, what we now call the "scientists" of the sixteenth through early nineteenth centuries would probably find MN shocking and superfluous (or worse). But this tension can be resolved if we recognize the considerable overlap between the constituent features of the earlier theological viewpoints and the contemporary atheological ones. For lack of a better term, I call the deliverance of the earlier theological commitments methodological providentialism (MP), and it includes the following elements:

- The world exists independent of human minds and is contingent and so must be explored empirically.
- It is law-like and so relatively constant, reliable, regular, and predictable in its deep, nonobvious structures and causal dynamics.
- Importantly, exceptional supernatural action (by God or other agents) will not fundamentally occlude these regularities and so does not play a prominent role in describing how the natural world typically works, or the proximate causes of events.
- The typical operations of the world are describable mathematically with accuracy (not merely useful models).
- Humans have a truth-aimed intellect that fits the world, which enables induction and learning from experience.
- But human intellectual powers are limited and distorted by ignoble aims, which requires special socially distributed practices and mechanisms for reducing or managing these limitations and distortions, through which we can remain optimistic in improving our understanding the world.

Importantly, this cluster of assumptions is largely shared by practicing scientists today, at least tacitly, not just by those pioneering natural philosophers who laid the foundations for modern science. And yet, these assumptions are far from universally affirmed by thinkers and scholars historically or even across universities around the world today.

These assumptions do, however, find a cozy home in Christian and neighboring theologies that include some key components: a creating and sustaining deity who freely created and ordered the world with law-like regularity, predictability, and deep, stable structures, has given humans truth-aimed conceptual systems but the freedom to become corrupted and mis-aimed in our thought, and exercises enough sovereignty over the created world that neither humans nor other intentional beings and forces (natural or otherwise) can fundamentally

change these regularities. To sum, what is required is an assumption of divine providence: that God freely gives and constantly preserves a stable, orderly creation and gives humans the gift to accurately—even if in limited ways—grasp truths about that creation.

From a Christian perspective, the very reason we can explore the natural world as if it is regular, law-like, and predictable is because God causes those regularities to persist through God's providence. As the Heidelberg Catechism answers question 27:

> Providence is the almighty and ever present power of God by which he upholds, as with his hand, heaven and earth and all creatures, and so rules them that leaf and blade, rain and drought, fruitful and lean years, food and drink, health and sickness, prosperity and poverty—all things, in fact, come to us not by chance but from his fatherly hand.

God is not in the business of changing creation willy nilly or arbitrarily, or tinkering here and there in irregular and unusual ways without good reason. This is God's world, not a world governed by lesser deities monkeying with nature and making datasets largely unpredictable. These theological commitments mean that we need not constantly appeal to new divine action or the work of spirits and lesser gods to account for features and processes of the natural world. Nature seems to have its own independent dignity precisely because God constantly gifts nature with that dignity. So, what looks like MN to an atheist or agnostic looks like MP to a theist who believes in such a creator God.

It just so happens that the theistic notion of divine providence in these ways maps onto the "blind luck" (to quote Chomsky) of MN. In many topical spaces in which one was already unlikely to regard supernatural beings (including God) as part of the data to be explained, as relevant proximal causal agents, or as part of the immediately relevant database, whether one adopts MN or MP will yield very similar results. If, for instance, I want to examine how de-icing salt on roads impacts macroinvertebrate diversity downstream from bridges, I am not investigating the presence of spirits or angels and am unlikely to invoke their activity in explaining findings; whether or not they exist is not part of the relevant evidence base that might make my explanations more or less plausible. I am likely to stick to an explanation that involves how the chemical properties of road salt change rivers' chemical properties, which may lead to changes in the habitat suitability, fertility, and fecundity of the macroinvertebrates that live in those rivers and streams. The situation is not unlike a scientist who fully believes in dark matter but has no need to bring it into their current study of macroinvertebrate diversity. Such a scientist may be practicing methodological a-dark-matterism.

Though grounded in a high view of God's providence, MP could be adopted by a non-theist, much like how supernaturalists adopt MN even if they reject metaphysical naturalism. It is methodological too for theists who think that God

and God's agents (or demonic powers) do occasionally act in special ways in the created world. For the sake of typical scientific inquiry, unusual intervention by spiritual beings is demoted in explanatory priority.

MP is not just comparable to MN, it is better. First, it is more flexible. Like MN, MP expects nature to be causally regular, without arbitrary and capricious monkeying by supernatural beings, but MP leaves open the possibility of special divine action in theologically understandable cases. Methodologically, both MN and MP would treat unusual causal events as initially just noise in the data, but MP would have motivation to track this "noise" and not ignore it. For instance, miraculous healings are reported all over the world. MN requires that they be ignored or even discarded as part of scientific practice, leading to an impoverished dataset or (unfair?) claims about the reliability or honesty of the sources of these reports. MP can accept that they are possibly genuine miracles without having to discard ordinary natural causal pathways.

Second, MP is more coherent than MN in relation to background assumptions concerning our ability to form true beliefs about the natural world. As Plantinga argues, naturalism gives very little reason to expect that our science-relevant reasoning is truth aimed. So, if the sciences are an epistemology, and MN is an assumption of that epistemology, this epistemology has an assumption that actually weakens our confidence in its success, particularly the farther we explore questions not plausibly related to human fitness (Barrett 2018). If we have no strong reason to think human reflective thought—the kind of thing scientists do—is part of our make up in order to give us true beliefs, then why put so much confidence in it? Under MP, we have no such worries. MP claims that our minds are created and sustained by a creator God who has equipped us to seek and grasp truths, even if imperfectly.

A third virtue of MP over MN is that it creates space for sciences of minds and other features of creation that are difficult to classify in terms of being natural versus non- or supernatural. In his critique of restricted MN, Joshua Lee Harris (2026) describes how MN has struggled with an intelligibility problem in that no consistent, principled, and satisfactory way of demarcating the natural from supernatural is has emerged. What is "natural" may turn into nothing more than a crude heuristic concerning those things that are nonphysical, hard to pin down ontologically, or just a bit spooky by contemporary standards of a given era. So, for instance, the behavioristic rejection of mental states as a legitimate area of psychological science in the early twentieth century arose in part because it seemed to fit better with MN:

> To venture a historical generalization, we might say that behaviorism was behaviorism *just to the extent* that it was naturalistic in spirit—with increasingly austere positivity and eventually Quinean banishments of the "non-physical" (often a euphemism for the super-natural) from the explanatory domain entirely. (Harris 2026, 33)

That is, in this case at least, a certain variation of MN proved to be too restrictive, rejecting mental states as legitimate areas of scientific inquiry. In primarily drawing an ontological line between God and Creation instead of ambiguously between "nature" versus all else, MP is more open to investigating created-but-not-physical entities such as percepts, thoughts, emotions, and consciousness.

MP also has resources for de-centering the sciences from selfish human aims that MN does not possess. If one approaches the sciences with the provisional operating assumption that the world is productively investigable because of some kind of divine providence, then one may be more likely to receive the potential of the sciences with gratitude instead of proprietary entitlement. Assuming some kind of divine benefactor, I may wonder for what purposes that benefactor has gifted humans, among the creatures, the ability to discern deep patterns and law-like regularities with some fidelity. Perhaps it is for divine aims and not merely for technological achievements or to satisfy human curiosity. I turn to these considerations more directly in the sections that follow.

To sum, because doing modern science is cognitively unnatural, it requires special conditions for its pursuit. In addition to using careful quantification and research instruments as cognitive and perceptual prosthetics for individuals, science is also socially distributed and regulated: the cognitive shortcomings of individuals are partially remediated through these social mechanisms (i.e., public reporting, data sharing, insistence on replicability, peer review, etc.). Special research methods such as experimentation or use of statistical control improve the ability for scientists to draw reasonable inferences from their observations. This whole complex of activities, however, requires a certain amount of intellectual support to maintain investments of individuals and institutions. Originally, this intellectual support came from theology. The key bundle of theologically derived assumptions may be called MP, but they are more flexible and expansive than today's MN, though they closely parallel.

Even if one is unpersuaded regarding MP's ability to intellectually support the sciences and prefers MN, MN itself bears many of the marks of a theological position. It generates normative claims about how one should or should not go about participating in a highly influential and authoritative form of intellectual inquiry that demands massive amounts of public support in terms of educational institutions and financial investment, and these claims are derived from attempts to specify what is or is not supernatural and whether their properties or activities are of the sort that they should be included as relevant to the public exercise of this form of intellectual inquiry we call the sciences. Such considerations are claimed by philosophers, but they are simultaneously theological. Theology of one sort or another then has played a key role in providing intellectual support for scientists and the scientific enterprise more broadly.

Much more briefly, I turn to two more forms of support that theology gives in keeping science healthy and productive: motivational support and directional

support. I regard these as perhaps more important than the intellectual support already discussed.

Motivational and Directional Support

People will likely keep singing and playing games with each other and innovating ways to prepare food without any special cultural support, funding, or educational systems. People drawn to these activities will rarely feel the need to pause and wonder, "Why am I doing this? Is it worth the effort?" They will simply engage in these activities. Doing science is not like this.

Even if I have intellectual support to do scientific work, I may still lack motivation to engage in activity that requires so much attention, effort, and learning. A curious child may be drawn to investigating the natural world, and delight in these explorations, but modern science is more than curious and careful exploration. The (cognitive) unnaturalness of science means that doing science is hard, even if it may bring enjoyment. The unnaturalness of science and the surprising and sometimes counterintuitive quality of its results not only stretches the minds of practitioners but also those of the publics the sciences rely upon for material support. Consequently, motivational impetus for both scientists and publics needs to come from somewhere to keep the scientific enterprise going. Theology may—and often does—supply this impetus.

Again, from an historical perspective, Harrison (2021, 5) observes:

> It is tempting to think that the high regard in which the natural sciences are typically held is owing to their obvious explanatory power and utility. However, neither of these features was conspicuous in the seventeenth century when the successes of science were limited and when utility and practical usefulness were not as highly valued as they are now. It was common to encounter the criticism that experimental sciences were useless and, further, that the practical goals at which they aimed were undignified and unworthy. Faced with these criticisms, advocates of the new scientific approaches appealed to religious considerations to establish the social legitimacy of science.

One such "religious consideration" for doing this new sort of natural philosophy was the idea that such careful study of the natural world is spiritually edifying (Harrison 2015, 2021). Such study, it was thought, detects divine design, thereby illuminating the intentions, power, and providence of God. Scientific discoveries, then, could (and do) motivate responses of awe, humility, and worship. As the geneticist Ruth Bancewicz (2018) artfully testifies:

> Science has the power to expand our horizons and helps us to see how great God is. The dazzling intelligibility of the world increases our humility, as we realize that because we ourselves are a fragile and finite part of the universe,

> we will never be able to fully grasp what we see in an objective intellectual way. Our response to what we see in the world is rational, emotional and active: worship as well as systematic theology.

Perhaps a motivation more resonant with contemporary culture is the utility of the sciences to solve problems facing humanity and the rest of the world. Though the pathway to theology is more indirect, here too we find motivational support from theology. Often scientists—perhaps especially those who are writing appeals to governmental or private funding bodies—claim their work will have a positive impact on various states of affairs such as curing disease, feeding more people more sustainably, or fortifying fragile ecosystems. Promoting general human wellbeing and flourishing is a common aim. But these notions of wellbeing and flourishing and motivations to care for other species and ecosystems come from some belief and value system outside of science proper. They cannot simply be taken for granted, particularly given the opportunity costs of the scientific efforts and potential moral tradeoffs. Who gets to decide that a particular scientific project really is for the greater good? Whose idea of good? Especially when considering general publics, the values commonly used to adjudicate such claims have their roots within religious worldviews and are articulated by theologies, even if these roots are not as readily recognized as in the past.

Christians may find theological motivations for doing science in its potential to help us love others and steward the natural world as we are called to by God (Barrett 2025). Other theological traditions may emphasize different theological motivations for doing the sciences, but few are without any such motivations (Cootsona 2023), and many of the motivations may converge. It is these motivations that must be appealed to in order to garner enthusiasm for tax revenue to be channeled toward scientific endeavors. Theology has a motivational role to play if science is to maintain strong support.

Whose Directions?

Motivating science by way of the goods it may (or may not) bring about introduces the fact that such motivations concern particular directions or aims for specific scientific enterprises. If you are motivated to cure disease because your worldview regards disease curing as an important good, such motivation will likely encourage enthusiasm for various biological sciences more than for astronomy, theoretical physics, or geology. Depending upon one's values, only some scientific endeavors may be regarded as worthy of investment.

Utilitarian approaches to the sciences will run into this trouble of particularities: not all areas of scientific research are plausibly worth investment because of the goods they may bring about. Many practical problems facing humanity or the world more generally could be more efficiently and effectively addressed using nonscientific means (e.g., trial and error, analogically reasoning

from neighboring problem spaces, local expertise, etc.). Furthermore, some scientific areas will have as much or more potential to bring about ills than goods, or the "goods" they bring about are narrowly aimed back to the scientists and technologists themselves. Pharmaceutical companies, military-industrial complexes, and tech-entertainment conglomerates may generate lots of scientific work for which the primary aims are very provincial "goods." Less dramatically, individual scientists, lacking a sound and salient theology, may be driven to conduct research aimed at self-promotion or professional security instead of some higher, sacred good.

Science needs motivational and directional support to keep it healthy. Specifically, it needs compelling reasons for individuals to go into the sciences, for societies to equip their children with the extensive prerequisite educations for going into the sciences, and for the public or wealthy citizens to financially support scientific institutions and activities. The needed motivation will also interact with the questions and problems the sciences are directed towards. None of these motivations or directions are intrinsic to what modern science is but must be derived from other values and commitments. Whence these values and commitments? From reflections on what we hold to be ultimate concerns, sacred principles, the nature of people, and the aims of lives worth living. In short, the values and commitments that will motivate and direct the sciences will come from theologies and theology-adjacent philosophical ruminations.

The trouble with pretending that science is autonomous of theological considerations is that scientists and scientific institutions will merely enshrine their own theologies—perhaps deifying "discovery," "progress," "knowledge for its own sake," or even "Science" itself—as ultimate goods that demand the allegiance of all who do science. Such sacralization may be tacit or effervesce passively (at first) from more localized efforts to curry popular favor and support. Nonetheless, it is not hard to see that the authority of science can be appealed to regarding not just its epistemological strengths but its particular aims. Resistance is bullied as "anti-science" and ignorant. The power of government is used to take resources from citizens to support "Science," whatever It decides to do, because its aims are unquestionably good.

Unchecked by broader considerations—theological and philosophical ones—scientists collectively risk producing their own science- and self-serving theology: whatever science does is good and worth public support, even borrowing against our children's futures. From such a viewpoint, all knowledge is good in and of itself, even if those who possess it lack the wisdom to steward it well. Surely this is not a rightly aimed condition for science.

Science Stewardship

To summarize the preceding reflections, I suggest that what modern science requires for its enduring thriving is a theological grounding I term science stewardship. Requisite components of science stewardship are to see the sciences

as good tools that must be cared for and employed to virtuous ends. They cannot be taken for granted or left to generate their own morals and purposes—a condition identifiable as scientism.[5] A Christian version of science stewardship would be to view modern science as a good gift from God that, like other cultural developments, needs to be cared for and deployed judiciously toward right ends. As God, in the Genesis account, commanded Adam and Eve to care for the garden (an artifact or cultural gift), science too is a cultural gift, a set of tools, for better understanding ourselves and the world around us. Used well, it enables us to better serve as God's representatives or stewards of God's creation, in part through better discerning God's wisdom in the world—its patterns and purposes—and in part by generating interventions and technologies that should be aimed at promoting God's purposes for the world as we best understand them.

This emphasis on God's purposes is consonant with MP. MP posits that our ability to successfully discern deep causal structures is due to some kind of divine providence. The world is not ours but God's, and our ability to successfully explore it is a gift. From that perspective, it is easy to wonder why God has gifted humans, among the rest of the creatures, in this way. Does God have purposes for our scientific enterprises that are not merely to satisfy human curiosity or desires? Theological motivations for doing the sciences may be particularly apt for refocusing scientific endeavors away from selfish and human-centered aims.

The health and goodness of scientific work also benefit from certain personal virtues of its practitioners. McCauley (2011, 275) observes that modern science "requires dedication, honesty, and lots of hard work." Additional virtues include "humility, open-mindedness, provisional trust of experts, an inclination to seek better evidence, recognition of personal blind spots, and a willingness to remedy these blind spots" (Barrett, 2025, 45). Within a theology that commends such virtues, as well as righteous ends, the sciences become powerful tools for good.

> Nonetheless, in actual practice, scientists and the scientific community, like any other culture, can fall victim to vices. Curiosity put to virtuous aims can slip into curiosity for self-gratification, prestige, or avoidance of responsible action . . . Much scientific work is driven by the hope of gaining power and control . . . As many sci-fi books and movies such as *Ex Machina* and *The Terminator* teach us, because the sciences have the potential to increase power, they should not be taken lightly. (Barrett, 2025, 45–46)

Part of not taking the sciences lightly is to insist that they are surrounded, supported, and guided by sound theology.

Concluding Thoughts

Though I argue science needs theology to thrive, not all theologies will do the job equally well. Further, my position leaves open a number of further

questions that will best be addressed with the assistance of empirical methods. If I am right that science needs particular theology, then it falls to theologians and theologically inclined scientists to provide science with adequate theological sustenance.

Not All Theologies Will Do

My argument is that doing the work of participating in and caring for the cultural complex we call "science" will not happen without sufficient intellectual and motivational support, and this support is best located in theology. But clearly not just any theology will do. The preceding analysis included historical observations of how the shift away from some aspects of medieval theologies to early modern and Reformation theologies sparked the scientific revolution. Similarly, my point in rehearsing what I see as the components of MP and science stewardship is to identify just which sorts of theological claims are supportive of scientific inquiry and institutions. Implicit in such an account is that not all theological positions are equally fertile soil for science. This was true in the sixteenth century and remains true today. For instance, a theology that suggests that realities of the world are largely inscrutable, or one that asserts that we each have our own individual, equally good "science" and idiosyncratic constructions of the world, would hardly drive its adherents to invest in the modern sciences as we know them.

Open Questions

As mentioned at the outset, science is a distributed enterprise undertaken by individual people sometimes working alone and often working collaboratively. As rhetorically efficient as it may be to discuss whether science needs theology in the abstract, ultimately, better questions would be more specific. They must concern the degree to which people doing or supporting the sciences in some sense need particular theological considerations to motivate, sustain, or inflect their efforts. Though I have argued that science needs theology, perhaps the more interesting questions remain open. These questions concern the degree to which theology is needed for individual scientists and the various communities of scientists.

It may be that we need some, but not a majority of, scientists to be motivated and instructed by theological commitments. The situation may be a bit like claiming that rock 'n' roll requires a drumbeat and therefore requires drummers. But not all or even a majority of rock 'n' roll musicians have to be drummers or even like the drummers in their bands. Science requires theology, but not all scientists have to do or even appreciate theological reflection. The distributed nature of the scientific enterprise means that, once instituted, it can keep running without reflection on its foundational commitments, at least for a while. (But how long?)

The analogy with music suggests a related question: Could it be that particular sciences are more in need of theological support than others? Drummers

are necessary for rock 'n' roll but not bluegrass or chamber music. Marching band music requires a prominent role for percussion. Perhaps some areas of the sciences are more or less dependent upon theological contributions, for instance, to keep their activities properly aimed, to fortify the waning support of the public, or to help scientists re-attend to necessary intellectual virtues.

So, even if science needs theology in the general sense I have presented here, it is reasonable to wonder: What proportion of scientists, and/or the general public from which those scientists draw support, needs to have the right sort of theological convictions, to what degree of salience, and in which particular spheres of the sciences? This complex of questions is surely one that will benefit from historical, philosophical, and even social–scientific analyses. These are, at least in part, empirical questions.

My argument also presumes that some degree of coherence between one's theological positions and the assumptions behind one's scientific efforts at least occasionally matter. That is, a theological or atheological foundation that does not cohere with how the sciences are done will lead to tension, demotivation, or distortion. It may be, however, that in the context of either doing or supporting the sciences, a fair amount of incoherence has little impact on the wellbeing of scientific enterprises. Perhaps I have overestimated the psychological harm of incoherence, or the degree of incoherence is what matters. For instance, even if MP is a stronger, more coherent foundation for doing science than MN, the relative weaknesses may not be especially harmful to the collective enterprise.[6] But there may still be a degree of incoherence that, if reached, will prove fatal to modern science. What is that degree?

A Challenge

A reasonable person may object that what I have argued for is that science needs philosophy. Especially when it comes to intellectual support, the commitments that underlie scientific efforts are the sorts of things philosophers of science talk about. I do not object to the claim that science needs philosophy. Adjudicating the boundaries of philosophy and theology is not my interest. Much like how the boundaries around "science" are the result of historical and cultural particularities, the purported boundaries around philosophy and theology are not fixed, nor tracking some immutable essences that govern these areas of inquiry.

For the Christian or Jewish theist, the love of wisdom (philosophy) springs from right understanding and relationship with God, a lived theology. "Fear of the Lord is the beginning of wisdom," after all (Proverbs 1, 2, 9; Psalms 111). There are certainly contemporary descriptive distinctions between what philosophers do and what theologians typically do. My point is that philosophers cannot claim undisputed sovereignty over the love and pursuit of

wisdom, understanding, and knowledge. Even today, the culturally constructed boundaries between theology and philosophy are porous. Moreover, given that the commitments I suggest are needed for the wellbeing of science concerns claims about divine/supernatural entities (e.g., whether or not they uphold or interfere with the causal dynamics of the world, where to draw the line between nature and super-nature) and the aims and values one holds preeminent or sacred, these strike me as very much theological concerns, even if they are also philosophical. For instance, Plantinga's reflections I have cited here are simultaneously Christian philosophy and theology.

Whether theologians have risen to the task of developing convincing and compelling treatments of the scientific enterprises is another matter. If I am right and science needs the right theology, then theological scholars who value the sciences need to develop and disseminate an adequate theology of science. As scientist-turned-theologian Alister McGrath (2022, 66–67) writes:

> To simplify a complex argument . . . science helps us understand how things work; theology helps us grasp what things mean. We need to hold these together, seeing them as integral elements of a "Big Picture" of reality. And that, in my view, is what theology helps us to do – to recapture the coherence and unity of our world, which is so easily lost, compromised or obscured by the rise of disciplinary specificity on the one hand, and reductionist approaches to nature on the other.

McGrath's picture of the relationship between theology and science is not one in which the scientific enterprise goes about its business, generating new findings, problems, theories, and technologies, and then theology integrates those findings into a "'Big Picture' of reality." To the degree that the scientific enterprise is part of the "Big Picture" itself—not merely its products but its people, relationships, institutions, sources of material support, and aims—it too is subject to theology. Just as theological reflections on the family, work, government, and the arts are legitimate and potentially valuable guides to the health of these aspects of human experience, so too is the theology of science for properly encouraging the thriving of science.

As much as theological scholars are needed to generate and communicate adequate theologies, these theological contributions will not penetrate the sciences as practiced passively. Those who work in the sciences must mindfully and judiciously bring their theology into their scientific work. But are we willing to consciously and conscientiously practice MP and science stewardship, or retreat to passive acceptance of MN and allow underexamined motives to direct the sciences?

Notes

[1] Importantly, because I am not addressing logical need but a functional one, what I am proposing is more a psychological and sociological reflection on doing the sciences than a philosophical treatment of "science" meant to demarcate what counts as science proper and what does not. I cannot tell that any consensus on such matters has been reached (Dicken 2018), and I certainly will not improve upon work in that regard here.

[2] Perhaps the strongest naturalistic experiment to test the relative efficacy of science-with-less-theology versus science-with-more-theology would be to compare the accomplishments of Soviet science versus Western science of the twentieth century. One might also compare Chinese versus American science of the twenty-first century. I doubt the results of such comparisons convincingly demonstrate that the theology-lite science of the Soviet Union or Communist China are superior, let alone superior because of their more complete distancing from theological foundations.

[3] It may be that some metaphysical positions other than varieties of realism could provide adequate intellectual support for doing science, but presumably these metaphysical positions will need to entail features very similar to those that philosophers of science have identified as characterizing modern science. Varieties of theistic pragmatism and theistic idealism may prove strong candidates.

[4] An objection could be that MN is not a claim about supernatural agency as much as a way of patrolling the boundaries for what counts as "science" as opposed to some kind of other inquiry. So it could be that spirits inhabit the trees, for instance, but we set aside that possibility for the sake of doing science. Hiding behind such a move, however, are assumptions about explanatory sufficiency. Scientific explanations are not worth the investment if we expect they are only sufficient in narrow domains or applications. These sufficiency assumptions are, themselves, metaphysical and—when dealing with gods—theological claims.

[5] The term scientism is used in various ways, but I regard it as an ideology or worldview that attempts to make claims about the nature of the world as well as human morality and purpose on the alleged basis of scientific inquiry and theories. A related concept is science fundamentalism, the tendency to have a narrow epistemology that only accepts authoritative input from the sciences. If one practices science fundamentalism, one will tend to embrace a version of scientism.

[6] Many theologies will undoubtedly present their own tensions with doing science. For instance, Buddhism is commonly regarded as especially coherent for doing science. And yet, prominent strains of Buddhism are strongly anti-realist—undercutting a major assumption of modern science—and reject the possibility of a universe with a definite beginning, a current cosmological consensus. Nonetheless, American Buddhists, at least, express great enthusiasm for science (Cootsona 2023).

Competing Interests

The author declares that they have no competing interests.

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