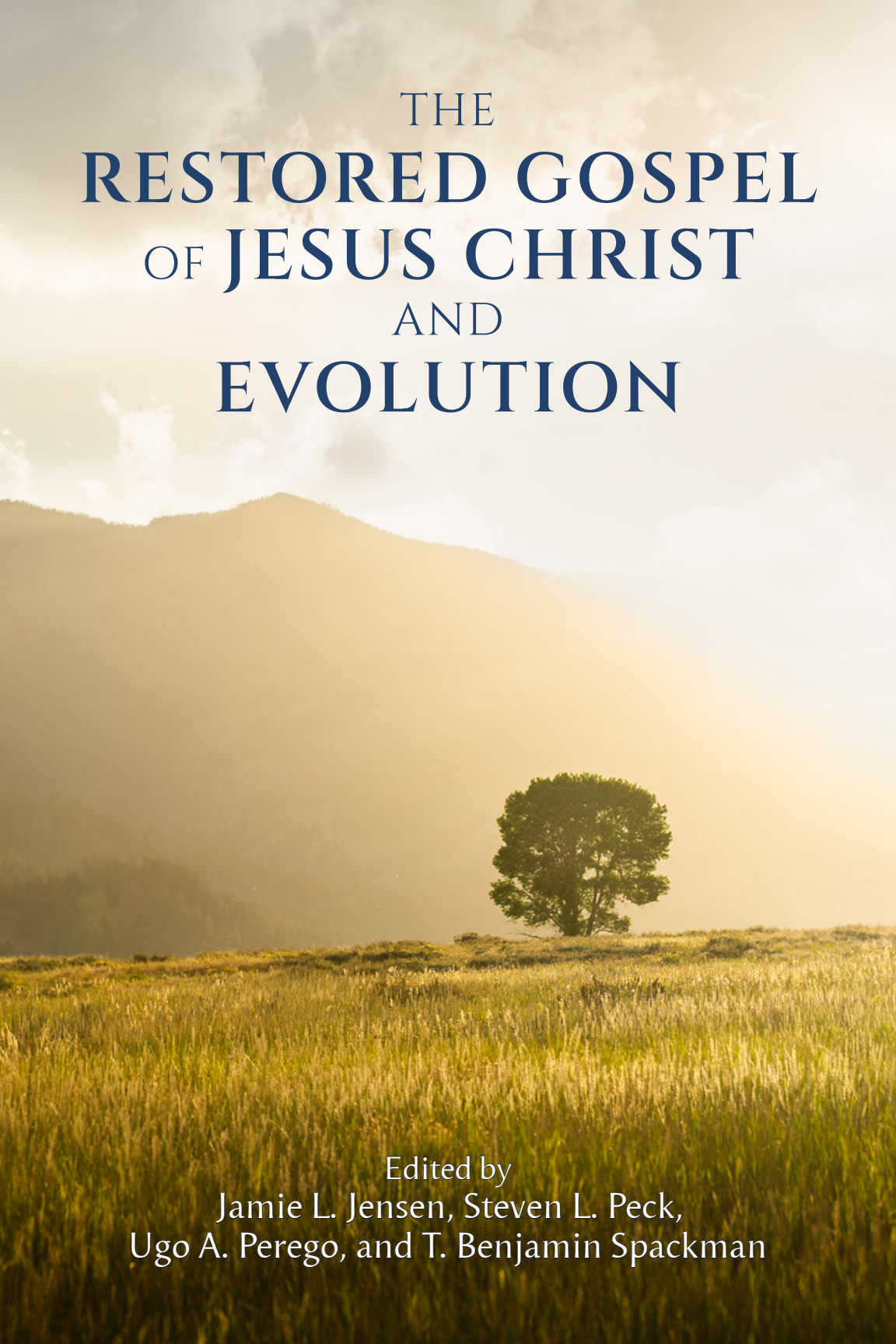
THE RESTORED GOSPEL OF JESUS CHRIST AND EVOLUTION



Edited by
Jamie L. Jensen, Steven L. Peck,
Ugo A. Perego, and T. Benjamin Spackman

We believe that questing for further light and knowledge leads, ultimately, to harmony between revelation and research, between academic and spiritual means of knowing, between scripture and science. This book provides information for sincere seekers on the science of evolution in light of the restored gospel of Jesus Christ. Some may feel compelled to choose between truths learned in biology and truths of religion. We do not claim to know how all truths relate or reconcile, but we know from our own experience that we do not have to choose between them. In this book, we seek to establish what we know from a religious standpoint, what we know from a scientific standpoint, and how we can bring these two epistemologies together in order to be one of the "best books" from which seekers can learn "by study and also by faith" (D&C 88:118). Every chapter was selected in light of and in fidelity to revealed truths.

Throughout the history of evolutionary science, Church leaders and members have espoused a variety of personal views. At the same time, the Church has constantly maintained the revealed truth that God planned for the eternal life of people and therefore created us on purpose, while also maintaining that "nothing has been revealed concerning evolution."[1] Within that space, this book intentionally shows that accepting evolution as a valid scientific theory is among the legitimate, faithful choices a person can make while maintaining faith in the restored scriptural truths of God's creative work and plan.

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1. "What Does the Church Believe about Evolution?," *New Era* 45, no. 10 (October 2016): 41, reprinted herein, 347.

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"This university is committed to searching for truth and to teaching the truth. All truth is part of the gospel of Jesus Christ. Whether truth comes from a scientific laboratory or by revelation from the Lord, it is compatible. All truth is part of the everlasting gospel. Brigham Young so taught: 'If you can find a truth in heaven, earth or hell, it belongs to our doctrine. We believe it; it is ours; we claim it.' There is no conflict between science and religion. Conflict only arises from an incomplete knowledge of either science or religion—or both."[1]

1. Russell M. Nelson, "The Tie between Science and Religion," in *Envisioning BYU: Volume 1, Foundations and Dreams,* ed. John S. Tanner (Provo, Utah: Brigham Young University, 2022), 291.

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We believe that questing for further light and knowledge leads, ultimately, to harmony between revelation and research, between academic and spiritual means of knowing, between scripture and science. Thus we are publishing this book on evolution and the restored gospel.

Evolution is commonly equated with the idea that humans were once apes. As several of the chapters in this book make clear, that is not what evolution posits. We hope that people will read the book thoroughly and come to understand that evolution means descent with modification.

We also hope this volume will be widely read, but we intend it primarily for BYU students. Its purpose is to educate them about evolution in light of the restored gospel of Jesus Christ. Some of these students feel compelled to choose between truths they learn in biology courses and truths they learn in religion courses. We do not claim to know how all those truths relate or reconcile, but we know from our own experience that we do not have to choose between truths. We feel confident that answers will come not by rejecting truths we already have but from more research and revelation that refines and explains what is presently known. We anticipate "a time to come in which nothing shall be withheld" (Doctrine & Covenants 121:28). "We believe all that God

has revealed, all that He does now reveal, and we believe that He will yet reveal many great and important things" (Articles of Faith 1:9).

One hundred percent of prophets and apostles teach that God created planets, plants, and people on purpose, as part of a divine plan. God's revealed purpose for creating is "to bring to pass the immortality and eternal life of man" (Moses 1:39). The scriptures are clear: divine creation that leads to immortality and eternal life includes a fallen state—mortality—followed by redemption from fallenness through Jesus Christ's Atonement and resurrection to immortality.

There is no apostolic consensus, however; nor is there an explicit scriptural record detailing *how* God created. When God invited Moses to "look, and I will show thee the workmanship of mine hands[,] . . . Moses looked, and beheld the world upon which he was created." He saw the inhabitants of the earth, and he "greatly marveled and wondered" (Moses 1:4, 8). He had two questions for his creative Heavenly Father: "Tell me, I pray thee, why these things are so, and by what thou madest them?" (Moses 1:30). The revealed answers are clear in some aspects and ambiguous and incomplete in others. "For mine own purpose have I made these things," God explained to him. "Here is wisdom and it remaineth in me. And by the word of my power, have I created them, which is mine Only Begotten Son, who is full of grace and truth. And worlds without number have I created; and I also created them for mine own purpose; and by the Son I created them, which is mine Only Begotten. And the first man of all men have I called Adam, which is many" (Moses 1:31–34).

It is clear from these scriptures and others that God purposefully created people by his Son. However, Moses apparently got only ambiguous answers to his question about *how* God created. What does it mean to create by the power of God's Only Begotten? What does it mean that Adam is "first" and also, somehow, "many"?

We feel a little like Moses. We delight in God's purposes. We are in awe of the power of the Only Begotten Son of God, and we marvel and wonder at the mechanisms of creation. Since we believe the revealed truths outlined above, we are inspired by, not afraid of, ambiguity, unreconciled truths, and unresolved problems of creation. As children of the Great Creator, we quest, Moses-like, for answers. We seek learning by study and faith simultaneously. We want to "be instructed more perfectly in theory, in principle, in doctrine, in the law of the gospel, in all things that pertain unto the Kingdom of God, . . . both in heaven and in the earth, and under the earth; things which have been, things which are" (Doctrine & Covenants 88: 118, 78–79).

In 1931, the First Presidency of The Church of Jesus Christ of Latter-day Saints responded to disagreement among General Authorities of the Church about evolution. "Upon the fundamental doctrines of the Church we are all agreed," the First Presidency said, then reminded the General Authorities that their primary mission was "to bear the message of the restored gospel to the world" as means to the end of the Creator's purpose. So the First Presidency admonished the General Authorities to "leave geology, biology, archaeology, and anthropology, no one of which has to do with the salvation of the souls of mankind, to scientific research."[1]

This volume seeks to establish what we know from a religious standpoint, what we know from a scientific standpoint, and how we can bring these two epistemologies together in order to be one of the "best books" from which seekers can learn by study and by faith. To that end, it begins with two essays as an introduction, first on why this matters (Jamie Jensen), and then how to reconcile our religious perspectives (Joshua Sears). It then

1. First Presidency minutes, April 7, 1931, quoted in William E. Evenson, "Evolution," in *Encyclopedia of Mormonism,* ed. Daniel H. Ludlow, 4 vols. (New York: Macmillan, 1992), 2:478, https://contentdm.lib.byu.edu/digital/collection/EoM/id/3666/.

begins with a series of chapters on what we know from a religious epistemology[2] (Kyle Greenwood, Avram Shannon, Nicholas Frederick, and Ben Spackman). Next follows a series of chapters on what we know from a scientific epistemology (Steven Peck, Heath Ogden, Tyler Kummer and Jamie Jensen, and Seth Bybee). Next is a series of chapters that provide perspectives on what and how Latter-day Saints (and others) have sought ways to reconcile evolution with religion (James Porter, Michael Whiting, Ugo Perego, Jared Lee, four student coauthors, and Jamie Jensen with Constance Bertka and Lee Meadows). It concludes with an essay on the official statements of the Church on these matters (Ben Spackman) and the inclusion of all official statements to date. Every chapter was selected in light of and in fidelity to revealed truths.

Throughout the history of evolutionary science, Church leaders and members have espoused and advocated a variety of personal views about it. At the same time, the Church has constantly maintained the revealed truth that God planned for the eternal life of people and therefore created us on purpose, while also maintaining that "nothing has been revealed concerning evolution."[3]

Within that space, this book intentionally shows that accepting the scientific theory of organic evolution is not antithetical to wholeheartedly believing in the restored gospel of Jesus Christ or to being his disciple. Accepting evolution as a valid scientific theory is among the legitimate, faithful choices a person can make while maintaining faith in the restored scriptural truths of God's creative work and plan.

This book also advocates and demonstrates what the First Presidency of The Church of Jesus Christ declared in 1910 regarding science-related questions: "Diversity of opinion does

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2. By "epistemology," we mean "a way of knowing truth."

3. "What Does the Church Believe about Evolution?," *New Era* 45, no. 10 (October 2016): 41, reprinted herein, 347.

not necessitate intolerance of spirit, nor should it embitter or set rational beings against each other."[4]

We are grateful to the authors of the chapters that follow. They are people of faith in God who seek truth. Neither they nor we claim to understand how all known truths relate or reconcile. Rather, we accept the truths we have and remain open to more because we expect that there is much yet to be learned by revelation and discovered by scientific research. We believe that ultimately both of those ways of knowing truth lead to one great whole.

4. "Words in Season from the First Presidency," *Deseret Evening News,* December 17, 1910, part 1, page 3.

Accepting Evolution

Why Does It Matter?

Jamie L. Jensen

As a professor at Brigham Young University (BYU) and the head of the assessment committee for the biology department, I have the opportunity each year to compile data on the effectiveness of the majors in our department. One of the data points collected is the results of the Biology Major Fields Exam, a national exam that graduating seniors take to show that they have sufficiently gained the knowledge to be considered a graduate of the biological sciences. On the subsection for evolution knowledge, students at BYU consistently score in the ninety-ninth percentile. In other words, our students are top-notch when it comes to *knowledge* of evolutionary theory, better than 99 percent of U.S. biology majors. However, when it comes to *acceptance* of evolutionary theory, BYU students can vary widely. For example, in the 2018 senior survey, 93 percent of seniors graduating from the biology department indicated that they had no conflict between their faith and evolution, but only 38 percent of BYU students coming into a nonmajor biology class (and 61 percent at the end of that class) accept human evolution,[1] contrasted with

1. William S. Bradshaw and others, "A Longitudinal Study of Attitudes toward Evolution among Undergraduates Who Are Members of The Church of Jesus Christ of Latter-day Saints," *PLOS One* 13, no. 11 (November 2018): e0205798.

the 81 percent of U.S. adults who accept human evolution.[2] When people find out about the research I do, one of the most frequent questions I get asked by Church members outside my academic circle is, "Why does it matter whether they (or I) believe in evolution or not? Your students certainly understand it. Why do you care so much?" These are very good questions, which I would like to address in this essay.

Knowledge and Acceptance

I would like to first address the all-too-common and inappropriate use of the word "believe," as in "I *don't* believe in evolution" or "I *do* believe in evolution." There are two problems with the use of *believe* in the context of evolution. The first is a semantic issue embedded in the nature of the scientific process. In actuality, scientific hypotheses are "accepted" or "rejected." There is no belief involved (although all too often I find that scientists, myself included, often misuse this word). For example, we don't *believe* gravity to be true. More accurately, we accept, based on the evidence, that gravity exists and is a good explanation for phenomena like an apple falling from a tree. Science, as a way of knowing, is an agnostic approach—there is no belief involved.

The second problem is epistemological. By setting up a scientific explanation as a "belief system," we are setting ourselves up for a challenge to our religious belief system. If we can successfully distinguish between a scientific way of "accepting" or "rejecting" theoretical explanations based on evidence and a religious "belief" in a divine being based on feelings of faith and confirmations to our souls (that is, two different ways of knowing), then the two, science and religion, do not have to challenge one another.

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2. Pew Research Center, "Asking about Evolution with One Question or Two: An Experimental Approach," February 4, 2018, https://www.pewresearch.org/religion/2019/02/06/the-evolution-of-pew-research-centers-survey-questions-about-the-origins-and-development-of-life-on-earth/.

The assumption of the question "Why does it matter whether I *accept* evolution?" is that evolution does not affect our lives and therefore is of little consequence to us. Why does it matter whether we assume that the Creation was a series of unexplainable events, that organisms are not related, and that the human body has not changed, and is continuing to not change, since its creative inception? Those who ask this question have perhaps never before been faced with a situation in which the reality of evolution mattered in any way. In their defense, we have all experienced some level of disassociation with concepts that do not seem to affect our lives directly. In reality, however, it may be that we are just blissfully unaware of all the ways that such a concept affects our lives, as is the case with the mechanisms of evolution. And maybe that unawareness is totally acceptable; maybe it really doesn't matter—until it does.

Let me present a simple, and certainly overly dramatic, example of this line of thinking (for example, that it doesn't matter because it doesn't affect me). Does it matter whether someone is knowledgeable about, and accepting of, the theory of gravity? One could argue that it doesn't really matter whether I *accept* that gravity exists or not. As long as I keep my feet firmly on the ground, I may not ever be faced with a situation in which it would matter whether I knew about gravity or not. But consider the moment when I am teetering on the brink of a windowsill, looking down at the sidewalk below and contemplating whether I can reach out to catch the butterfly hovering outside my window. Does it matter then? I guess I could argue, even then, that it doesn't matter whether I accept the reality of gravity. However, my acceptance or lack of it doesn't change the fact that if I reach too far out that window, I *will* fall, whether I accept gravity or not. It would be wiser for me to learn this very important principle of nature so that I can make wise decisions.

Now, you might be thinking, "Who on planet earth has never had any experience with gravity?" Probably no one. So maybe that's an overly simplified example. But let's try another.

Bernoulli's principle states that as the speed of a fluid increases, the static pressure decreases, thus increasing potential energy. What does that mean? Many reading this chapter have likely never heard of Bernoulli's principle (or perhaps it sounds familiar from tenth-grade physics, but who can remember?). Again, does it matter whether I accept Bernoulli's principle as truth? Probably not. However, Bernoulli's principle applies to gas movement as well as fluid movement. If I were ever to fly in an airplane, I should be incredibly thankful that *someone* accepted Bernoulli's principle as truth, for that is why we can fly. The shape of an aircraft wing makes air flow faster over the top than underneath, causing air pressure to be higher underneath and consequently allowing the plane to lift into the air. Many aspiring inventors lost their lives because they did not understand (much less accept) this principle. So whether I accept Bernoulli's principle or not is irrelevant; it is still what keeps me in the air on my transatlantic flight to Paris. We are all probably grateful that someone accepts it. And would it not be potentially beneficial for everyone to accept this basic principle of physics? Similarly, evolution is a principle of nature with as much supporting evidence as the theory of gravity or Bernoulli's principle. Whether I accept its reality or not does not stop it from acting upon my life. And failing to accept it may deprive me of incredible insights into and solutions to widespread problems.

Evolution's Influence in Our Lives

If we are going to be intellectually curious and honest about the gaps in our understanding, this question must be answered: "How does evolution directly affect me?" Let me offer just a couple of examples. The first involves a hypothetical little boy named Wyatt. Wyatt was born premature, at thirty-one weeks. Due to his underdeveloped lungs and complicated birth, his brain went without oxygen for a few precious moments during his birth, leading to a lifetime condition called cerebral palsy. The cause of this tragic result is a condition called preeclampsia, a condition

Wyatt's mother spontaneously developed during late pregnancy, causing her blood pressure to spike to dangerous levels for both her and Wyatt. Doctors had no choice but to deliver him to save his life and his mother's. Wyatt is not the first to be a victim of this condition. Preeclampsia is one of the leading causes of maternal mortality and occurs in 2 to 8 percent of all pregnancies; it is also the cause of 15 to 20 percent of all preterm births.[3] Preeclampsia is currently unpreventable and untreatable besides immediate delivery of the fetus and placenta.[4] For decades, doctors have searched for a potential cause in the mother's body, something that provokes a spontaneous and dangerous spike in blood pressure. They came up empty until 1993, when Dr. David Haig entered the scene.[5] He was an evolutionary biologist, not a trained physician, and had a firm understanding and acceptance of the evolutionary history of the human body. He proposed that evolutionary theory would predict that the causative agent of preeclampsia is *not* produced by the mother at all; rather, it is produced by the baby as a consequence of the father's genes.[6] How does this make sense? Well, natural selection would dictate that larger offspring are more likely to survive and would therefore select any genes that would increase the size of the offspring. If a male parent's genes prompted the fetus to increase blood flow to itself (that is, increase blood pressure), the resultant increased flow of nutrients would cause the fetus to grow larger and stronger. Natural selection would also predict that female bodies with regulatory mechanisms capable of moderating this call for more nutrients would be more likely to survive the reproductive process. However, the problem appears when a man with these

3. Arun Jeyabalan, "Epidemiology of Preeclampsia: Impact of Obesity," *Nutrition Reviews* 71, suppl. 1 (2013): 18.

4. Jeyabalan, "Epidemiology of Preeclampsia," 18.

5. Carl Zimmer, "Silent Struggle: A New Theory of Pregnancy," *New York Times*, March 14, 2006, https://www.nytimes.com/2006/03/14/health/silent-struggle-a-new-theory-of-pregnancy.html.

6. Zimmer, "Silent Struggle."

upregulating genes reproduces with a woman who may not have adequate moderation genes to combat the surge from the fetus. The result is preeclampsia.[7] Having hypothesized such a process, Dr. Haig took his theory to Dr. Ananth Karumanchi of Harvard Medical School, a physician working on preeclampsia treatments. Thankfully, Dr. Karumanchi and his colleagues accepted that humans have evolved and were willing to spend the money and effort (not to mention stake their reputations) on testing out this idea. It turns out Dr. Haig was right. The signal that causes preeclampsia comes from the fetus. Treatments based on this new evidence are currently in the works.[8]

You might be thinking, "Fine, so doctors should accept evolution like airplane designers should accept Bernoulli's principle, but why do I have to accept it?" Let's look at another example that perhaps we have all experienced. It deals with microbes.[9] Antibiotics, which we use to combat harmful microbes, are perhaps one of the most important discoveries of the modern age. They save countless lives every year. However, the efficacy of antibiotics is quickly waning due to misuse. There are many who can share the blame, from physicians to pharmaceutical companies. But much of the blame can also be shared by patients who, understandably, just want to get better but perhaps do not understand, or perhaps do not care, that microbes evolve and that patients' misuse of antibiotics is leading us back into the nineteenth century, when people died of strep throat or an infected paper cut. Let me briefly explain this. When you are prescribed an antibiotic, like Joe (fig. 1), who has a bacterial infection in his lungs, ideally it is because doctors have confirmed that you have an overabundance of a particular bacteria in your system that is causing disease (in

7. Zimmer, "Silent Struggle."

8. Zimmer, "Silent Struggle."

9. Interestingly, research shows that most people have little to no issue with microbes evolving. For some reason, when things get bigger than microbes, people with less exposure to the science behind evolution have a harder time accepting it, even though the mechanism is the same.

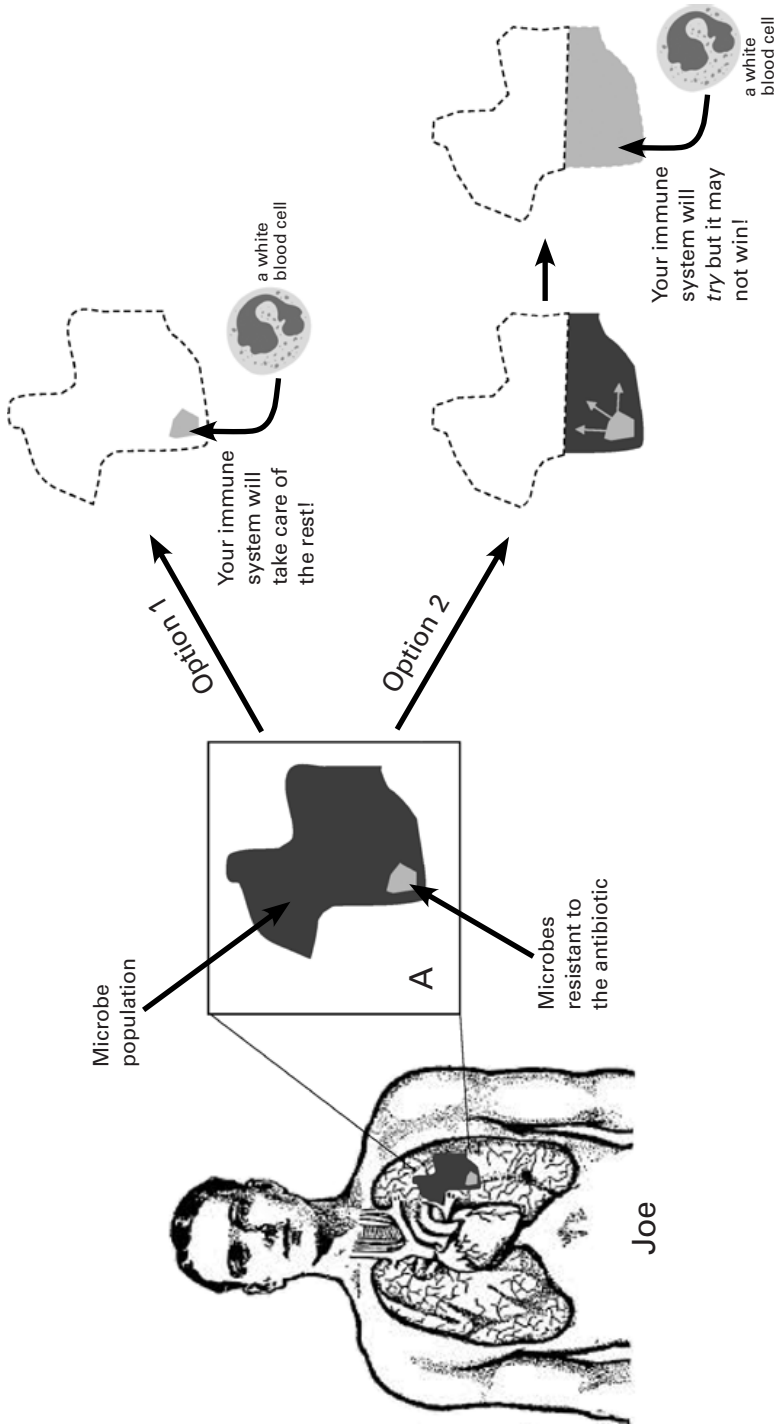

Figure 1. The development of antibiotic-resistant strains of bacteria. Body image from RawPixel, https://www.rawpixel.com/search/lungs%20hand%20drawn?page=1&sort=curated, public domain.

Joe's case, it is *mycobacterium tuberculosis*). The antibiotic that the doctor prescribed to you is designed to wipe out this particular bacterial species. However, some percentage of the bacterial population, by chance alone, has developed certain mutations that allow them to survive the onslaught of the antibiotic you are taking (pictured in the lighter color). If you take your antibiotics to completion, like the doctor ordered (option 1), you will wipe out all but the resistant strain. Hopefully, this knocks the bacterial population down low enough that your immune system can take care of the rest.

If, however, you are unaware of microbe evolution, and you choose to discontinue your antibiotics as soon as you start feeling better (option 2), you may have killed off only part of the population. Not only will both the nonresistant and resistant strains continue to thrive, but bacteria also have a nasty habit of sharing genes with each other, allowing the nonresistant strains to pick up this nifty antibiotic-resistance trait. Now you have a healthy, thriving population of antibiotic-resistant bacteria in your lungs that your immune system might not be able to handle. Even worse, however, are the repercussions for your neighbors. If you cough on a neighbor and infect him or her with this new antibiotic-resistant strain, then the entire resultant bacterial population will be resistant, and your neighbor will have no options for treatment. This is what has been taking place (and currently continues to take place) in India, where a new strain of tuberculosis has emerged that is resistant to almost all known treatments.[10] Every year, almost a half million people are dying in India as a consequence of this disease.[11] So in the case of antibiotics, it is not just necessary for people to understand how "scientists say" evolution works on microbes; people must also accept

10. WHO Team, "Tuberculosis: Multidrug-Resistant Tuberculosis (MDR-TB) or Rifampicin-Resistant TB (RR-TB)," World Health Organization, May 20, 2024, https://www.who.int/news-room/questions-and-answers/item/tuberculosis-multidrug-resistant-tuberculosis-(mdr-tb).

11. Annabel Kanabus, "Information about Tuberculosis," GHE, www.tbfacts.org.

it as real for themselves and take appropriate actions to prevent the development of more drug-resistant bacteria (that is, taking antibiotics only when necessary and taking them as prescribed).

A False Dichotomy

I have given two simple examples of how evolution directly impacts human lives. Now I would like to discuss an entirely different reason why accepting evolution (and any scientific knowledge we have gained, for that matter) is wise, beyond the fact that it may directly impact our health: understanding *and* accepting evolution can help protect our faith and possibly our testimonies.

I recently had a long conversation with an individual who is deeply concerned over the rising secularity of the youth—that is, that too many young adults are leaving The Church of Jesus Christ of Latter-day Saints in favor of secularity. (This, by the way, is a national trend that is not unique to Latter-day Saint youth. A recent Pew survey suggests that at least 36 percent of young millennials are unaffiliated with religion.[12]) After talking with this individual about the reasons why the youth are leaving the Church, it was clear to me that he placed a large amount of blame on science,[13] and more specifically on the teaching of evolution. In his mind, many principles of evolution were in direct conflict with the teachings of God. His solution was to propose the teaching of an alternative theory that would directly support a literalist interpretation of the Creation as told in Genesis, a theory with absolutely no scientific evidence and a great amount of speculation behind it. In other words, his solution was to teach youth to ignore the science rather than to teach youth correct scientific principles and how these principles can be in harmony with religious faith. Unfortunately, though well-intentioned, his creative solution will not hold up to scientific scrutiny and may end

12. Pew Research Center, "Younger Millennials," *Religious Landscape Study*, https://www.pewresearch.org/religious-landscape-study/.

13. For a description of big "S" Science versus little "s" science, see Bruce Alberts, "The Breakthroughs of 2012," *Science* 338, no. 6114 (2012): 1511.

up contributing to the very thing he is trying to prevent—youth leaving the Church when they are eventually confronted with the considerable evidence of evolution after being taught these alternative, nonscientific ideas.

Like so many others, this individual has set up a false dichotomy between science and religion. This dichotomy is often preached from both sides of the aisle. We see young-earth creationism that abandons science in favor of a literalist interpretation of Genesis. And we see the misinformed rhetoric of a vocal minority of atheistic scientists who have forgotten that science is agnostic and are using science as a tool to preach atheism. Fortunately, standing in contrast to these creationists and scientists are many notable scientists who have embraced faith along with their scientific expertise (such as Francis Collins, former head of the National Institutes of Health and leader of the Human Genome Project).

Science Is Agnostic

Let me first reemphasize and explain what I mean by saying, "Science is agnostic." It means that science cannot provide evidence that there *is* a God, nor can it provide any evidence that there is *not* a God. Science is *not* atheistic (as many religious people presume and many atheistic scientists attest); it is agnostic, plain and simple. Knowing whether God exists or not is not a question for science but a question of faith. The existence of God is a question about the supernatural, that which is above nature and therefore outside the realm of scientific study. There are some cases where religious claims about the natural world directly conflict with the evidence that science has provided. For example, the claim that the earth is less than ten thousand years old conflicts with the ample evidence we have of an earth that exceeds 4.5 billion years of existence. Because this question pertains to the natural world, science can provide evidence to support or refute either claim. This can cause a certain amount of discomfort and uncertainty about science or religion. In these cases, it is important to

evaluate both claims with a mind open to finding the truth. Is it possible that the religious claim represents a misinterpretation of scripture? Is it possible that the scientific evidence is not sound? In the case of the earth's age, the scientific evidence is sound, plentiful, and replicable. So it may be that the religious claim is a misinterpretation. However, the scientific evidence pertains to the natural world only and, therefore, still cannot make claims about the supernatural—that is, whether God was involved in the creation of the earth or not.

Interestingly, colleagues of mine at Arizona State University are curious about how prevalent the misunderstanding that science is atheistic is, and about whether this misunderstanding has a direct impact on students' acceptance of the theory of evolution. My colleagues surveyed more than one thousand college students and found that 48 percent of them believed that, in order to accept evolution, you have to reject God.[14] They also found that the more students thought that science had to be atheistic, the less willing they were to accept evolution. This result indicates that the viewpoint that science is somehow atheistic is common and that this misunderstanding may be driving an unnecessary wedge between religious youth and science. It is a fundamental misunderstanding of the nature of science. A correct understanding of the agnostic nature of science, incidentally, is one of the best ways to increase acceptance of evolution.[15]

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14. M. Elizabeth Barnes and others, "'Accepting Evolution Means You Can't Believe in God': Atheistic Perceptions of Evolution among College Biology Students," *CBE—Life Sciences Education* 19, no. 21 (June 2020): 1–13.

15. Briana Pobiner, "Accepting, Understanding, Teaching, and Learning (Human) Evolution: Obstacles and Opportunities," *American Journal of Physical Anthropology* 159 (January 2016): 232–74; Dunk 2017; Amanda L. Glaze, M. Jenice Goldston, and John Dantzler, "Evolution in the Southeastern USA: Factors Influencing Acceptance and Rejection in Pre-Service Science Teachers," *International Journal of Science and Mathematics Education*, no. 13 (December 2015): 1189–209; B. Elijah Carter and Jason R. Wiles, "Scientific Consensus and Social Controversy: Exploring Relationships between Students' Conceptions of the Nature of Science, Biological Evolution, and Global Climate Change," *Evolution: Education and Outreach* 7, no. 6 (2014), https://doi.org/10.1186/s12052-014-0006-3; Tania Lombrozo,

Now that I have explained the agnostic nature of science, let me point out that all of us—including our children, their children, and so on—will be exposed to evolution. It is one of the most well-supported and most explanatory theories we have in biology, and the evidence just keeps coming. Evolutionary theory is not going anywhere. We use it to improve our lives, as discussed above. Wouldn't it be wise to learn this theory accurately prior to being bullied by an atheistic individual who may be purposefully playing on our misunderstandings to destroy our faith? The scriptures clearly favor becoming educated: "If a person gains more knowledge and intelligence in this life through his diligence and obedience than another, he will have so much the advantage in the world to come" (D&C 130:19); "the glory of God is intelligence, or, in other words, light and truth" (D&C 93:36); and "to be learned is good if they hearken unto the counsels of God" (2 Ne. 9:29). President Gordon B. Hinckley once extolled the virtues of science when he said, "[The twentieth century] has been the best of all centuries. . . . The fruits of science have been manifest everywhere. . . . This has been an age of enlightenment."[16]

Avoiding a God of the Gaps

This brings me to a third point: avoid a "God of the gaps." What does it mean to have a "God of the gaps"? It is when an individual inserts God as an explanation for anything that science cannot currently explain. For example, the ancient Greeks created gods to explain weather patterns for which they had no current explanation (Zeus was the god of lightning, Poseidon the god of earthquakes and hurricanes, and so forth). However, once science became advanced enough to explain these phenomena, the Greeks' gods disappeared. If there are uncertainties in science,

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Anastasia Thanukos, and Michael Weisberg, "The Importance of Understanding the Nature of Science for Accepting Evolution," *Evolution: Education and Outreach* 1 (2008): 290–98.

16. Gordon B. Hinckley, "Thanks to the Lord for His Blessings," *Ensign* 29, no. 4 (April 1999): 88.

someone with a "God of the gaps" attitude would argue that God's existence resolves these uncertainties, and his existence explains things that we cannot explain (for example, such a person would answer the question of how lifeforms can be so complex by saying that they must have been created in their present form by God). But this viewpoint is dangerous. What happens when science comes up with a reasonable and even testable explanation (for example, that evolution has led to the great diversity of life that we see) for this gap in our understanding. Does your faith disappear just because something you attributed to God can be explained by science? It should not, and it will not if your belief is not based in a God of the gaps. A paradigm shift must occur such that your belief in God is for an entirely different reason—not because he can explain the gaps in your current temporal understanding but because he gives you spiritual understanding, and you have felt his presence in your life (this is evidence, too, by the way; it is just not the same kind of evidence we gather in science).

Let me share an experience I recently had. This is going to sound like the start of a corny joke, but bear with me. I was sitting in a restaurant in Washington, D.C., with a Catholic priest and a humanist;[17] both men have become friends of mine through my work on the Broader Social Impacts Committee of the Human Origins Project at the Smithsonian. We were discussing morality and what it meant for the existence of God. The priest, taking somewhat of a "God of the gaps" approach, suggested that human morality is direct evidence of the existence of God (that is, we cannot explain it scientifically, so we must attribute it to God). The humanist, taking a secular approach, suggested that moral tendencies simply increase fitness and are therefore evolutionarily selected for. In other words, those who naturally tended (through genetic programming) to be kind and not kill each other were more likely to be welcomed into society,

17. Humanists believe that human experience and rational thinking provide all knowledge and morals; they reject the idea of a God.

chosen by a mate, and able to pass on those moral genes. I agree with the humanist; this idea has been well-studied and well-supported.[18] However, my response to both of them was this: Whether human morality evolved or was endowed upon us by God is irrelevant to my conviction that God is real. I believe in God because I have evidence of a different kind, a nonscientific kind, but real nonetheless. I believe God exists because he has spoken to me in very real ways, because I feel his presence in my life, because I have chosen to open the lines of communication with him, and because he has made himself known to me. This sort of spiritual evidence looks different for everyone because everyone has made different efforts to allow God into their lives.

I want to emphasize the difference between this spiritual evidence and scientific evidence. Scientific evidence pertains only to the natural world. Science demands that to be considered reliable, this evidence must be tangible, shareable, and repeatable. Spiritual evidence differs in that it pertains to the realm beyond the natural world. Spiritual evidence is not necessarily tangible, and it is not shareable (beyond the fact that you can share your testimony, of course; you cannot share the actual experience of receiving spiritual confirmations or revelations with another person). However, spiritual evidence is most certainly repeatable. At the end of the Book of Mormon, Moroni offers a test:

> Behold, I would exhort you that when ye shall read these things, if it be wisdom in God that ye should read them, that ye would remember how merciful the Lord hath been unto the children of men, from the creation of Adam even down until the time that ye shall receive these things, . . . I would exhort you that ye would ask God, the Eternal Father, in the name of Christ, if these things are not true; and if ye shall ask

18. Donald M. Broom, "The Evolution of Morality," *Applied Animal Behavior Science* 100 (October 2006): 20–28; Douglas Allchin, "The Evolution of Morality," *Evolution: Education and Outreach* 2 (2009): 590–601; Dennis Krebs, "The Evolution of Morality," in *The Handbook of Evolutionary Psychology,* ed. David M. Buss (Hoboken, N.J.: John Wiley and Sons, 2005), 747–71.

> with a sincere heart, with real intent, having faith in Christ, he will manifest the truth of it unto you, by the power of the Holy Ghost. And by the power of the Holy Ghost ye may know the truth of all things. (Moro. 10:3–5)

So here is the clear experiment with a clear prediction (very scientific):

Hypothesis: The record is true. (Alternative: the record is *not* true.)

Experiment: Ask God.

Prediction: If this record is true (my proposed hypothesis), and if I ask God (that is, I pray about it), then I will be given confirmation by the Holy Ghost.

This test is available to anyone. Of course, it assumes that you know how to recognize the Holy Ghost and the evidence he gives. But the evidence is very real, and I have gathered this evidence many times. However, the evidence is personal and would not mean the same thing to someone else if I shared it. Others must obtain it on their own. In terms of science, there is nowhere that this type of hypothesis testing fits in; this type of evidence is unmeasurable, and therefore, this hypothesis is untestable in a scientific sense. Spiritual evidence gathering is simply an alternative way of knowing.

Finding Reconciliation

So, if accepting evolution is so important to our well-being and can help us protect our testimonies in an ever-more-educated world, how do we accept it and still feel faithful? I would like to discuss the approach we use at BYU. We have called it the "reconciliation approach." What do I mean by reconciliation? Let me start by contrasting three alternative approaches that I have seen used in a science classroom. The first is the deficit approach. This approach teaches that if you do not accept evolution, it is because you have a deficiency somewhere, either in your knowledge of evolution or in your intelligence in general. Richard Dawkins is a great proponent of this approach, remarking, "Evolution is almost

universally accepted among those who understand it, almost universally rejected by those who don't."[19] Evidence is not on the side of this argument. Several studies have shown the relationship between knowledge of evolution and acceptance of evolution to be tenuous.[20] In addition, studies have shown that one's scientific reasoning ability is in no way related to one's acceptance of evolutionary theory.[21] So the deficit approach is not entirely accurate and can be incredibly off-putting to those who may be struggling with accepting evolution. I believe it does a great deal of harm.

The second approach is the resolution approach. This is the one I was most familiar with in school and one that I was forced to use in the introductory biology courses I taught as a graduate student at Arizona State University. To resolve means to "settle or find a solution to."[22] In this approach, at least as I used it, we pitted two theories against each other: special creation (a literalist interpretation of the Bible) and evolution through descent with modification. I would then present evidence to the students—including the fossil record, radiometric dating techniques, embryological evidence, the presence of vestiges and atavisms, and so forth—and help them *resolve* the idea that evolution was a better explanation than special creation. While this approach appeals to logic and reason in the student, it pits evolution against religion unnecessarily, in a way that seems to suggest that evolution is antitheistic (although I think the main point was simply to disprove religious claims about young-earth creationism). I have found, instead, that the third approach, the reconciliation approach, is best.

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19. "Darwin and the Case for 'Militant Atheism,'" CNN, November 24, 2009, http://english.igg.cas.cn/NC/News2015/2009/200911/t20091125_47642.html.

20. Gale M. Sinatra and others, "Intentions and Beliefs in Students' Understanding and Acceptance of Biological Evolution," *Journal of Research in Science Teaching* 40, no. 5 (2003): 510–28.

21. Katie F. Manwaring and others, "Scientific Reasoning Ability Does Not Predict Scientific Views on Evolution among Religious Individuals," *Evolution: Education and Outreach* 11, no. 2 (2018), https://doi.org/10.1186/s12052-018-0076-8.

22. Google Dictionary, s.v. "resolve."

The reconciliation approach is one in which we help students see potential compatibility between the science of evolution and their religious beliefs. This approach is one of the identified approaches determined to be successful in helping students accept evolution.[23] Indeed, researchers have conducted several studies using this approach and have found it to be radically successful in increasing student acceptance while, importantly, not decreasing their religious faith.[24]

Our particular approach involves the following components:

1. We acknowledge the existence of conflict using cultural competence. To be culturally competent means that you understand the cultural barriers that your audience might be facing; it also somewhat implies that you may not share that culture. Unfortunately, this is often the case across the country. According to recent poll data, 89 percent of the U.S. population believes in God, compared to only 25 percent of biologists and 10 percent of evolutionary biologists.[25] Thus, there is a cultural conflict in many classrooms. By acknowledging the potential discomfort, this approach allows students to feel less threatened by the content.

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23. M. Elizabeth Barnes and Sara E. Brownell, "A Call to Use Cultural Competence When Teaching Evolution to Religious College Students: Introducing Religious Cultural Competence in Evolution Education (ReCCEE)," *CBE—Life Sciences Education* 16, no. 4 (December 2017): 1–10.

24. Bradshaw and others, "A Longitudinal Study of Attitudes toward Evolution"; John Lindsay and others, "Using a Reconciliation Module Leads to Large Gains in Evolution Acceptance," *CBE—Life Sciences Education* 18, no. 58 (Winter 2019): 1–11; Katie F. Manwaring and others, "Influencing Highly Religious Undergraduate Perceptions of Evolution: Mormons as a Case Study," *Evolution: Education and Outreach* 8, no. 23 (2015), https://doi.org/10.1186/s12052-015-0051-6.

25. Art Swift, "In U.S., Belief in Creationist View of Humans at New Low," Gallup News, May 22, 2017, https://news.gallup.com/poll/210956/belief-creationist-view-humans-new-low.aspx; Elaine Howard Ecklund and Christopher P. Scheitle, "Religion among Academic Scientists: Distinctions, Disciplines, and Demographics," *Social Problems* 54, no. 2 (May 2007): 289–307; Gregory W. Graffin and William B. Provine, "Macroscope: Evolution, Religion and Free Will," *American Scientist* 95, no. 4 (July–August 2007): 294–97.

2. We address the difference between science and religion. As discussed above, science and religion approach truth in many different ways. Helping students understand the boundaries of each way of knowing can help them resolve the perceived conflict between the two. We encourage them to consider that science answers questions about the natural world (What are the mechanisms of the creation of diversity on earth? How old are these organisms? When did one species diverge from another?), whereas religion answers supernatural questions (Who was involved in the Creation? What is the purpose of life?).

3. We address the Creation from a religious standpoint. What do the scriptures actually tell us? What are the scriptures? Are they meant to be scientific texts? Historical accounts? Spiritual allegories? What modern revelation do we have on the Creation? What is the Church's position on evolution?

4. We explain the cultural history of evolution—that is, the reasons that students might perceive a sense of controversy about evolution. We discuss both the U.S. history surrounding evolution and the cultural history within the Church.

5. We offer students ways to reconcile their beliefs. Using a modified version of Eugenie Scott's evolution vs. creation continuum,[26] we discuss the various ways of viewing the Creation. In table 1, the ideas under "Not Scientifically Compatible" do not fit with the data and are therefore not options for reconciliation. The ideas labeled "Potentially Scientifically Compatible" could be compatible depending on how you interpret the periods of time. The ideas at the bottom are completely scientifically compatible. As we discussed previously, the most accurate of the these compatible ideas would be agnostic evolution, considering that science cannot provide evidence for or against God's involvement in evolution. However, the belief that God used evolution as a

26. Eugenie Scott, *Evolution vs. Creationism: An Introduction,* 2nd ed. (Berkley: University of California Press, 2009), 63–64.

Table 1. The range of belief systems
(adapted from Scott, *Evolution vs. Creationism,* 63–64)

Flat Earth: the belief that the earth is flat rather than a sphere.	**Not Scientifically Compatible**
Geocentrism: the belief that the earth is the center of the universe.	
Universal Model: the belief that the center of the earth is water and that the earth is less than ten thousand years old.	
Young Earth Creationism: the belief that the earth was created less than ten thousand years ago by God as literally interpreted from Genesis.	
Intelligent Design: the belief that life is too complex to have arisen through gradual evolution and therefore must have an intelligence involved.	
Gap Creationism: the belief that the creation took place twice with a large gap of time in between; the second of which happening in six 24-hour periods.	
Day-Age Creationism: the belief that the creation took place in six time periods of unknown length, but as described in Genesis.	**Potentially Scientifically Compatible**
Progressive Creationism: the belief that there were muliple God-guided creation events that happened over hundreds of millions of years.	
Theistic Evolution*: the belief that modern diversity arose through evolution with God guiding it.	**Scientifically Compatible**
Agnostic Evolution: the belief that modern diversity arose through evolution with no statement on whether God was involved or not.	
Atheistic Evolution*: the belief that modern diversity arose through evolution and God was definitely *not* involved.	

*Both of these scientifically compatible ideas rely on faith in something for which we do not have scientific evidence.

tool of creation is perfectly compatible with the scientific evidence. We are simply including our faith in a Supreme Creator in our explanation. Also, note that atheistic evolution relies just as much upon faith (faith that there is no Supreme Creator) as theistic evolution does.[27]

Please note that for reconciliation to be truly effective, it is imperative that we all become more comfortable with uncertainty. Let's face it: none of us knows everything there is to know about the gospel, nor does science have all the answers. President Russell M. Nelson once said that there is no conflict between science and religion, that "conflict only arises from an incomplete knowledge of either science or religion, or both."[28] Dogmatism, in science or in religion, closes down your ability to learn and progress. So if something seems in conflict to you, just wait, hold off judgment, learn more about both sides, and be patient. In time, we will know all things.

Conclusion

In my classes at BYU, I often conclude my introductory lecture on evolution with a clip of a magician auditioning for *America's Got Talent.*[29] The contestant gives a superb performance that leaves even the skeptic impressed. I tell students that when I first saw this clip, the only logical explanation my brain could conjure up was that the contestant was indeed magical, that he had true magical powers. But after thinking for a moment, it was obvious to me that he does not have magical powers and that there is a reasonable and logical explanation for how he performed these tricks. Then his magic act became fascinating and exciting to me,

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27. You can find more information about the reconciliation model at our website, https://biology.byu.edu/reconciling-evolution.

28. Russell M. Nelson, in "Life Sciences Building Dedicated," BYU College of Life Sciences, April 9, 2015, https://lifesciences.byu.edu/life-sciences-building-dedicated.

29. "Smoothini: Bar Magician Flies through Amazing Tricks—America's Got Talent 2014," https://www.youtube.com/watch?v=AU8NPmx66j8.

because if there was a way in which he was doing it, then I could find out! That is far more exciting than magic. I view the Creation in a similar way. Is it possible that God created all the diversity on earth in a magical instance? I suppose it is. However, what I find more spectacular, more fascinating and exciting, is that he probably did not perform the Creation using magic; rather, I believe and accept that he used mechanisms within the laws of nature that have left behind evidence of the beauty and even simplicity of the process, evidence that I can find and analyze. In other words, I can study the works of God. And to me, that is so much more exciting than an exclusively magical act. That makes the study of biology a true study of *magic*—the magic of Creation. Through my studies, I have had the opportunity to study and sit in awe of the beauty and fascination of God's works upon the earth. And it brings me peace.

There is one last thing I would like to convey: Remember that your salvation does not depend on your understanding of or acceptance of evolution. We are here on earth to learn and grow. No one believes in education more than I do. "To be learned is good," as the scriptures say (2 Ne. 9:29). You should not turn away from learning about evolution. Evolutionary science improves our lives in ways most people are probably not even aware. Evolutionary science is amazing. But if learning about evolution puts your faith in jeopardy, choose your faith. Choose your faith until you can better understand the science (or until science can provide better explanations). I firmly believe that both kinds of truth (religious and scientific) exist in harmony. We just need to be patient enough to find that reconciliation and to recognize that when we find it, it may still be incomplete until "that day when the Lord shall come, [and] reveal all things" (D&C 101:32).

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Impacts Committee of the Human Origins Project at the Smithsonian's National Museum of Natural History, she works with scientists from a variety of religious denominations to help the public feel more comfortable with human evolution. In addition, with generous funding from the Department of Science Education at the Howard Hughes Medical Institute, she has brought together biologists, theologians, and local pastors and ministers from a variety of religions to help students accept the science of evolution without losing religious faith. She has built a website full of resources for the faithful seekers of reconciliation (https://biology.byu.edu/reconciling-evolution/). Her most fulfilling role, however, is being a wife and a mother of four boys.

From Biology Major to Religion Professor

Personal Reflections on Evolution

Joshua M. Sears

When I arrived at Brigham Young University as an excited freshman, my plan was to major in biology. I had really enjoyed biology in high school and scored a perfect 5 on the AP exam, so I figured this was something I could be good at. That first year I took courses in general biology, biodiversity, chemistry, and physical science.

Those courses were not at all what I had expected. They taught evolution.

My high school courses had also taught biological evolution, of course. And I had learned everything really well. But I had consistently bracketed anything to do with evolution into a separate category of my brain labeled "This is false—learn it well enough for the test but don't buy into it!"

I had been trained that way my whole life. I remember as a little boy watching Jiminy Cricket show a caveman and sing, "You are a human animal"—right until the TV was turned off halfway through the song and I was told that *we* believe in Adam and Eve.[1] After I saw *Jurassic Park* as an eight-year-old, we had a family discussion to discredit the movie's repeated suggestion that modern birds descend from prehistoric reptiles. As a teenager,

1. *You—the Human Animal,* directed by Les Clark, aired October 20, 1955, 8:11 (Orlando, Fla.: Walt Disney, 1955).

I came across statements in some of the Church books we kept in our home library that seemed to confirm that the restored gospel debunks the theory of evolution.

That is why I was so flabbergasted when I arrived at BYU and discovered that all my science professors continued to teach evolution just as my high school teachers had done. I had been looking forward to getting the "real scoop" from professors who shared my faith in God as Creator. I remember spending that year often feeling disappointed and confused.

Several years have passed since I entered BYU as a freshman. After my mission, I ended up switching my major to Ancient Near Eastern Studies, meaning I studied the Bible, with a particular focus on learning Hebrew and the contexts of the Old Testament. At two other universities, I received a master's degree and a PhD in the Old Testament, after which I returned to BYU to teach in religious education. And although it may surprise some people, I am much more comfortable with the idea of evolution today than I was as a biology student. I attribute this shift to three primary factors: (1) an improved understanding of how official doctrine is defined in The Church of Jesus Christ of Latter-day Saints; (2) my study of what the Old Testament does and does not say about the Creation; and (3) a growing comfort with ambiguity, complexity, and unresolved questions. I hope that this brief description of my personal journey will be helpful to others who are navigating similar questions.

Official Church Doctrine

I was born in a Latter-day Saint family, so while growing up I often heard about the importance of *doctrine.* I knew that there is true doctrine and false doctrine. I knew that true doctrine comes from the scriptures and from living prophets. And I knew that people of the world often "teach for doctrines the commandments of men" (JS–H 1:19).

Despite my appreciation for the beautiful doctrines of the restored gospel, I look back now and think that as a young college

freshman I did not understand the parameters and limits of what can be considered *official* Church doctrine. That lack of clarity, in turn, only added to my confusion that year.

On May 4, 2007, The Church of Jesus Christ of Latter-day Saints posted an important statement to its online newsroom to clarify what is and is not official Church doctrine, and that statement has been quoted multiple times in subsequent general conference addresses.[2] Let's look at three of the important principles it outlines.

1. "Not every statement made by a Church leader, past or present, necessarily constitutes doctrine. A single statement made by a single leader on a single occasion often represents a personal, though well-considered, opinion, but is not meant to be officially binding for the whole Church."[3]

This point has been quoted in general conference by Elder D. Todd Christofferson and President Dallin H. Oaks, both of whom commented on its implications.[4] Elder Christofferson added Joseph Smith's explanation that "a prophet [is] a prophet only when he [is] acting as such."[5] As a then-member of the First Presidency, Elder Dieter F. Uchtdorf also reiterated that not every idea expressed by a Church leader necessarily reflects the doctrine of the Church. "There have been times," he explained,

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2. "Approaching Mormon Doctrine," Newsroom, May 4, 2007, The Church of Jesus Christ of Latter-day Saints, https://newsroom.churchofjesuschrist.org/article/approaching-mormon-doctrine. For additional explorations of what constitutes "doctrine," see Robert L. Millet, "What Is Our Doctrine?," *Religious Educator* 4, no. 3 (2003): 15–33; Anthony Sweat, Michael Hubbard MacKay, and Gerrit J. Dirkmaat, "Doctrine: Models to Evaluate Types and Sources of Latter-day Saint Teachings," *Religious Educator* 17, no. 3 (2016): 100–25; Michael Goodman, "'Oh Say, What Is Truth?': Approaches to Doctrine," *BYU Studies Quarterly* 60, no. 3 (2021): 13–38, https://byustudies.byu.edu/article/oh-say-what-is-truth.

3. "Approaching Mormon Doctrine."

4. D. Todd Christofferson, "The Doctrine of Christ," *Ensign* 42, no. 5 (May 2012): 88; Dallin H. Oaks, "Trust in the Lord," *Ensign* 49, no. 11 (November 2019): 28–29.

5. "Journal, December 1842–June 1844; Book 1, 21 December 1842–10 March 1843," [170], Joseph Smith Papers, accessed March 30, 2022, https://www.josephsmithpapers.org/paper-summary/journal-december-1842-june-1844-book-1-21-december-1842-10-march-1843/178, quoted in Christofferson, "Doctrine of Christ," 88.

"when members or leaders in the Church have simply made mistakes. There may have been things said or done that were not in harmony with our values, principles, or doctrine."[6]

I did not understand this my freshman year. Shocked that my professors were teaching evolution, I undertook my own study to really pin down what the Church's doctrine on evolution was, and I spent more than a semester compiling various quotes and talks. I found many statements opposing evolution by past Church leaders, and for a time that settled the matter in my mind. Since then, the teachings of modern Apostles have taught me that I need to be more careful in how I identify doctrine.

So, if any statement by any Church leader does not *necessarily* represent doctrine, what does?

2. "With divine inspiration, the First Presidency (the prophet and his two counselors) and the Quorum of the Twelve Apostles (the second-highest governing body of the Church) counsel together to establish doctrine that is consistently proclaimed in official Church publications."[7]

This point was reiterated in a general conference address by Elder Neil L. Andersen:

"A few question their faith when they find a statement made by a Church leader decades ago that seems incongruent with our doctrine. There is an important principle that governs the doctrine of the Church. The doctrine is taught by all 15 members of the First Presidency and Quorum of the Twelve. It is not hidden in an obscure paragraph of one talk. True principles are taught frequently and by many. Our doctrine is not difficult to find."[8]

In a later general conference, President Oaks quoted Elder Andersen's explanation, citing "The Family: A Proclamation to the World" as an example of a doctrinal declaration "signed by

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6. Dieter F. Uchtdorf, "Come, Join with Us," *Ensign* 43, no. 11 (November 2013): 23.
7. "Approaching Mormon Doctrine."
8. Neil L. Andersen, "Trial of Your Faith," *Ensign* 42, no. 11 (November 2012): 42.

all 15 prophets, seers, and revelators."[9] President James E. Faust explained that the Lord has an important purpose behind this principle of a "unanimous voice" (D&C 107:27): "This requirement of unanimity provides a check on bias and personal idiosyncrasies. . . . It ensures that the best wisdom and experience is focused on an issue before the deep, unassailable impressions of revealed direction are received. It guards against the foibles of man."[10]

In other words, while the corpus of official Church doctrine is much more limited when you count only what all fifteen Apostles are teaching, those teachings go through a fifteen-layer vetting process that helps ensure that the Lord's doctrine is taught in its purity. Elder M. Russell Ballard testified that blessings come as we look to the unified teachings of those two quorums, for "when the First Presidency and the Quorum of the Twelve speak *with a united voice,* it is the voice of the Lord for that time."[11]

To be honest, this restricted definition of doctrine can sometimes make it a little harder to figure out if something represents official doctrine—you can't just find a single quote and say that is the official word on the matter! So if something qualifies as official doctrine only when it is taught by all fifteen Apostles, where do we find it?

3. "This doctrine resides in the four 'standard works' of scripture (the Holy Bible, the Book of Mormon, the Doctrine and Covenants, and the Pearl of Great Price), official declarations and proclamations, and the Articles of Faith."[12]

Official doctrine is taught in the scriptures and official Church declarations and "is consistently proclaimed in official Church publications."[13] The "consistency" of these teachings is just as important as where the teachings are found, as continuing revelation

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9. Oaks, "Trust in the Lord," 29.

10. James E. Faust, "Continuous Revelation," *Ensign* 19, no. 11 (November 1989): 11.

11. M. Russell Ballard, "Stay in the Boat and Hold On!" *Ensign* 44, no. 11 (November 2014): 91; emphasis added.

12. "Approaching Mormon Doctrine."

13. "Approaching Mormon Doctrine."

will make some older teachings out of date.[14] An article in the Church's *New Era* magazine suggests asking the following question to help determine if something is official doctrine: "Has it *recently* been *officially* published by the Church (such as in general conference, manuals, magazines, and Church websites)? If the answer . . . is no, you can probably safely conclude that it's not official doctrine."[15]

I did not understand this as a freshman, so my search for the Church's doctrine often cast too wide a net, bringing in statements from unofficial sources, or from once-official sources that were by then much too old to be considered "recent." But we are counseled to make sure we stay up to date with the *current* leaders of the Church. Elder Ballard gave these instructions to teachers:

"As you teach your students and respond to their questions, let me warn you not to pass along . . . outdated understandings and explanations of our doctrine and practices from the past. It is always wise to make it a practice to study the words of the living prophets and apostles; keep updated on current Church issues, policies, and statements through mormonnewsroom.org [now newsroom.churchofjesuschrist.org] and LDS.org [now churchofjesuschrist.org]; and consult the works of recognized, thoughtful, and faithful LDS scholars to ensure you do not teach things that are untrue, out of date, or odd and quirky."[16]

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14. Elder Orson F. Whitney taught, "Divine revelation adapts itself to the circumstances and conditions of men, and change upon change ensues as God's progressive work goes on to its destiny. . . . What the Lord said to the Jews and Nephites 2,000 years ago or what He said to the Latter-day Saints 50 or 60 years ago has no force whatever at this time unless it agrees with present-day revelation, with the Lord's most recent instructions to His people through His chosen or appointed servants." As cited in "Build upon the Rock," *Ensign* 45, no. 3 (March 2015): 80.

15. "How Can I Know If Something I Hear Is 'Official Doctrine'?," *New Era* 47, no. 2 (February 2017): 41; emphasis added.

16. M. Russell Ballard, "By Study and by Faith," *Ensign* 46, no. 12 (December 2016): 27.

I have grown to love the fact that Church teachings and practices can change over time. The Lord called this a "living church" (D&C 1:30), which points to its ability to grow, mature, and adapt, as living things do. As we respond to new mortal circumstances and as the Lord reveals truth "line upon line" (2 Ne. 28:30), Church teachings are adjusted and perfected. This is not a bug in our belief in prophetic revelation; this is the truth at the heart of that belief.

Official Doctrine on Evolution

I have reviewed apostolic teachings about what constitutes official Church doctrine, observing that a teaching is not doctrine just because of the position of the one who said it, that official doctrine is established by the scriptures and by the united voice of the First Presidency and Quorum of the Twelve, and that current official doctrine is consistently taught in recent official publications.

So what, then, of evolution?

Because new revelation may come or Church leaders may issue new clarifying statements, my conclusions here are subject to revision in the future—we have been talking about staying current, after all! But as I write this chapter two decades into the twenty-first century, it seems to me that, at this time, the official doctrine is that there *is* no official doctrine.

While my parents and grandparents grew up in an era when anti-evolution statements were sometimes preached over the pulpit in Church settings, that has simply not been my experience as a Latter-day Saint millennial. I have never heard a general conference speaker decry the theories of "so-called scientists," nor received a new manual stating that there was no death anywhere in the world before the Fall, nor read a Church magazine saying that evolution is contrary to the teachings of the gospel. While I have come across statements like these made by individual Church leaders, the vast majority were made before I was

born. They do not represent recent, official statements authorized by the united voice of the Church's leading quorums.

Tellingly, the most recent statements I can find from official Church sources are emphatically neutral with regard to evolution. "The Church has no official position on the theory of evolution," the *New Era* magazine stated in its October 2016 issue. It went on to explain that "organic evolution, or changes to species' inherited traits over time, is a matter for scientific study. Nothing has been revealed concerning evolution. . . . The details of what happened on earth before Adam and Eve, including how their bodies were created, have not been revealed."[17] Another article (this one featuring a painting of a feathered dinosaur) states that "the details of what happened on this planet before Adam and Eve aren't a huge doctrinal concern of ours. The accounts of the Creation in the scriptures are not meant to provide a literal, scientific explanation of the specific processes, time periods, or events involved."[18]

In 2022, the third volume of the official history *Saints* noted that Apostle John A. Widtsoe had published a series of articles intended to "reconcile gospel knowledge with secular learning," including evolution.[19] *Saints* also describes the national controversies over evolution that took place in the early twentieth century, explaining the different positions of "modernist" Christians (who allowed for evolution) and "fundamentalist" Christians (who saw human evolution as blasphemy) without choosing sides. President Heber J. Grant, *Saints* explains, did not feel he had to "tell people what to believe" about the issue.[20] A Church History Topics article titled "Organic Evolution," prepared to accompany *Saints* and posted to the Church's website, similarly explains evolution

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17. "What Does the Church Believe about Evolution?," *New Era* 46, no. 10 (October 2016): 41.

18. "What Does the Church Believe about Dinosaurs?," *New Era* 46, no. 2 (February 2016): 41.

19. *Saints: The Story of the Church of Jesus Christ in the Latter Days,* vol. 3, *Boldly, Nobly, and Independent, 1893–1955* (Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 2022), 112.

20. *Saints,* 3:247–49.

in a neutral and even-handed tone. It states that "faithful Latter-day Saints [have] continued to hold diverse views on the topic of evolution."[21]

Of course, the Church *does* have official doctrine that touches on the Creation of the earth and the origin of human beings. The same Church magazine article indicating that nothing has been revealed about evolution gave this summary of what doctrine *has* been revealed:

> Before we were born on earth, we were spirit children of heavenly parents, with bodies in their image. God directed the creation of Adam and Eve and placed their spirits in their bodies. We are all descendants of Adam and Eve, our first parents, who were created in God's image. There were no spirit children of Heavenly Father on the earth before Adam and Eve were created. In addition, "for a time they lived alone in a paradisiacal setting where there was neither human death nor future family." They fell from that state, and this Fall was an essential part of Heavenly Father's plan for us to become like Him.[22]

This same careful distinction between what we *do not know* and *do know* from revelation was also modeled by Elder Jeffrey R. Holland in general conference: "I *do not know* the details of what happened on this planet before [the Fall of Adam and Eve,] but I *do know* these two were created under the divine hand of God, that for a time they lived alone in a paradisiacal setting where there was neither human death nor future family, and that through a sequence of choices they transgressed a commandment of God which required that they leave their garden setting but which allowed them to have children before facing physical death."[23]

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21. See "Organic Evolution," Church History Topics, The Church of Jesus Christ of Latter-day Saints, https://www.churchofjesuschrist.org/study/history/topics/organic-evolution, reprinted herein, 331–36.

22. "What Does the Church Believe about Evolution?," 41.

23. Jeffrey R. Holland, "Where Justice, Love, and Mercy Meet," *Ensign* 45, no. 5 (May 2015): 106; emphasis added.

This doctrine of the Creation and the Fall, as expressed by Elder Holland and other Church leaders, of course precludes certain ways of looking at the origin of life, such as the belief that everything is the result of random chance, or the assertion that humans are no different than any other species on our planet. Our belief in heavenly parents who created this earth to help us progress in a great plan of salvation means that there is great purpose and design to our experience here. But as far as the details of how that Creation was carried about, the Church has said it leaves that up to "scientific study."[24]

Understanding What Genesis Is (and Is Not) Doing

In addition to modern apostolic statements, my understanding of evolution as a freshman was shaped by my interpretation of ancient scripture. I read the Creation account in Genesis and concluded that it was clearly opposed to the idea of organic evolution. God designed plants and animals to reproduce "after his" or "their kind" (Gen. 1:11–12, 21, 24–25), not to turn into other things. Before Adam, "there was not a man" (Gen. 2:5), whereas evolutionists claimed a long line of hominids. Adam was told if he ate the fruit he would "surely die" (Gen. 2:17), suggesting death was not a given.

However, having gone through thirteen more years of university study, most of it dedicated to studying the Old Testament, I have come to believe that the clarity I once saw in Genesis was an illusion. When I read Genesis in a nicely printed English book, as in the image below (fig. 1), the text felt very modern, familiar, and accessible:

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24. "What Does the Church Believe about Evolution?," 41. This position is not new. In 1931, the First Presidency wrote that "upon the fundamental doctrines of the Church we are all agreed. Our mission is to bear the message of the restored gospel to the world. Leave geology, biology, archaeology, and anthropology, no one of which has to do with the salvation of the souls of mankind, to scientific research." First Presidency Minutes, April 7, 1931, quoted in William E. Evenson, "Evolution," in *Encyclopedia of Mormonism,* ed. Daniel H. Ludlow, 4 vols. (New York: Macmillan, 1992), 2:478.

In the beginning God created the heaven
and the earth.
2 And the earth was without form, and void;
and darkness was upon the face of the deep.
And the Spirit of God moved upon the face of
the waters.

Figure 1. Genesis 1:1–2 text from the King James Bible.

In contrast, when I think of Genesis today, it is images like this (see fig. 2) that I think of first:

Figure 2. Genesis 1:1–2 as found on a Dead Sea Scrolls manuscript. "Dead Sea Scroll fragment 4Q7 with Genesis 1," by KetefHinnomFan, cropped, https://commons.wikimedia.org/wiki/File:Genesis_1_Dead_Sea_Scroll.jpg, public domain.

This second image (fig. 2) is a snippet from 4QGen^{g}, a copy of Genesis from the Dead Sea Scrolls. Unlike the first image (fig. 1), it comes from a Hebrew scroll, not an English book. It is handwritten, and although it displays Genesis 1:1–2 as in the first image, several words are missing from this fragment today due to its antiquity.

These two images are a visual metaphor for my changing perspective on the text of Genesis. Genesis is *old.* It was written by people who spoke and thought differently than I do. It comes from a culture far removed from my own. It has its own context and history. The handwritten manuscript also hints at the humanity involved in scriptural composition and preservation, something a cleanly printed modern book tends to obscure.

How does the foreignness of Genesis affect how we read it today? On a linguistic level, reading in English masks the complexity and richness of the Hebrew vocabulary. Words like *God, created, heaven, earth, deep, Spirit, waters, day,* or *firmament* all have their own history, nuances, and interpretive challenges, even in Hebrew. In English, it is deceptively easy to think that a word has a single, clear meaning without realizing how much is going on under the surface.

On a cultural level, the Creation account in Genesis both utilizes and reacts to cultural frameworks and cultural points of reference from Israelite society and the broader ancient Near Eastern "pop culture" that the Israelites participated in. By way of analogy, imagine someone giving a sacrament meeting talk today and saying, "Captain America may have beat the Nazis in World War II, but he's no Captain Moroni." That statement draws upon (1) Latter-day Saint insider knowledge, (2) American pop culture, and (3) world history, but it makes sense to any American Latter-day Saint because of our shared cultural references. Someone three thousand years from now, however, might not understand how these two captains are not alike when they share the same rank, and they might not appreciate that Captain America's exploits are fiction even though the Nazi defeat in a world war is real history. In a similar way, there are numerous features of the Genesis Creation account that would have made perfect sense to

an Israelite audience three thousand years ago but that are not clear to us now because we no longer share a common cultural frame of reference.

How do we go about recovering that lost context? To return to our hypothetical sacrament meeting statement, scholars in three thousand years who want to understand the differences between Captain Moroni and Captain America would have to read widely from Latter-day Saint scripture *and* engage with American pop culture—like maybe a few Marvel comics or movies. They would also need a good enough handle on twentieth-century history to recognize truth and fiction regarding World War II. That kind of wide reading would then let them go back to the sacrament meeting talk and figure out all the points of reference. Modern biblical scholars have followed this same procedure for Genesis. Not only have they studied Genesis and the rest of the Old Testament in the original Hebrew, but they also read widely from the surviving texts of Israel's contemporary neighbors, like the Egyptians, Canaanites, and Babylonians. Reading all this comparative literature has revolutionized our understanding of Genesis because now a lot more of the assumed cultural references suddenly make sense.[25]

What have we found from studying texts like Genesis 1 in context? There is not space here to get into much detail, but the super short version is that Genesis is not primarily interested in revealing the physical processes by which the earth was formed and life came to be. The concern, rather, is theological.[26] The cultures

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25. "If this [Genesis 1–11] were the only ancient text we had ever read, it would certainly strike us as quite unique. But for those familiar with other texts from the ancient world, our natural response is a déjà vu feeling that we've seen it all before." James K. Hoffmeier, Gordon J. Wenham, and Kenton L. Sparks, *Genesis: History, Fiction, or Neither? Three Views on the Bible's Earliest Chapters,* Counterpoints: Bible and Theology (Grand Rapids: Zondervan, 2015), 117.

26. See Steven L. McKenzie, *How to Read the Bible: History, Prophecy, Literature—Why Modern Readers Need to Know the Difference, and What It Means for Faith Today* (New York: Oxford University Press, 2005), 31–36; see also Eric A. Eliason's review essay "The Genesis Creation, Eden, and Flood Accounts' Relationship to Natural History in the Light of Recent Bible Scholarship on Ancient Worldviews: What's in It for Latter-day Saints?," *BYU Studies* (forthcoming).

around the Israelites believed many things about God and the world that Genesis considers to be false, and it wants to explain how things *really* are. Here are paraphrases of some of the ideas being taught by the Israelites' neighbors:

- "The gods don't care about humans."
- "Creation couldn't happen until the creator god defeated the forces of chaos in a tremendous battle."
- "Divine beings often quarrel among themselves."
- "We are nothing like the gods."
- "The greatest god is Marduk/Baal/Ra/etc."
- "Who knows why the gods do what they do?"[27]

The revealed truths in Genesis 1 push back against these ideas. The God of Israel is the Creator, not Marduk or Baal or Ra. There is only one God who rules the cosmos, not many gods competing with each other for position. Creation was not the result of an epic divine battle, but rather God commanded, "Let there be!" and creation obeyed. Human beings are not an afterthought but the entire purpose of Creation. God created humans in his image and revealed himself to them from the beginning.[28]

Genesis 1, then, is trying to answer questions about God and his relationship to human beings. It is not interested in answering my modern questions about the age of the earth or human evolution or tectonic plates—the Israelites would not have even understood those questions, let alone the answers, nor would they have found them to be important.

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27. I am paraphrasing all these ideas, but for more information on the ancient Near Eastern context of Genesis, see Peter Enns, *The Evolution of Adam: What the Bible Does and Doesn't Say about Human Origins* (Grand Rapids: Brazos, 2012), 35–76; Peter Enns, *Inspiration and Incarnation: Evangelicals and the Problem of the Old Testament,* 2nd ed. (Grand Rapids: Baker Academic, 2015), 13–60; Marc Zvi Brettler, *How to Read the Bible* (Philadelphia: Jewish Publication Society, 2005), 37–47; and Mark S. Smith, *The Priestly Vision of Genesis 1* (Minneapolis: Fortress, 2010).

28. For a fictional, narrative depiction of how Genesis might have helped ancient Israelites respond to the polytheistic cultures around them, see Rachel Held Evans, *Inspired: Slaying Giants, Walking on Water, and Loving the Bible Again* (Nashville: Nelson, 2018), 1–6.

Using Genesis to learn about physical creation from a modern, scientific point of view has other challenges. Perhaps none is greater than this: not only is Genesis 1 not interested in describing the physical universe from a modern, scientific point of view, but it deliberately utilizes ancient Near Eastern models of the universe that we know are inaccurate.[29]

To explain what I mean, we need to think carefully about how revelation works. The diagram below (see fig. 3) represents how many people imagine the relationship between revealed knowledge and human culture. The dark gray area represents the human cultural environment surrounding us—the customs and beliefs and assumptions and practices of the world at large. Revealed truth, as represented by the white space in the middle, is completely separate from the philosophies of men and other cultural errors. The two sources of knowledge are completely distinct inasmuch as revealed truth comes from a God who knows all truth in its fulness and purity.

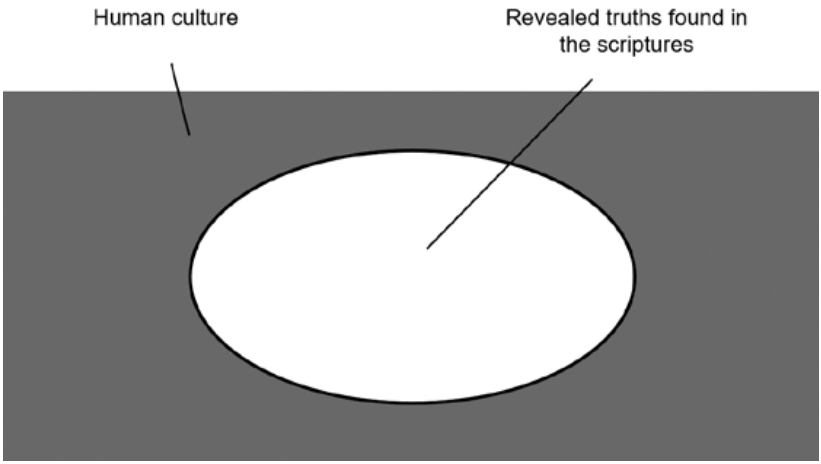

Figure 3. One way to visualize the relationship between revealed knowledge and human culture is to see them as completely distinct.

29. See Kyle Greenwood, "When Worlds Collide: Scripture and Cosmology in Historical Perspective," herein, 49–59.

Although revelation is often assumed to work this way, I don't think that illustration can explain everything we find in the scriptures, nor does it match how the scriptures describe their own nature. In modern revelation, the Lord explained, "Behold, I am God and have spoken it; these commandments are of me, and were given unto my servants in their weakness, after the manner of their language, that they might come to understanding" (D&C 1:24). In other words, God wants to be understood, but with all his infinite power and wisdom, he cannot speak truth in its full perfection and expect us to be able to understand. Instead, he adapts the manner of his language to match our own and speaks to accommodate for our human weakness.[30]

In the modified diagram below (see fig. 4), the dark gray area still represents human culture, along with all of its assumptions and ideas, good or bad. But in this representation, I have separated revealed truth into two categories. In the middle is revelation that "confound[s] false doctrine" (2 Ne. 3:12) by pushing back against false human ideas. These revelatory truths contrast with the ideas of the world, but they are not completely separate from human thought either; at a minimum, such revelation must still conform to "the manner of their language" (D&C 1:24), so I've left it slightly gray in the diagram.[31] Next is a category of revelation I have depicted as light grey, representing an even greater accommodation of divine revelation to human perspectives. This manner of revelation not only conforms to human language but also

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30. For additional discussion of how revelation accommodates for human weakness, see Ben Spackman, "Truth, Scripture, and Interpretation: Some Precursors to Reading Genesis," address, FairMormon conference, August 2017, https://www.fairlatterdaysaints.org/conference/august-2017/truth-scripture-and-interpretation. See also T. Benjamin Spackman, "The 1909 and 1925 First Presidency Statements in Historical and Scientific Contexts," herein, 299–329.

31. For additional discussion of how human interpretation is necessary to understand revelation, see Ben Spackman, "A Paradoxical Preservation of Faith: LDS Creation Accounts and the Composite Nature of Revelation," address, FAIRMormon conference, Provo, Utah, August 7–9, 2019, https://www.fairlatterdaysaints.org/conference/august-2019/a-paradoxical-preservation-of-faith. See also Spackman, "1909 and 1925 First Presidency Statements."

utilizes cultural models, assumptions, and ideas as vehicles for communication—including cultural models, assumptions, and ideas that may be wrong. Such revelation is adapted to human "weakness" (D&C 1:24), sacrificing some accuracy in order to convey more important spiritual truths. Thus, this modified diagram recognizes that there is no sharp division between human culture and divine revelation, for divine revelation is filtered to some degree or another through the limited capacity of human understanding.

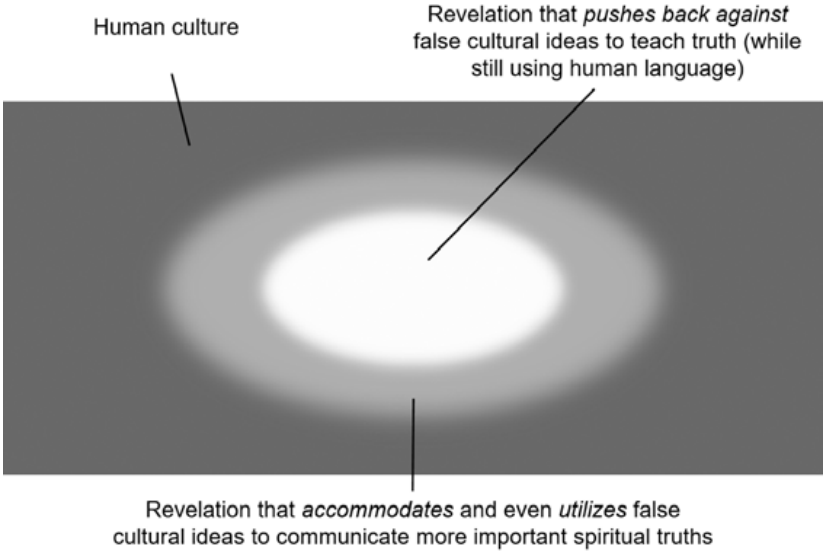

Figure 4. Another way to visualize the relationship between revealed knowledge and human culture is to see God as utilizing human frameworks to communicate with us.

Here is how we might map this framework onto a scriptural text like Genesis 1, our classic account of Creation.[32] As we

32. Latter-day Saints have additional accounts of Creation beyond Genesis 1, including the accounts in the book of Moses, the book of Abraham, and the temple endowment. However, in their own way, each of these accounts are inspired revisions and expansions of Genesis, so they share many of the characteristics of Genesis, including a theological focus on the nature of God and his relationship to humanity over any interest in describing physical creation in scientific terms.

discussed above, some aspects of Genesis 1 *push back against* incorrect cultural ideas (as in the mostly white space in fig. 4). In other ways, however, Genesis 1 taught the Israelites not by *contradicting* the incorrect ideas of their cultural environment, but by *accommodating* and *using* them (as in the light gray space). The revealed text utilizes an incorrect but then-common model of the physical universe (a "cosmology") in order to teach spiritual truths.

Here is a quick summary of that model: As depicted in the Old Testament, the earth is a flat disc, with its land resting on watery depths ("the great deep"; Gen. 7:11; see Gen. 1:2; 8:2). A solid hemisphere (the "firmament") rests above it like an upside-down bowl (Gen. 1:6–8; Ex. 24:10; Job 37:18; Ezek. 1:22), and above that is a watery environment ("the waters which were above"; Gen. 1:7), with the firmament keeping it from crashing down on earth (Ps. 148:4–6). However, gaps can open up in the firmament ("the windows of heaven" Gen. 7:11; 8:2; 2 Kgs. 7:2; Mal. 3:10; see also Isa. 24:18), which allow water to come through in the form of rain. The sun, moon, and stars move "in the firmament," or underneath the solid dome, to provide light to the dry land below (Gen. 1:14–18).[33]

Why would God choose to *accommodate* the Israelites' inaccurate model of the universe instead of *correct* it? My honest answer is that I don't know. If I had to guess, however, I would start by asking what good that would have done. Most ancient Israelites were simple farmers or shepherds. They worked hard from sunup till sundown. Many would never have traveled very far from where they were born. They never looked in a telescope or a microscope. If God had tried to explain solar systems and

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33. For more detail on this biblical model of the universe, see Kyle Greenwood, *Scripture and Cosmology: Reading the Bible between the Ancient World and Modern Science* (Downers Grove, Ill.: IVP Academic, 2015), particularly chapter 3, "Cosmology in Scripture," 71–102; and John H. Walton, *The Lost World of Genesis One: Ancient Cosmology and the Origins Debate* (Downers Grove, Ill.: IVP Academic, 2009).

black holes and nuclear fusion, could they possibly have understood it? And what would have been gained for the effort? I imagine that God had much more important things he wanted them to understand (such as their place in Creation and its goodness), and their existing cosmology, inaccurate as it may have been, worked just fine as a vehicle through which to teach those more important spiritual truths.

Here is a personal story by way of analogy. In my high school science classes, I was taught that atoms look something like figure 5:

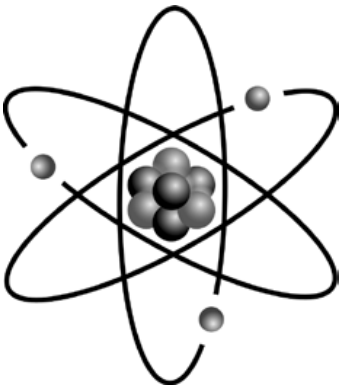

Figure 5. The Bohr model of the atom. "Stylised atom with three Bohr model orbits and stylised nucleus," image by Indolences, modified by Rainer Klute, https://commons.wikimedia.org/wiki/File:Stylised_atom_with_three_Bohr_model_orbits_and_stylised_nucleus.svg, licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license.

This is called the Bohr model of the atom, and the basic idea is that you have the nucleus in the middle with electrons orbiting like planets do around the sun. I remember being taught how to use this model to calculate, for example, which atoms would come together to form molecules.

Then I got to BYU and took Chemistry 105. There I learned that the Bohr model is inaccurate and in fact was obsolete as early as the 1920s. Instead of orbits, electrons actually move unpredictably through sets of probability clouds, like figure 6:

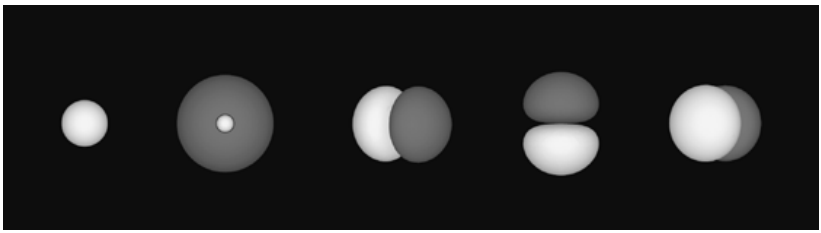

Figure 6. The valence shell model of the atom. "Neon orbitals," by Rakudaniku, https://commons.wikimedia.org/wiki/File:Neon_orbitals.png, public domain.

I remember feeling really confused. Why had my high school teacher taught me a model that was wrong? Our class teaching assistant had an answer: despite its limitations, the Bohr model is (1) easier for high school students to quickly grasp and (2) is actually quite useful for making a number of basic predictions. It reaches a point where it stops being useful (thus we now have quantum physics), but it gets the job done for beginners. As one high school chemistry teacher explained, "Even [information] that is somewhat wrong can be enormously useful."[34]

The cosmology in Genesis 1 is *wrong,* but I think that for the ancient Israelites it was still *useful.* It allowed God to teach them about himself and his purposes for Creation in a way that made sense to them. It is an example of revelation "given unto [God's] servants in their weakness, after the manner of their language, that they might come to understanding" (D&C 1:24). So when we ask if Genesis 1 is "wrong," we have to be careful to define what we mean by wrong. If we are speaking in terms of modern, scientific principles of planetary formation, then yes, it is wrong. But *that is not what Genesis 1 is even trying to do.* If its primary purpose was to teach the ancient Israelites who God was and what their relationship was to him, then Genesis 1 succeeds beautifully.

Let's bring this all together now. I began by saying that as a freshman I read Genesis and thought it clearly spoke against

34. Jason Dyke, quoted in Sam Anderson, "Why It's Okay to Teach Wrong Ideas in Physics," May 31, 2016, Scientific American, https://blogs.scientificamerican.com/guest-blog/why-it-s-okay-to-teach-wrong-ideas-in-physics/.

evolution. Now I think it is very problematic to use Genesis that way. Genesis was not written to answer my modern questions about the age of the earth, or dinosaurs, or Adam's relationship to other hominids. The ancient Israelites would not have even understood those questions. Rather than a scientific treatise in the modern sense, Genesis is a revelatory text answering the ancient Israelites' spiritual questions, and we risk misusing it if we try to make the text do something it was not designed to do. The fact that it chooses to adopt an inaccurate ancient Near Eastern cosmology is even more reason to be cautious about trying to read it as a modern textbook on geology or biology.

Ambiguity, Complexity, and Unresolved Questions

While I was too quick to conclude that the doctrine of the Church and the scriptures are unambiguously opposed to evolution, that does not mean that making sense of evolution has ever been simple. I still have so many questions and have not yet figured everything out. But in comparison with my freshman self, today I am much more comfortable living with ambiguity, complexity, and unresolved questions. When I wrestled with evolution as a freshman, I could not see how the scriptural and prophetic teachings on Adam and Eve could be reconciled with the idea that life has been gradually developed over billions of years. Because I could not see any way to harmonize those ideas, that was evidence for me that either the scriptures were wrong or that the scientists were wrong. (Given that choice, I chose to believe the scriptures.) Today, trying to reconcile these ideas still leads to a lot of unanswered questions. I have had people ask me, "If, theoretically speaking, God did create life on earth through a process of evolution, how does that work with the doctrine of the Fall?" My answer would be that, in all honesty, I have no idea. But unlike my freshman self, I no longer take my inability to *explain* how this would work as sure evidence it *couldn't* work.

I am big on analogies, so here is another—take a look at these two maps (figs. 7 and 8):

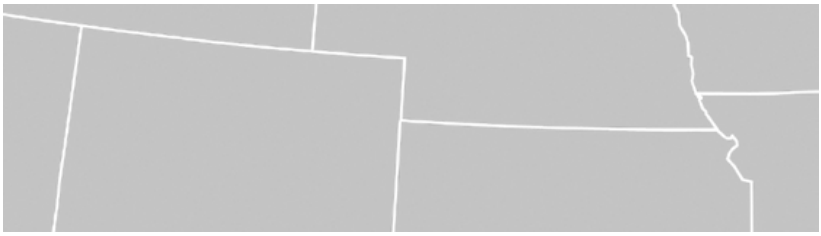

Figure 7. A map showing state borders. "Blank US Map (states only) 2" by Jamesy0627144, modified by Szmenderowiecki, cropped, https://commons.wikimedia.org/wiki/File:Blank_US_Map_(states_only)_2.svg, licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license.

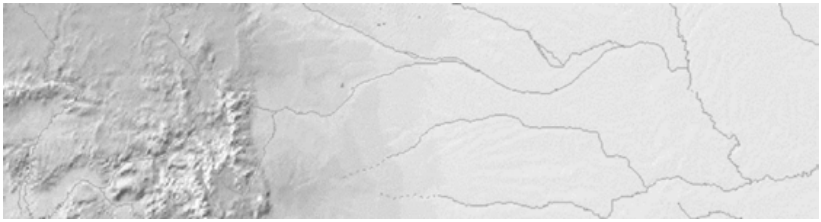

Figure 8. A map showing the physical landscape. "Topographical map of the United States of America," by demis.nl, cropped, https://commons.wikimedia.org/wiki/File:Topographic_map_of_the_USA.png, public domain.

These two maps use state borders and topography respectively to represent the exact same area inside the United States. But because they are answering different questions ("Where are the divisions between states?" versus "What physical features are present?"), the answers each map provides do not appear to be aligned. In fact, the maps may look completely incompatible, like they are not representing the same area at all. In a similar way, it is at least *possible* that evolution as described by scientists and the Fall as described in the scriptures both accurately describe how humans got started, but the answers they provide look different because they are responding to different questions. Reconciling these different questions and answers may not be possible given our current limited knowledge about either scientific evidence or God's revelations, but that does not mean that they cannot be reconciled someday.

As I have come to realize, there are actually many fundamental gospel doctrines I cannot explain in scientific terms. I believe in

the reality of the Resurrection, but I do not know how the physical components that make up my body will be brought together and perfected. I have experience receiving answers to prayer, but I cannot explain how God is able to speak to my mind and heart. And despite the fact that I believe in him, teach about him, and have felt his power on many occasions, I really have no idea how the Atonement of Jesus Christ works. The scriptures testify of the reality of the Savior's sacrifice, and they teach how I can draw upon his healing and saving power, so I am not particularly concerned that I cannot comprehend the metaphysics of it all.[35]

These kinds of limitations are a natural part of our mortal experience where we cannot "comprehend all the things which the Lord can comprehend" (Mosiah 4:9). Even with all that we know, I have come to appreciate Elder Ballard's counsel that sometimes it is "perfectly all right to say, 'I do not know.'"[36]

Conclusion

Speaking of not knowing, I still don't know how exactly God created the earth; introduced plant and animal life; and sent his spirit children, Adam and Eve, to live here. On these questions, I am

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35. Elder Bruce R. McConkie taught, "We do not know, we cannot tell, no mortal mind can conceive, the full important of what Christ did. . . . We know that in some way, incomprehensible to us, his suffering satisfied the demands of justice, ransomed penitent souls from the pains and penalties of sin, and made mercy available to those who believe in his holy name. . . . Then, in a way incomprehensible to us, he took up that body which had not yet seen corruption and arose in that glorious immortality which made him like his resurrected Father. . . . Again, in some way incomprehensible to us, the effects of his resurrection pass upon all men so that all shall rise from the grave. . . . The atonement of Christ is the most basic and fundamental doctrine of the gospel, and it is the least understood." McConkie, "The Purifying Power of Gethsemane," *Ensign* 15, no. 5 (May 1985): 9–10.

36. Ballard, "By Study and by Faith," 27. Elder Paul V. Johnson, serving as the Church's Commissioner of Education, told teachers, "Many of us have a difficult time dealing with ambiguity, especially in issues concerning the Church. In fact, we may be drawn to use quotes in our teaching that are definitive because they seem to dispel the ambiguity. But some quotes are definitive on issues where there is no official answer. People who are more tentative on a subject that hasn't been revealed or resolved don't get quoted as much but may be more in line with where our current knowledge is." Paul V. Johnson, "A Pattern for Learning Spiritual Things," *Religious Educator* 14, no. 3 (2013): 19.

still a seeker. But since my freshman year, I have learned that the Church does not consider evolution to be a doctrinal matter and has said that this is a matter for science to answer. Given that, I am inclined to let the many intelligent men and women who work in those fields help me better understand what evidence has been left in the earth for us to find. I am aware that some Church leaders in the past have said that evolution is incompatible with the doctrine of the Fall, but although I take their concerns very seriously, I also recognize that their opinions do not represent the united voice of the current First Presidency and the Quorum of the Twelve. My own study of the Old Testament has also led me to appreciate the ancient context in which Genesis was created and its limitations for answering my questions in modern, scientific terms. As I continue to study these issues, I strive to seek wisdom "by study and also by faith" (D&C 88:118), ignoring neither the best books nor the voice of the Spirit. Rather than feel frustrated at what I still don't know, I feel incredibly thankful for the Restoration of the gospel of Jesus Christ, which has richly blessed me with knowledge of my heavenly parents and their great plan of happiness. However the world was created, I know who my Creator is, and however God's children got here, I know we can all return home someday.

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What Do We Know from a Religious Epistemology?

When Worlds Collide

Scripture and Cosmology in Historical Perspective

Kyle R. Greenwood

Collision Course

Scientists are generally lauded for their stellar achievements for the cause of humanity. Their work is tedious and painstaking, requiring great intellect and greater patience. They dedicate their lives to thinking outside the box, asking unimaginable questions, and resolving seemingly unresolvable problems. Every now and then they reach a breakthrough, identifying the cause or cure for a disease, locating a distant planet where life could be viable, or finding a more efficient source of energy. In most cases, the general public appreciates their efforts and celebrates new discoveries, excited for the promise these triumphs hold for the qualitative improvement of human life—that is, until science interferes with ideology.

There are many ideological obstructions to the advancement of science. Some obstructions are warranted and necessary. For example, as science moves at breakneck speed with respect to genetic engineering, there are legitimate ethical concerns regarding not what *can* be done but what *should* be done. Other obstructions would seem to be unwarranted and unnecessary. These roadblocks generally operate under the assumption that certain scientific ventures are prompted by ulterior motives. One

such ideological obstruction confronting science is scripture, or more specifically, a tradition of scriptural interpretation that fails to acknowledge a reality of the world apart from the world that is portrayed in the reader's understanding of the Bible. In other words, we have the collision of two worlds: the world as it is and the world as it was.

Well before Charles Darwin ever set foot on the HMS *Beagle,* numerous naturalists had already argued that current species—including humans—descended from other, older species. Some naturalists and clerics were not on board with these new findings, noting "that each species had been independently created and remained fixed and unchanged throughout its existence."[1] Thus, when Darwin first published his *On the Origin of Species,* he articulated his concern that some would dismiss his theory not on the merits of the evidence but on the "plan of creation" and the "unity of design."[2] Unfortunately, he overestimated the impact his evidence would yield in persuading the naysayers and underestimated the degree of influence Protestant creation theology had on accepting what seemed to him obvious scientific conclusions. In his second revised edition, Darwin confronted the ideological obstruction head-on, adding that there is "no good reason why the views given in this volume should shock the religious feelings of anyone."[3] In the 161 years since *On the Origin of Species* was first released, evolutionary theory has been refined and clarified through studies in anthropology, geology, and genetics. Despite the overwhelming evidence in support of the theory, opposition persists in some theological quarters.

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1. Elizabeth A. Johnson, *Ask the Beasts: Darwin and the God of Love* (London: Bloomsbury, 2014), 30.

2. Charles Darwin, *On the Origin of the Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (London: John Murray, 1859), 482.

3. Charles Darwin, *On the Origin of the Species,* 2nd rev. ed (London: John Murray, 1860), 481.

Although the collision between scripture and science as exemplified in Darwin's theory of evolution perseveres,[4] a survey of how this collision played out in another area offers some historical perspective on how biblical interpretation has adapted in light of new scientific information. In exploring that perspective, perhaps Christians can learn from their own history so as not to repeat it and to gain insight on how to proceed with future collisions.

Cosmology in the Ancient World

In his best-selling book *A Brief History of Time,* Stephen Hawking recounts a tale—perhaps apocryphal in origin—about a public encounter between an astronomer and a spunky elderly woman:

> A well-known scientist (some say it was Bertrand Russell) once gave a public lecture on astronomy. He described how the earth orbits around the sun and how the sun, in turn, orbits around the center of a vast collection of stars called our galaxy. At the end of the lecture, a little old lady at the back of the room got up and said: "What you have told us is rubbish. The world is really a flat plate supported on the back of a giant tortoise." The scientist gave a superior smile before replying, "What is the tortoise standing on?" "You're very clever, young man, very clever," said the old lady. "But it's turtles all the way down!"[5]

Amusing as this anecdote may be, it illustrates the collision of two worlds: a modern scientific view of cosmology and a primitive view of cosmology.

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4. That is, the so-called "conflict" or "warfare thesis" between science and religion. See chapter 1 in James R. Moore, *The Post-Darwinian Controversies* (New York: Cambridge University Press, 1981); and more recently, Jeff Hardin, Ronald L. Numbers, and Ronald L. Binzley, eds., *The Warfare between Science and Religion: The Idea That Wouldn't Die* (Baltimore: Johns Hopkins University Press, 2018). Compare Peter Harrison, "Is Science-Religion Conflict Always a Bad Thing? Augustinian Reflections on Christianity and Evolution," in *Evolution and the Fall,* eds. William T. Cavanaugh and James K. A. Smith (Grand Rapids, Mich.: Eerdmans, 2017).

5. Stephen Hawking, *A Brief History of Time* (New York: Bantam, 1996), 2.

In the ancient Near East, the cultural milieu of the Hebrew Bible, the cosmos was not predicated on turtles but on a closed system consisting of three distinct domains: heavens, earth, and sea. The Mesopotamian creation-flood epic *Atra-Hasis* opens with Anu (god of the heavens), Enlil (god of the earth), and Ea (god of the sea) casting lots for possession of the heavens, the earth, and the sea.[6] In Egypt, these three domains are evident, for example, in the "Great Cairo Hymn of Praise to Amun-Re":

> Hail to you—by all flocks,
> Jubilation to you—by all foreign lands,
> To the heights of *heaven,* to the breadth of the *earth,*
> To the depths of the *ocean,*
> The gods bowing to Your Majesty . . .[7]

The Hebrew Bible, likewise, affirms this same cosmic structure. It is used to describe the categories of animals God created in Genesis 1: birds of the heavens, beasts of the earth, and fish of the sea. In the Ten Commandments, the Sabbath is modeled after God's rest on the seventh day after having "made heaven and earth, the sea, and all that in them is" (Ex. 20:11). In Ezra's prayer at the Water Gate, he acknowledged God as maker of heaven, earth, and seas (Neh. 9:6). The book of Proverbs recalls how the Lord in his wisdom founded the earth, established the heavens, and broke open the deep (3:19–20).

However, it is simply not enough to say the cosmos was three-tiered. It is also important to understand how the ancients viewed those domains. For them, the earth was not a sphere but considered a flat disk (Dan. 4:10–11) supported by foundational pillars (Job 38:4–6). The realm of the dead, or "the land of darkness" (Job 10:21), lay beneath the earth and was situated at the opposite end of the cosmos from the heavens (Amos 9:2).

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6. For more on Mesopotamian cosmology in particular, see Wayne Horowitz, *Mesopotamian Cosmic Geography* (Winona Lake, Ind.: Eisenbrauns, 1998).

7. Robert K. Ritner, "Great Cairo Hymn of Praise to Amun-Re (1.25)," in *The Context of Scripture,* vol. 1, *Canonical Compositions from the Biblical World,* ed. William W. Hallo and K. Lawson Younger Jr. (Leiden: Brill, 2003), 38, emphasis added.

The heavens were divided into the lower and upper heavens by a dome or tent-like structure known as the firmament (Gen. 1:6–8). In the lower heavens were the birds, as well as the stars (1 Sam. 17:44; Isa. 14:12), which revolved around the earth (Josh. 10:12–13) and were set in the firmament (Gen. 1:14). The upper heavens were reserved for deities and angels (Job 1:6). Surrounding the entire cosmos were the cosmic seas (Gen. 7:11; Ps. 72:8). The seas above were held aloft by the firmament (Gen. 1:6–7; 7:11), an impermeable barrier that had windows through which precipitation fell (2 Kgs. 7:2). The seas below were the source for springs, wells, rivers, and lakes (Ezek. 31:3–5) but were also the source of potential chaos (Isa. 27:1), whose powers needed constraining (Hab. 3:10; Job 38:8–11). This is not to say that the Bible borrowed from the ancient Near East. Rather, it is better to say that the Bible assumed the trappings of its environment.

Aristotelian Cosmology

Starting in the fifth century BCE, the Greek philosopher Parmenides began to question the structure of the cosmos, not on theological or mathematical grounds per se but on philosophical grounds. For Parmenides, the cosmos must be spherical because the sphere is the perfect shape, "identical throughout, consisting of like bordering on like."[8] Over the next two centuries, Greek philosophers refined the idea of a spherical cosmos, culminating in Aristotle's geocentric cosmological model consisting of one sphere for each of the heavenly bodies. Aristotle, like those before him, was a philosopher grounded in Platonism, in which perfection lay in the forms and whereby Earth is but a shadow of the perfect heavens. According to Aristotle's model, the earth was situated at the center of the cosmos, with each of the interconnected heavenly physical spheres revolving around it in a twenty-four-hour cycle. Beyond the outermost sphere resided an

8. I. Crystal, "The Scope of Thought in Parmenides," *Classical Quarterly* 52, no. 1 (2002): 216.

Unmoved Mover, a spiritual entity responsible for the movement of the spheres. Aristotle's cosmology was simple and accounted for nearly every observable astronomical phenomenon. A few centuries later, the Greek mathematician Ptolemy, detached from Platonic influences, accounted for the apparent retrograde movement of planets by abandoning the metaphysical requirement of spheres and posited "epicycles," miniature orbits around the rotating sphere.

Neither Aristotle nor Ptolemy were men of biblical faith, yet Aristotelian cosmology was generally accepted by both Jews and Christians. Even when these interpreters did not fully accept every tenet of Aristotelian cosmology, they were compelled to reckon their views with it. The Aristotelian model could not merely be ignored or dismissed on the basis that it did not originate from the Bible or from Christian thinkers. Moreover, these interpreters not only conceded many of the Aristotelian concepts but occasionally appealed to them to support their own exegesis.

Broadly speaking, then, post-Aristotelian interpreters adapted their interpretation of scripture in light of new understandings of the physical universe, which had implications for several areas of biblical interpretation. The foundations of the earth could no longer be thought of as physical columns but rather as a metaphor for God's sustaining power. The greater light and lesser light were reinterpreted in terms of the amount of light the sun and moon emitted, rather than their size. The fact that Genesis 1 speaks of two heavens suddenly became nonproblematic, since the Greek philosophers had determined several more than that. A global earth had to be reconciled with the possibility of people living on the other side of it.[9] The waters above

9. The idea that Europeans prior to Columbus believed in a flat earth was popularized by one of the "warfare hypothesis" authors in the nineteenth century. See Jeffrey Burton Russell, *Inventing the Flat Earth: Columbus and Modern Historians* (New York: Praeger, 1991); and Lesley B. Cormack, "Myth 2. That before Columbus, Geographers and Other Educated People Thought the Earth was Flat," in *Newton's*

the firmament suddenly became problematic in light of a spherical firmament. Wherever the biblical text touched on issues of cosmology, interpreters had to contend with Aristotelian cosmology, which meant that they often had to adjust the way they interpreted scripture.

Perhaps the most influential element of Aristotelian cosmology did not have to do with how interpreters had to respond but how the Roman Catholic Church embraced its premise to exercise control. According to the Aristotelian model, humans maintained their pride of place as the pinnacle of—and the center of—God's creation.[10] Since the church declared itself as the divinely established institution to govern humanity, the Aristotelian model validated its status as the center of the cosmos, around which all else revolved.

Copernican Cosmology

In the midst of the Renaissance, which saw a flurry of advances in the arts and science, the brilliant mathematician Nicholas Kopernik was born in the Polish town of Turin. Although the parish was his career, astronomy was his obsession. Frustrated with the complexities of Ptolemy's epicycles, he wondered if a moving, rather than stationary, earth might better explain planetary observations. Using geometrical theorems, mathematical formulae, and simple surveillance of the heavens, Copernicus (as he would come to be known) determined that the Aristotelian-Ptolemaic system could not stand up to scrutiny, ultimately concluding that "it is more probably that the Earth moves than that it is at rest—especially in the case of the daily revolution, as it is

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Apple and Other Myths about Science, ed. Ronald L. Numbers and Kostas Kampourakis (Cambridge: Harvard University Press, 2015).

10. David C. Lindbergh, "The Medieval Church Encounters Classical Tradition: Saint Augustine, Roger Bacon, and the Handmaiden Metaphor," in *When Science and Christianity Meet,* ed. David C. Lindbergh and Ronald L. Numbers (Chicago: University of Chicago Press, 2003), 7–32.

the Earth's very own."[11] Finally in 1543, Copernicus mustered the courage to publish *De Revolutionibus orbium coelestium,* where he posited the revolutionary idea that Earth orbits the sun, along with the five planets: Mercury, Venus, Mars, Jupiter, and Saturn.

Copernicus was well aware of the implications this theory had on interpretations of church dogma. He even disdainfully anticipated her resistance: "But if perchance there are certain 'idle talkers' who take it upon themselves to pronounce judgment, although wholly ignorant of mathematics, and if by shamelessly distorting the sense of some passage in Holy Writ to suit their purpose, they dare to reprehend and to attack my work; they worry me so little that I shall even scorn their judgments as foolhardy."[12] Little did he know that there would be little opportunity for him to face any potential accusers, for he died within the year. Instead, another astronomer would soon take up the mantle and feel the full force of the Holy See's ire.

In his late teens, Galileo Galilei enrolled in the University of Pisa to study medicine. It was there that he earned the perpetual reputation as an intellectual who would not accept an argument without evidence. Due to this inquisitive spirit, he would eventually be known as the "father of the scientific method." For the first half decade he was on faculty at the University of Padua, Galileo taught Aristotelian cosmology. One day while pondering the tides, Galileo concluded that the Copernican system provided a more logical explanation of the cosmos than the Aristotelian model. His new position was bolstered when the German mathematician-philosopher Johannes Kepler sent him a copy of his *Mysterium cosmographicum,* which provided mathematical verification for the Copernican system.

While Galileo remained relatively quiet about his newfound appreciation for Copernican cosmology, two major events turned

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11. Nicolaus Copernicus, *On the Revolutions of Heavenly Spheres,* trans. Charles G. Wallis, Great Minds Series (Amherst, N.Y.: Prometheus, 1995), 18.

12. Copernicus, *On the Revolutions of Heavenly Spheres,* 7.

him into a vocal supporter of heliocentrism and a vocal critic of geocentrism. First, two supernovas appeared between 1572 and 1604, completely undermining the Aristotelian position that the heavens were unchanging. Second, the Dutch eyeglass maker Hans Lippershey invented the telescope, prompting Galileo to invent his own. He soon pointed his instrument at Jupiter and discovered four moons orbiting the planet. He looked at Venus and realized that its moon-like phases indicated that Venus, too, orbited the sun. He saw that the moon was not a perfectly round sphere, but was pocked with craters, and that the sun had spots. It was now incontrovertible that the heavens were not perfect or immutable. The stage was set for yet another collision.

Aristotle's model had stood firm for over two thousand years. Whereas Aristotelian cosmology was received fairly warmly by biblical interpreters, the Copernican Revolution was met with strong theological resistance, primarily due to the conflation of Aristotelian cosmology with Catholic (and in other instances Protestant) theology and anthropology. The Copernican model was so threatening to the church's authority that Galileo was ultimately forced to recant heliocentrism and was placed under house arrest for the final nine years of his life. For Protestants, the main point of contention was its apparent violence against the "plain sense" meaning of the biblical text. If the Bible says the earth does not move (Ps. 104:5) and that God caused the sun, not the earth, to stand still (Josh. 10:12), then no mathematical equation could overturn it.

When Worlds Collide

There is little dispute today regarding the basic structure of the universe, that it began with a massive explosion of space approximately fourteen billion years ago, that it is expanding, that there are dark matter and black holes, and that there are galaxies billions of light-years away. The Bible speaks of none of these things, yet for thousands of years biblical interpreters wrestled with how

their understanding of the cosmos fit into their understanding of scripture. They were, in effect, attempting to cognitively navigate the collision of two worlds.

The nature of science is such that it is always changing. For some skeptics, this fact is reason enough to distrust it. With rare exception, however, a turn in scientific opinion does not result in an overturning of old scientific theories. Copernicus did not get it right that the universe is comprised of seven (and only seven) spheres orbiting a stationary sun. He could not have seen that our solar system is part of a galaxy or that the galaxy itself is moving through the universe. These factors do not negate his model; they are improvements upon his theory. We have not seen a reversal of Copernican cosmology, but a refinement of it.

If we have learned anything from cosmological history, it is that eventually interpretations of scripture are subject to negotiation when confronted with compelling external evidence. The primitive cosmological model was eventually overthrown by the more sophisticated Aristotelian model, and interpreters adapted by employing more sophisticated interpretive strategies. The Aristotelian model was eventually overthrown by the even more sophisticated Copernican model, and interpreters adapted by employing even more sophisticated interpretive strategies. Modern interpreters have learned that they must rely on more than just their *sense* of what the text means. They must consider the original culture, linguistic facets of the text, the rhetorical purpose of the narrative, the use of idioms and other figures of speech, and an ever-increasing array of hermeneutical tools.

Like science, biblical interpretation is constantly in a state of flux. Each time a new artifact is unearthed from the biblical world, every time a new text surfaces from the Middle East, with every advancement in linguistic studies of Semitic languages, the potential exists that some facet of biblical interpretation may be turned on its head. Despite the possibility of such negative prospects, Christianity typically does not shudder from such ventures but rather (hopefully) relishes the exciting possibility that

new insights will be gleaned and our understanding of scripture heightened.

Believers typically fear the colliding of scripture and science. After all, collisions usually bring destruction, wreaking irreparable harm on both parties. But not all collisions are destructive. Some collisions are constructive, resulting in fusion. The church is at its best when it recognizes that all truth is God's truth, that Creation reveals its Creator, and that the God revealed in scripture is the same God who reveals science. Scripture and science complement, rather than contradict, each other.

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The Genesis Creation Account in Its Ancient Context

Avram R. Shannon

The Old Testament begins with the famous words "In the beginning God created the heaven and the earth" (Gen. 1:1). There is, in the Bible as it stands, no prelude to or explanation of this text, so this section immediately invites question and interpretation. Indeed, the famous Jewish biblical interpreter Rashi said, "This verse says nothing other than, 'Interpret me!'"[1] Example questions that immediately arise include "Who is God?" "In the beginning of what?" and "What does it mean to create?" Further, the question of how creation informs our relationship with God and each other has underscored Jewish and Christian cosmologies for centuries, including the cosmology of Latter-day Saints.[2]

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1. Rashi, on Genesis 1:1 (author's translation). There is an accessible Jewish Bible with English translations of the various medieval Jewish commentators in *The Commentators' Bible: Genesis: The Rubin JPS Miqra'ot Gedolot,* ed. Michael Carasik (Philadelphia: Jewish Publication Society, 2018). The citation from Rashi is on p. 3.

2. The first few chapters of Genesis have been the subject of myriads of studies and commentaries. Some that the present author found useful were the following: Claus Westermann, *Genesis 1–11: A Commentary*, trans. John J. Scullion, (Minneapolis: Augsburg Publishing House, 1984); E. A. Speiser, *Genesis* (Garden City, N.Y.: Doubleday, 1964); Umberto Cassuto, *A Commentary on the Book of Genesis: Part I from Adam to Noah,* trans. Israel Abrahams (Jerusalem: Magnes Press, 1961); Ronald S. Hendel, *The Text of Genesis 1–11: Textual Studies and Critical Edition* (New York: Oxford University Press, 1998); and Thomas Krüger, "Genesis 1:1–2:3 and the

The Church of Jesus Christ of Latter-day Saints is not committed to a specific literal reading of much in the Genesis Creation accounts.[3] For example, in discussing the description of Eve's creation from the rib, President Spencer W. Kimball succinctly observed, "The story of the rib, of course, is figurative."[4] In a similar vein, Elder Russell M. Nelson stated that "whether termed a *day,* a *time,* or an *age,* each phase was a period between two identifiable events—a division of eternity."[5] These observations create space for understanding the Creation accounts in Genesis in a variety of ways, whether figuratively as President Kimball did or indefinitely as Elder Nelson did.[6]

The purpose of this paper is to explore the ancient context and cosmological worldview of the Creation account as presented in Genesis 1 and 2 as well as what that means for Latter-day Saints. It

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Development of the Pentateuch," in *The Pentateuch*: *International Perspectives on Current Research,* ed. Thomas B. Dozeman, Konrad Shmid, and Baruch J. Schwartz (Tübingen: Mohr Siebeck, 2011), 125–38.

3. Although not quite as many as in the sphere of general biblical scholarship, there are numerous Latter-day Saint studies on Genesis as well. See Kevin L. Barney, "Examining Six Key Concepts in Joseph Smith's Understanding of Genesis 1:1," *BYU Studies* 39, no. 3 (2000): 107–24 https://byustudies.byu.edu/article/examining-six-key-concepts-in-joseph-smiths-understanding-of-genesis-11; Daniel L. Belnap, "The Law of Moses: An Overview," in *New Testament History, Culture, and Society: A Background to the Texts of the New Testament,* ed. Lincoln H. Blumell (Provo, Utah: Religious Studies Center, Brigham Young University; Salt Lake City: Deseret Book, 2019), 19–34; Daniel L. Belnap, "In the Beginning: Genesis 1–3 and Its Significance to the Latter-day Saints," in *From Creation to Sinai: The Old Testament through the Lens of the Restoration,* ed. Daniel L. Belnap and Aaron P. Schade (Provo, Utah: Religious Studies Center, Brigham Young University; Salt Lake City, Deseret Book, 2021), 1–42; and David Rolph Seely, "'We Believe the Bible as Far as It is Translated Correctly': Latter-day Saints and Historical Biblical Criticism," in *Tracing Ancient Threads in the Book of Moses: Inspired Origins, Temple Contexts, and Literary Qualities*, ed. Jeffrey M. Bradshaw and others (Orem, Utah: Interpreter Foundation, 2021), 137–62.

4. Spencer W. Kimball, "The Blessings and Responsibilities of Womanhood," *Ensign* 6, no. 3 (March 1976): 71.

5. Russell M. Nelson, "The Creation," *Ensign* 30, no. 5 (May 2000): 85, emphasis in original. Elder Nelson cited the textual difference in the book of Abraham as part of the rationale for this statement.

6. Philip L. Barlow describes this Latter-day Saint reading tendency as "selective literalism." See Philip L. Barlow, *Mormons and the Bible: The Place of the Latter-day Saints in American Religion* (New York: Oxford University Press, 1991), 33–35.

is also worth noting what this paper is *not* doing. This paper does not attempt a reconciliation between modern science and the Creation account in the biblical book of Genesis.[7] Indeed, in this chapter, I take as a base assumption Nephi's statement that God speaks to people "according to their language, unto their understanding" (2 Ne. 31:3). The authors and editors of Genesis were not twenty-first-century scientists, and we do them and ourselves a disservice if we expect twenty-first-century science from them.[8] In the dedication of the Life Sciences Building at BYU, President Russell M. Nelson stated, "There is no conflict between science and religion. Conflict only arises from an incomplete knowledge of either science or religion, or both."[9] Understanding what Genesis is and is not doing gives us a more complete knowledge of the scriptural perspective by showing its ancient perspective. This can then help us to reduce potential conflict in reading the scriptures by giving us a more complete knowledge of religion.

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7. Others have attempted to make this connection, and the interested reader is directed in that direction. For a few Latter-day Saint examples, see R. Grant Athay, "'And God Said, Let There Be Lights in the Firmament of Heaven,'" *BYU Studies* 30, no. 4 (1990): 39–53, https://byustudies.byu.edu/article/and-god-said-let-there-be-lights-in-the-firmament-of-the-heaven; Hollis R. Johnson, "Worlds Come and Pass Away: Evolution of Stars and Planets in the Pearl of Great Price?," *BYU Studies* 50, no. 1 (2011): 46–64, https://byustudies.byu.edu/article/worlds-come-and-pass-away-evolution-of-stars-and-planets-in-the-pearl-of-great-price; and Michael D. Rhodes, "The Scriptural Accounts of the Creation: A Scientific Perspective," in *Converging Paths to Truth: The Summerhays Lectures on Science and Religion,* ed. Michael D. Rhodes and J. Ward Moody (Provo, Utah: Religious Studies Center, Brigham Young University; Salt Lake City: Deseret Book, 2011), 123–49.

8. T. Benjamin Spackman has been speaking and writing on this topic for long time. See his FairMormon presentations "Truth, Scripture, and Interpretation: Some Precursors for Reading Genesis," https://www.fairmormon.org/conference/august-2017/truth-scripture-and-interpretation; and "A Paradoxical Preservation of Faith: LDS Creation Accounts and the Composite Nature of Revelation," https://www.fairlatterdaysaints.org/conference/august-2019/a-paradoxical-preservation-of-faith. Spackman is particularly good at articulating how our expectations feed into our readings of Genesis.

9. Marianne Holman Prescott, "Church Leaders Gather at BYU's Life Sciences Building for Dedication," Church News, The Church of Jesus Christ of Latter-day Saints, April 17, 2015, https://www.churchofjesuschrist.org/church/news/church-leaders-gather-at-byus-life-sciences-building-for-dedication.

Moses and Authorship

In order to understand the ancient context of Genesis, it is important to consider who wrote it. Numerous Restoration scriptures, including the Book of Mormon and Joseph Smith's New Translation of the Bible (JST), assume the existence of Moses as a historical figure associated with a law given by God.[10] However, Moses can be a historical prophet, and the books in the Bible records can be of God's doing, without Moses specifically having written those books as we now have them. Moreover, Restoration scriptures do not claim that Moses wrote every word in the "five books of Moses," nor do the books themselves.[11] In fact, they make no claims about authorship at all and are all written in the third person, suggesting that the record that we have is from someone else speaking about Moses.[12]

This is true even of the inspired changes made by Joseph Smith as part of his New Translation. Because the Creation accounts in Moses 2–3 are framed as direct discourse between the Lord and Moses, Latter-day Saints have occasionally assumed that the JST supports notions of Mosaic authorship.[13] But a close examination of the Book of Moses, especially the prefatory vision published as Moses 1, shows that this is not the case (see the revelatory aside to Joseph Smith in Moses 1:42). Like the Book

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10. See, for example, 1 Nephi 4:2; 17:24–29; 2 Nephi 3:9–10; 25:20–24; Mosiah 13:5.

11. Belnap, "The Law of Moses," 20. For some thoughts on the organization and composition of the law of Moses on the brass plates, see Avram R. Shannon, "The Documentary Hypothesis and the Book of Mormon," in *They Shall Grow Together: The Bible in the Book of Mormon*, ed. Charles Swift and Nicholas J. Frederick (Provo, Utah: Religious Studies Center, Brigham Young University; Salt Lake City: Deseret Book, forthcoming), 249–76. Although the Church's Bible Dictionary entry for "Pentateuch," 2020, https://www.churchofjesuschrist.org/study/scriptures/bd/pentateuch, suggests that Moses was the principal author of the Pentateuch (the first five books of the Bible), it also suggests that he used sources and that the books were edited by later authors.

12. This is not to say that the scriptures claim that Moses did no writing. In fact, Moses 1:40 explicitly states Moses does write. It does not claim, however, that we have that writing, and Moses 1:41 implies that we do not have that writing.

13. Kent P. Jackson, *The Restored Gospel and the Book of Genesis* (Salt Lake City: Deseret Book, 2001), 55–65.

of Mormon, Genesis is an ancient record that draws on previous sources to produce an inspired record. The JST supports the theory that the Creation accounts are based on revelations given to Moses, but it also informs us that this is a third-person retelling of Moses's interaction with the Lord, rather than a first-person account of his experience. We see similar things happening with Mormon in the Book of Mormon and with certain sections of the Doctrine and Covenants.[14]

Although Latter-day Saints affirm the inspired nature of Genesis, it should not be troubling for Latter-day Saints to think of our scriptural books as revisions of various edited and redacted sources.[15] This process of combining and updating the scriptures is an important part of how the scriptures remain relevant for the Lord's people in every dispensation.[16] As we read the Book of

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14. For the Book of Mormon, see Grant Hardy, *Understanding the Book of Mormon: A Reader's Guide* (New York: Oxford University Press, 2010), 121–51. See also Hardy's earlier "Mormon as Editor," in *Rediscovering the Book of Mormon*, ed. John L. Sorenson and Melvin J. Thorne (Provo, Utah: Foundation for Ancient Research and Mormon Studies, 1991), 15–28. For the Doctrine and Covenants, see Ryan J. Wessel, "The Textual Context of Doctrine and Covenants 121–23," *Religious Educator* 13, no. 1 (2012): 103–15. See the discussion on redaction in the scriptures in Avram R. Shannon, "The Bible Before and After: Interpretation and Translation in Antiquity and the Book of Moses," in Bradshaw and others, *Tracing Ancient Threads,* 257–92, discussion on 263.

15. For a Latter-day Saint discussion of the law of Moses, with a discussion of sources and redaction, see Belnap, "The Law of Moses." See also the historical overview in Shannon, "Bible Before and After," 261–63. A popular explanation of what is called the Documentary Hypothesis is available in Richard Elliot Friedman, *Who Wrote the Bible?* (San Francisco: Harper San Francisco, 1997). The first Creation is associated with the Priestly Source, while the second is associated with the Yahwistic Source. For a recent discussion of the composition of Genesis 1 and 2 from a scholarly perspective, see David M. Carr, *The Formation of Genesis 1–11: Biblical and Other Precursors* (New York: Oxford University Press, 2020). On the other side, David Fried has recently argued that Genesis 1 and 2 are integrally related to one another. See David Fried, "The Image of God and the Literary Interdependence of Genesis 1 and Genesis 2–3," *Jewish Bible Quarterly* 47, no. 4 (2019): 211–16.

16. The process of ongoing revelation is a vital part of how Latter-day Saints understand their religion and their relationship with Jesus Christ. This is evident in Joseph Smith's Article of Faith 1:9. See the discussion in Richard Lyman Bushman, *Rough Stone Rolling* (New York: Alfred A. Knopf, 2005), 172–76. See also Shannon, "Bible Before and After," 266–74.

Mormon, we see that Mormon's project was one of editing and compiling but also that Mormon felt comfortable including his interpretive glosses (see Alma 24:27). The Book of Mormon is explicit that the book of Alma in its present form was composed by Mormon from authentic material deriving from Alma. In a similar fashion, the five books of Moses, including Genesis, seem to have been composed and compiled from authentic material deriving from Moses and other earlier prophetic sources.[17] All of this suggests that Latter-day Saints can take a strong stand on the inspired nature of the material in Genesis while still allowing for complexities in how it came together.

The Work of the Editor

The use of sources by the inspired editor of Genesis suggests that there is not a unified Creation account in Genesis. As scholars have studied Genesis, they have identified two Creation accounts woven together by a later editor or redactor.[18] The first Creation account runs from Genesis 1:1 through 2:3. The second begins at 2:4. The two Creation accounts differ in several particulars. In the first Creation account, males and females are created at the same time (Gen. 1:26–27), while in the second account, the female is created after and from the male (Gen. 2:18–22). The splitting up of the Creation into days is a characteristic of the first Creation account, while the creation of the Garden of Eden is a characteristic of the second account.

It is also worth remembering that the authors and editors of Genesis were not writing for a future audience the way Mormon was. The immediate addressees of the Creation accounts were not

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17. It is perhaps worth noting that we do not have evidence for Hebrew as a language until centuries after Moses. This means that Moses could not have written Genesis in its present form, since Genesis is written in Hebrew and Moses did not speak Hebrew. See Angel Sáenz-Badillos, *A History of the Hebrew Language,* trans. John Elwolde (Cambridge: Cambridge University Press, 1993), 53–56, 64–65.

18. See Bradford A. Anderson, *An Introduction to the Study of the Pentateuch* (London: Bloomsbury T&T Clark, 2017), 78–79. Because Latter-day Saints "believe the Bible to be the word of God" (A of F 1:8), this implies that we believe this editor or redactor to be inspired. See Seely, "We Believe the Bible," 141–43.

modern Latter-day Saints; they were ancient Israelites, and the Creation accounts in Genesis contain cosmological and scientific perspectives that are derived from that audience's worldview. Although it can be valuable to read the Creation accounts as metaphorical and figurative (we will see clear examples of this, even anciently), they also had scientific value in the ancient world. The ancient Israelites simply had a different understanding of science than we do today. It appears the Lord was comfortable with that—as noted above, this is part of what Nephi seems to be referring to when he talks about God speaking to people "according to their language, unto their understanding" (2 Ne. 31:3). This statement can include cosmological and scientific understandings.[19]

Cosmology in Genesis 1

The difference between ancient and modern understandings comes out even in translation. The King James translation of Genesis 1:1 is, in many ways, a reflection of how the seventeenth-century European cosmological perspective differed from that of the ancient Israelite-Judahite authors and editors of Genesis.[20] As it stands in the English of the KJV, "In the beginning" reflects a notion that this was where everything started, and there was nothing before.[21] This is not the Latter-day Saint position, and it is not really the position of the book of Genesis.

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19. See Doctrine and Covenants 1:24, where the Lord tells the Saints that he gave the revelations in the Doctrine and Covenants to "[his] servants in their weakness." The Lord acknowledges that we are not able to comprehend everything he is trying to tell us.

20. There is a useful discussion of the cosmological worldview of the ancient Israelites in Luis I. J. Stadelmann, *The Hebrew Conception of the World: A Philological and Literary Study* (Rome: Pontifical Biblical Institute, 1970). See also Louis Jacobs, "Jewish Cosmology," in *Ancient Cosmologies,* ed. Carmen Blacker and Michael Loewe (London: George Allen and Unwin, 1975), 66–86. Although it is focused on the New Testament, Lincoln H. Blumell and Jan J. Martin's article on the history and character of the KJV is instructive. See Lincoln H. Blumell and Jan J. Martin, "The King James Translation and the New Testament," in *New Testament History, Culture, and Society,* 672–90.

21. For a discussion of the difficulties in translating Genesis 1:1, see Krüger, "Genesis 1:1–2:3," 128–29. See also Barney, "Examining Six Key Concepts."

In fact, the Hebrew here, *bereshit,* lacks the definite article and would be better translated as "in *a* beginning."[22] This certainly fits Latter-day Saint understandings better. However, a closer examination of the Hebrew shows that even this does not quite explain what is happening grammatically.[23] *Bereshit* is best understood as a temporal adjunct explaining the situation that arises when God creates the earth. The New Jewish Publication Society (NJPS) translation of Genesis 1 provides a translation that reflects this grammatical reading: "When God began to create heaven and earth—the earth being unformed and void" (Gen. 1:1–2a). Note here how this translation turns the term not into an absolute statement about beginnings but rather into a statement about the state of the earth when Creation begins.[24]

The NJPS translation of Genesis 1:1 retains the very theological-sounding word "heaven." Although this is fine, it does not really reflect the nuance of the Hebrew. "Heaven" is one possibility for the Hebrew word *shamayim*, which has "sky" as its core meaning.[25] Many languages do not differentiate between "sky" as a descriptive noun and "heaven" as a theological or cosmological concept.[26] Hebrew is no different. As far as Genesis is concerned, what is being created here is not the heavens in the specific sense of the grand cosmological worldview but the visible sky, which is understood as being in some sense where God will dwell, but he clearly does not at this point because the sky has not yet been created. There is a similar process going on with the Hebrew word *eretz*, which does mean "earth," but usually in the sense of

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22. To say "In the beginning," it would need to read *bareshit*. There is some evidence of this reading in Origen's Hexapla, but that is not how the Masoretes (the school of copyists who preserved the traditional reading of the Hebrew text) understood the Hebrew of Genesis 1:1. In the Middle Ages, Jewish scholar and exegete Rashi discussed the grammatical difficulties with this word, concluding that water must have already existed when the earth was created. See Rashi, on Genesis 1:1, in Carasik, *Commentators' Bible,* 4–5.

23. Cassuto, *Commentary on the Book of Genesis*, 19–20.

24. Barney, "Examining Six Key Concepts," 110–12.

25. Stadelmann, *Hebrew Conception*, 37–39.

26. See, for example, *ciel* in French or *Himmel* in German.

land or ground[27] rather than in the sense of the entire planet (in part because, as we will see, the ancient Israelites did not view the world as a globe). Thus, I would translate Genesis 1:1–2a as, "When God began to create sky and land, the land being empty and desolate."[28]

Creation in Genesis is not framed around the idea of creation out of nothing but is based on the organization of material that is already extant. The word "create" is translated from the Hebrew *bara*, a word that means something like "organize" rather than active creation out of nothing.[29] Therefore, the original Genesis 1 presumes that there is already something there when God begins his creative activity: "empty and desolate" land.

Genesis 1:2 (NJPS) goes on, "With darkness over the surface of the deep, and a wind from God sweeping over the water." The KJV here has "And darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters." There is here a key difference between "wind from God" and "the Spirit of God." Once again, the difference lies in the translation. In Hebrew, the word for "spirit" and the word for "wind" are the same.[30] This

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27. Biblical scholar Scott B. Noegel has argued from Mesopotamian parallels that it means "underworld" in this context. Scott B. Noegel, "God of Heaven and Sheol: The 'Unearthing' of Creation," *Hebrew Studies* 58 (2017): 119–44. Noegel is correct in his observation that there are numerous places in both the Hebrew Bible (Old Testament) and cognate literature where *eretz* means "underworld." He himself notes that the ordinary meaning of the word is "earth, land" (120). It does not materially affect the argument of this paper, however, which is that the ancient conception of Creation involves the organization of something that is already in place.

28. "Empty and desolate" translates *tohu vevohu,* which KJV has as "without form and void." For the meaning and translation of this, see Speiser, *Genesis,* 5 n. 2; David Toshio Tsumura, *The Earth and the Waters in Genesis 1 and 2: A Linguistic Investigation* (Sheffield: Sheffield Academic Press, 1989), 41–43; and Cassuto, *Commentary on the Book of Genesis,* 21–23.

29. This verb was the subject to a specific exegesis by Joseph Smith in his famous King Follett discourse. See Barney, "Examining Six Key Concepts" 108–9. Barney correctly points out that Joseph Smith's understanding of this particular verb is defensible from the Hebrew.

30. The idea is that it is breath or wind that animates people. For a discussion of the ancient ideas behind breath and wind and the Latter-day Saint use of this idea, see Dana M. Pike, "The Latter-day Saint Reimaging of 'the Breath of Life' (Genesis 2:7)," *BYU Studies Quarterly* 56, no. 2 (2017): 71–104, especially 74–77, https://

makes it very difficult (if not impossible) to differentiate between the theological and the natural meaning of this word.[31]

The different cosmological perspective of Genesis is made very clear by the discussion of the "firmament."[32] This unusual English is translated from an unusual Hebrew word: *raqia.* This word comes from a Hebrew root that means "to beat out," as in beating out a metal plate.[33] This is how Genesis understands the sky—a flat surface that separates the waters above from the waters below. Again, it is worth noting here that the ancient Israelites were not stupid—they based their different scientific perspective on the observational evidence of the world they saw. The ancient Israelites speak of waters above because of the clear example of falling rain. This idea is at play in the famous verse in Malachi about tithing, where the Lord promises to "open you the windows of heaven, and pour you out a blessing" (Mal. 3:10, author's translation). The "windows of heaven" here are windows in the sky, and the blessing that the Lord is pouring out is rain.[34]

Thus, Genesis describes the sky as a barrier that separates the "waters above" from the "waters below." Retranslating Genesis 1:6–8 yields, "And God said, 'Let there be a beaten dome[35] in the middle of the waters and let it separate the waters from the waters.' God made the beaten dome, and it separated the waters that were under the beaten dome from the waters that were on top of the beaten dome, and it was so. And God called the beaten

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byustudies.byu.edu/article/the-latter-day-saint-reimaging-of-the-breath-of-life-genesis-27.

31. For an attempt at this differentiation, see Lynn Hilton Wilson, "The Holy Spirit: Creating, Anointing, and Empowering throughout the Old Testament," in *The Gospel of Jesus Christ in the Old Testament,* ed. D. Kelly Ogden, Jared W. Ludlow, and Kerry Muhlestein (Provo, Utah: Religious Studies Center, Brigham Young University; Salt Lake City: Deseret Book, 2009), 250–281.

32. See *Oxford English Dictionary Online,* s.v. "firmament," last modified March 2022, https://www.oed.com/view/Entry/70586.

33. Francis Brown, S. R. Driver, and Charles A. Briggs, *The Brown-Driver-Briggs Hebrew and English Lexicon* (Peabody, Mass.: Hendrickson, 2008, reprinted from the 1906 edition), 955–6; Jacobs, "Jewish Cosmology," 81–82 n. 4.

34. Stadelmann, *Hebrew Conception,* 46.

35. For *raqia,* which the KJV translates as "firmament."

dome 'sky' and there was evening and there was morning—day two." On day three, the Lord gathers the "waters below" into one place and all of the land into one place: "And God said, 'Let the waters under the sky be gathered together to one place, and let the dry land be seen,' and it was so. And God called the dry land 'land' and the gathering of the waters he called 'seas,' and God saw that it was good" (Gen. 1:9–10, author's translation). The cosmological picture presented within Genesis 1 is of a central land mass, floating on top of great waters, protected from waters above it with the sky acting as a kind of barrier.

The theological underpinning of Genesis 1 derives from the Hebrew word *hibdil*, meaning "to separate." Creation in Genesis 1 is fundamentally a process of dividing in order to put things into their proper places.[36] Light is separated from darkness (1:4), the upper waters are divided from the lower waters (1:6–7), and day is divided from night (1:14, 18). Even when the specific sense of *hibdil* is not used, division is a major feature of creation in Genesis 1—a key example of this is the specification of plants and animals "according to type" (1:11, 21, 24, author's translation). Even within categories of creation, Genesis 1 presents subcategories. Thus, the category of land animals contains wild animals (KJV's beasts "of the earth" [Gen. 1:24] or "of the field" [Gen. 2:19]), domesticated animals (KJV's "cattle" [Gen. 1:25]), and a special category of ritually unclean animals (KJV's "every creeping thing" [Gen. 1:26]).

Biblical scholarship ascribes the current form of Genesis 1 to a school of ancient authors who were associated with the ancient

36. Anthropologist Mary Douglas, in explaining the dietary laws of Leviticus 11, articulated this idea. See Mary Douglas, *Purity and Danger: An Analysis of Concept of Pollution and Taboo* (New York: Routledge Classics, 2002), 51–71. Douglas's theory has been generally accepted in biblical scholarship, with some individual disagreements about proper application. See the discussion in Howard Eilberg-Schwartz, "Creation and Classification in Judaism: From Priestly to Rabbinic Conceptions," *History of Religions* 26, no. 4 (1987): 357–81, discussion of Douglas at 358–60. Eilberg-Schwartz points out that Mircea Eliade postulated a similar system before Douglas.

priesthood and the temple.[37] In Leviticus 10:10–11, the Lord commands certain behaviors of Aaron's priest descendants, "that ye may put difference between holy and unholy, and between unclean and clean." The verb that the KJV translates here as "put difference" is *hibdil,* the same verb that appears in the Creation account in Genesis 1. Genesis 1 teaches that Creation was an act of division and making differences, and Leviticus shows that when priests are making these kinds of distinctions, they are engaged in divine behavior.[38]

The Creation of Humanity

The culmination of Creation in both Genesis 1 and 2 is the creation of humanity. For both of these Creation accounts, it is humanity and its role in the cosmos that take the center stage. The accounts take slightly different perspectives on the process, and so it is profitable to explore the similarities and the differences between the two accounts.

One of the first differences is the relationship between males and females. In the first Creation account, now recorded in Genesis 1:26–27, males and females are created simultaneously, and both are called "human." In the second Creation account,

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37. Friedman, *Who Wrote the Bible?,* 162. Although Latter-day Saints are used to a concept of priesthood that is focused on Church service and administration, this is not the case in the ancient world. There, the priestly focus is on the temple, sacrifice, and the cosmic order. This is laid out nicely in terms of its relation to Creation in Mark S. Smith, *The Priestly Vision of Genesis 1* (Minneapolis: Fortress Press, 2010). For a Latter-day Saint discussion on priestly material in Genesis and Moses, see John W. Welch with Jackson Abhau, "The Priestly Interests of Moses the Levite," in Bradshaw and others, *Tracing Ancient Threads,* 163–256, especially the discussion on 173–88. For a discussion of the priestly concern with temples and divine order, see the seminal John M. Lundquist, "What Is a Temple? A Preliminary Typology," in *Temples of the Ancient World: Ritual and Symbolism,* ed. Donald W. Parry (Salt Lake City, Deseret Book; Provo, Utah: Foundation for Ancient Research and Mormon Studies, 1994), 83–117.

38. Eilberg-Schwartz, "Creation and Classification," 362. Leviticus fundamentally understands this divine quality of being able to make distinctions to be holiness, as in Leviticus 11:44–45, where the Lord tells Israel to "be holy; for I am holy." See the discussion in Warren Zev Harvey, "Holiness: A Command to *Imitatio Dei,*" *Tradition: A Journal of Orthodox Jewish Thought* 16, no. 3 (1977): 7–28.

recorded in Genesis 2:18–22, the female is created not only after the male but after all of the rest of the animals as well. Females are the final living thing created, a helper equal to the male. Both of these accounts have things to teach about these scriptures' views on humanity and on the male-female relationship.

For the account in Genesis 1, humans are fundamentally both female and male from the very beginning. Females are not a derivative form of males but are an independent part of Creation, and both are created in the image of God.[39] There has been, of course, much discussion in both Christianity and Judaism about the interpretation of these verses, but Latter-day Saints have traditionally read them as referring to humanity's physical body being like God's.[40] Because the ancient Israelites did not have the distinctive creedal position that their God was wholly other, in this case Latter-day Saint readings reflect something very similar to the likely ancient conception of these verses.[41]

As noted above, the creation of humanity is one of the distinctive elements between the two Creation accounts. In the first account, humanity is created, male and female, through God's speech. In the second account, God first forms the male human from dirt and then breathes life into him (Gen. 2:7).[42] All the animals are then considered as companions for the male human, but none of them are suitable, so the Lord puts the male human to

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39. Westermann, *Genesis 1–11,* 160.

40. For a discussion of the various ways of reading this verse, see Westermann, *Genesis 1–11*, 147–61. On the Latter-day Saint side of discussion, the Guide to the Scriptures entry on "Body" glosses Genesis 9:6 as meaning, "God created male and female in the image of his own body." See "Body," Guide to the Scriptures, The Church of Jesus Christ of Latter-day Saints, accessed April 28, 2022, https://www.churchofjesuschrist.org/study/scriptures/gs/body. BYU professor Larry Tucker gave a devotional dealing with the implications of this teaching for Latter-day Saints. See Larry Tucker, "The Human Body: A Gift and a Responsibility," devotional address, Brigham Young University, May 28, 2013, https://speeches.byu.edu/talks/larry-tucker/the-human-body-a-gift-and-a-responsibility/.

41. Cassuto, *Commentary on the Book of Genesis,* 56; C. L. Crouch, "Genesis 1:26–7 as a Statement of Humanity's Divine Parentage," *Journal of Theological Studies* 61, no. 1 (2010): 1–15, discussion on 3–5.

42. Pike, "Reimaging of 'the Breath of Life,'" 72–74.

sleep and builds a female human from the male human's rib as a "helper appropriate to him" (Gen. 2:18, author's translation).[43]

Comparing these two Creation accounts, in both their similarities and their differences, shows that when we speak of the biblical perspective of Creation, we are not speaking of a single perspective with a single goal. Both of the Creation accounts present important viewpoints on the role of humanity in Creation, but neither presents a single authoritative statement on how humanity came into this world. These multiple perspectives reinforce to readers the importance of reading Genesis and the Creation in its ancient context, as an ancient Israelite would.[44] President Brigham Young once asked, "Do you read the Scriptures, my brethren and sisters, as though you were writing them a thousand, two thousand, or five thousand years ago? . . . If you do not feel thus, it is your privilege to do so."[45] It also helps to remind us that, as noted at the beginning of this chapter, Latter-day Saints are not committed to a specific literal interpretation of Creation in Genesis.

Conclusion

In order to understand Creation in its ancient context, it is necessary to understand that the picture painted in Genesis 1 and 2

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43. KJV has the famous "help meet for him." In its original English meaning and in Hebrew, "help meet" is not a single collocation but is instead using "meet" in the sense of "appropriate" for him. See Donald W. Parry, "Eve's Role as a 'Help' (*'ezer*) Revisited," in *Seek Ye Words of Wisdom: Studies of the Book of Mormon, Bible, and Temple in Honor of Stephen D. Ricks,* ed. Donald W. Parry, Gaye Strathearn, and Shon D. Hopkin (Orem, Utah: Interpreter Foundation; Provo, Utah: Religious Studies Center, Brigham Young University, 2020), 199–216. Parry correctly notes that this story of human creation does not place women in an inferior role but in an equal role. It is certain that God did not intend this story to signify inferiority, but that does not change the fact that many have read it that way and have used it to justify the oppression of women. See the discussion in Carol Meyers, *Discovering Eve: Ancient Israelite Women in Context* (New York: Oxford University Press, 1988), 74–78.

44. Meyers, *Discovering Eve,* 74.

45. *Discourses of Brigham Young,* ed. John A. Widtsoe (Salt Lake City: Deseret Book, 1954, reprinted numerous times), 128.

derives from cosmological and scientific perspectives different from modern ones. As we think about the relationship between scripture and science, it is useful for us to remember what the scriptures are and are not doing. The Creation accounts are not intended, either anciently or modernly, to serve as definitive scientific statements about the universe from our current perspective. This is not to say that everything in these chapters is to be understood in terms of metaphor or symbolism (although there are certainly symbolic aspects to the narratives)—it is likely the ancient authors and editors viewed their universe as it is described. However, that acknowledgement should not diminish our appreciation of the value Genesis brings to the table.

For the authors and editors of Genesis, Creation is fundamentally about humanity and its relationship to God. Both of the Creation accounts discussed in this paper show not only the centrality of humanity in God's creative plans but also his divine care for the other animals that share this world with us. The dominion described in Genesis is not an absolute or unrighteous dominion. Although humans are the culmination of Creation (see Gen. 2), they are still part of a broader creative process. The earth is not here for humans to despoil.

The ancient perspective on Creation provides another point of view in the inexhaustible world of interpreting scripture. It illustrates amply the importance of recognizing that the relationship between science and scripture is not an inherently adversarial one, especially if both sources of knowledge are placed in their proper contexts.

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The Seven Seals, the Age of the Earth, and Continuing Revelation

Nicholas J. Frederick

One of the more intriguing elements of the book of Revelation is its mention of a book sealed with seven seals (Rev. 5:1). As John's vision progresses over the next two chapters, each of the seven seals is broken. These have been interpreted by scholars in a variety of ways. One interpretation, typically known as the "historicist" view, saw the seals as representing periods of time in the earth's history, whether the entirety of the earth's history from Adam on or just parts, such as early Christian history.[1]

With regard to Latter-day Saint debates over the age of the earth, the seven seals become particularly relevant due to an 1832 revelation titled "Revelation Explained."[2] Received "in connection with the translation of the scriptures"[3] (that is, the Joseph Smith Translation process), it was first printed in the *Times and Seasons* on August 1, 1844, and canonized in 1876 as section 77

1. For further information, see Nicholas J. Frederick, "Section 77 and Book of Revelation Scholarship," *Religious Educator* 22, no. 2 (2021): 47–71.

2. Matthew C. Godfrey and others, eds., *Documents, Volume 2: July 1831–January 1833*, Joseph Smith Papers (Salt Lake City: Church Historian's Press, 2013), 209.

3. "History, 1838–1856, Volume A-1 [23 December 1805–30 August 1834]," 192, Joseph Smith Papers, accessed November 12, 2021, https://www.josephsmithpapers.org/paper-summary/history-1838-1856-volume-a-1-23-december-1805-30-august-1834/198.

of the Doctrine and Covenants. Presented as a series of questions and answers and referring to the scroll of Revelation 5:1, it asked, "What are we to understand by the seven seals with which it was sealed?" (D&C 77:7). The answer Joseph received was, "We are to understand that the first seal contains the things of the first thousand years, and the second also of the second thousand years, and so on until the seventh" (D&C 77:7). Reflecting a "historicist" interpretation, the seals represented periods of time in the earth's history, with the first seal presumably beginning with Adam and Eve and the seventh signaling the millennial age. It has thus become common for many Latter-day Saints to speak of the earth having roughly a seven-thousand-year history since the Fall (what's sometimes referred to as the "millennial day" theory; compare 2 Pet. 3:8).

Often omitted in these conversations about the age of the earth and the seven seals are statements made by Joseph Smith later in his life. In 1843, Joseph declared that "none of the things John saw had any allusion [to] the days of Adam, Enock Ab[raham] or Jesus—only as represented to John & clearly set forth—John saw that which was shortly to come to pass. . . . those things that John saw in h[eaven] had no allusion to any things that had been on the earth because John saw what was to shortly come to pass—John saw beasts that had to do with things on the earth—but not in past ages."[4] Joseph's statement here casts the seven seals in a much different light than section 77, more in line with the historicists who interpreted the seals as corresponding with historical events limited strictly to the Christian era. I am not sure that we can say why Joseph began to teach a view of the temporal context of the book of Revelation that differed from Doctrine & Covenants 77. It is certainly possible that subsequent revelations and experiences along with a deepening understanding of scripture led Joseph to provide a different answer in 1843 than he had

4. David W. Grua and others, *Documents Volume 12: March–July 1843*, Joseph Smith Papers (Salt Lake City: Church Historian's Press, 2021), 187.

provided in 1832, as sometimes happened with the JST and other revelations. What we should be wary of, though, is privileging one source over the other. To cite Doctrine & Covenants 77:7 as the final word on the age of the earth when Joseph would preach a very different perspective a decade later leaves us using only half the pieces of the puzzle.

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(No) Death before the Fall?

The Basis and Twentieth-Century History of Interpretation

T. Benjamin Spackman

Introduction

In an 1855 talk, President Brigham Young spoke on the nature of God and set forth the following useful principle: "Were the former and Latter-day Saints, with their Apostles, Prophets, Seers, and Revelators collected together to discuss this matter, I am led to think there would be found a great variety in their views and feelings upon this subject, without direct revelation from the Lord."[1] This principle holds true through Latter-day Saint history. When there is not clear revelation on a matter, Apostles, prophets, seers, and revelators are likely to hold a variety of views.[2]

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1. Brigham Young, in *Journal of Discourses,* 26 vols. (Liverpool: F. D. Richards, 1855–86), 2:123 (April 17, 1853). Note, however, that there are potential issues with the *Journal of Discourses.* See Gerrit J. Dirkmaat and LaJean Purcell Carruth, "The Prophets Have Spoken, but What Did They Say? Examining the Differences between George D. Watt's Original Shorthand Notes and the Sermons Published in the Journal of Discourses," *BYU Studies Quarterly* 54, no. 4 (2015): 24–118, https://byustudies.byu.edu/article/the-prophets-have-spoken-but-what-did-they-say-examining-the-differences-between-george-d-watts-original-shorthand-notes-and-the-sermons-published-in-the-journal-of-discourses.

2. See, for example, the different views among Apostles on the idea of progression between kingdoms in Terryl L. Givens, "How Limited Is Postmortal Progression?," *BYU Studies Quarterly* 60, no. 3 (2021): 127–38, https://byustudies.byu.edu/article/how-limited-is-postmortal-progression. Such views are not always held evenly among members of the Quorum—for example, a 6-6 Apostolic split.

This principle—diversity of thought in absence of clear revelation—is one of two keys to understanding the interpretive history of 2 Nephi 2:22–25, particularly verse 22. The verse reads, "And now, behold, if Adam had not transgressed he would not have fallen, but he would have remained in the garden of Eden. And all things which were created must have remained in the same state in which they were after they were created; and they must have remained forever, and had no end." This verse has often been cited in relation to the question of "no death before the Fall" (hereafter NDBF), and further associated with questions about fossils,[3] evolution, and the age of the earth. The former two both imply death before c. 4000 BC—the traditional date of the Fall of Adam—though they are not under consideration here.[4]

The second key is recognizing that the way we make meaning of scripture—that is, *interpretation*—depends in part upon the assumptions we bring to scripture. Differing assumptions will produce differing interpretations.

This article does not take a position on 2 Nephi but presents the relevant assumptions and general history of its interpretation in the twentieth century. This history demonstrates that a significant number of Church leaders and approved publications

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3. Some Latter-day Saints have asserted that fossils are indeed millions of years old but from other planets which made up the building materials of the earth. There are serious problems with this assertion from both a scientific and theological perspective. See Trent Stephens, "Was the Earth Formed from the Debris of Other Planets?," *Religious Educator* 21, no. 3 (2020): 160–71, https://rsc.byu.edu/vol-21-no-3-2020/was-earth-formed-debris-other-planets.

4. Because of the scope and intended audience for this paper, I do not provide extensive quotations here of the evidence for some of my historical claims. See my doctoral dissertation: Thomas B. Spackman, "'The Scientist Is Wrong': Joseph Fielding Smith, George McCready Price, and the Ascendency of Creationist Thought among Latter-day Saints in the Twentieth Century" (PhD diss., Claremont Graduate University, 2024). This should be available electronically via university library requests through ProQuest. Quotations without reference are to archival or nonpublic sources, and full citations are provided in my dissertation. I also write about these topics at http://benspackman.com.

have rejected the idea that 2 Nephi establishes no death of any kind before 4000 BC as either core doctrine or scientific fact. I begin by naming and explaining some of the key assumptions involved, move to tracing different Church publications and General Authorities who did not see 2 Nephi as necessitating NDBF, and end by elucidating some possible scenarios from different assumptions.

Key Assumptions

Eyeglasses shape the light passing into our eyes. Though ideally our glasses bring the outside world into focus, smudged glasses or a wrong prescription can make things less clear. Sometimes we need particular glasses for a particular setting, like reading glasses at home or 3D glasses at the movie theater. When it comes to scripture, assumptions are like the lenses in our glasses; they shape our understanding of what scripture means. If our glasses are smudged—or we deny we're even wearing glasses!—it can skew our perceptions.

Notably, in this metaphor, we are *all* wearing glasses, because we *all* make assumptions when we interpret and assign meaning to scripture. This is universal and normal; as humans, we can't help but make assumptions—it's simply how we function.[5] Becoming aware that we're wearing glasses and then cleaning our lenses means trying to take conscious stock of our assumptions, being as explicit as we can about them, and evaluating how reasonable they are.

5. For justification and examples, see E. Randolph Richards and Brandon J. O'Brien, *Misreading Scripture with Western Eyes: Removing Cultural Blinders to Better Understand the Bible* (Downers Grove, Ill.: InterVarsity Press, 2013); and the follow up, E. Randolph Richards and Richard James, *Misreading Scripture with Individualist Eyes: Patronage, Honor, and Shame in the Biblical World* (Downers Grove, Ill.: IVP Academic, 2020).

To lay out the relevant interpretive assumptions to this history, Elders Joseph Fielding Smith,[6] Bruce R. McConkie,[7] James E. Talmage,[8] and John A. Widtsoe[9] provide useful contrast. Three key assumptions led Elders Smith and McConkie to assert NDBF based on 2 Nephi—a scripture Smith in particular cited frequently throughout his life as proof of NDBF—which they considered a core and necessary doctrine of the gospel.[10] Elders Talmage and Widtsoe rejected two of these assumptions and thus rejected NDBF.

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6. Smith became President of the Church in 1970. He plays a central role in this paper because he preached these assumptions throughout his life, left a large paper trail documenting them, and is the source I know best due to my dissertation research. For a general overview, see Reid L. Neilson and Scott D. Marianno, "True and Faithful: Joseph Fielding Smith as Mormon Historian and Theologian," *BYU Studies Quarterly* 57, no. 1 (2018): 6–64, https://byustudies.byu.edu/article/true-and-faithful-joseph-fielding-smith-as-mormon-historian-and-theologian. See also Matthew Bowman, *Joseph Fielding Smith: A Mormon Theologian* (Urbana: University of Illinois Press, 2024).

7. Trained as a lawyer, Bruce McConkie served in the Quorum of the Seventy from 1946 to 1972, when he was called into the Quorum of the Twelve Apostles, where he served until his death in 1985. He shared the assumptions of his father-in-law, Joseph Fielding Smith, and edited or collaborated with him on several books. Latter-day Saint undergraduates may know him best from his 1958 book *Mormon Doctrine*.

8.James Talmage, a British convert, received a PhD in geology, and the First Presidency relied on him for scientific, doctrinal, and historical work before calling him into the Quorum of the Twelve in 1911. He died in 1933.

9. John Widtsoe was born in Norway, found the gospel at a young age, and received a PhD in chemistry. Like Talmage, the First Presidency relied on Widtsoe's scientific expertise before calling him as an Apostle (1921–1952).

10. To the First Presidency and Quorum of the Twelve in 1931, for example, Smith argued, "We are taught that there was no death in any of the earth's creations, neither plant, fish, fowl, beast or man. . . . If this story is not true, then there can be little real purpose in these ordinances in the Temple. They are futile, meaningless, and not worthy of the place we give them." This formed part of his fifty-six-page argument against B. H. Roberts's views, discussed below. See Joseph Fielding Smith address to President Rudger Clawson and Members of the Council of Apostles, January 14, 1931, 15, Leonard J. Arrington Papers, series 9, box 50, folder 1, LJAHA COLL 001, Merrill-Cazier Special Collections and Archives, Utah State University (hereafter cited as "Smith address").

First Assumption: Concordism

The first assumption, shared between Widtsoe, Talmage, Smith, and McConkie, has been an extremely common one among Christians for the last few hundred years.[11] It played a central role in the widely misunderstood conflict between Galileo and the Catholic Church, where Galileo asserted that the earth circled the sun, not the other way around.[12] In short, *concordism* is the assumption that harmony between science and religion is possible because scripture and science are describing the same thing: the natural world. Concordism would assert that, although not a science textbook, scripture's inspiration nevertheless entails natural history and scientific facts.[13] From this assumption, Genesis 1–3 (and 2 Nephi and other such passages) must match what physics, geology, biology, and other sciences reveal about the origins of the universe, the earth, and humans. While concordist interpreters reconcile science and religion by making them match up somehow, nonconcordist interpreters assert that science-religion harmony is possible because scripture is not necessarily describing the natural world, though it may.[14]

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11. See, for example, Edward B. Davis, "The Word and the Works: Concordism and American Evangelicals," in *Perspectives on an Evolving Creation,* ed. Keith B. Miller (Grand Rapids, Mich.: William B. Eerdmans, 2003).

12. This was not a simple case of "religion vs science," though notably Galileo's religious critics were correct that the heliocentric view doesn't match what the Bible says. Galileo wrote that the Holy Ghost teaches "how one goes to heaven, not how the heavens go." Galileo, *Discoveries and Opinions of Galileo,* trans. Stillman Drake (New York: Anchor Books, 1957), 189. Galileo relied on the principle of accommodation to explain why the inspired biblical authors didn't know the earth circles the sun. See Ernan McMullin, "Galileo's Theological Venture," *Zygon: Journal of Religion and Science* 48, no. 1 (2013): 192–220.

13. Authors use the term in various ways, and some distinguish between a "hard" and "soft" concordism. See Denis Alexander, "The Various Meanings of Concordism," Biologos, March 23, 2017, https://biologos.org/articles/the-various-meanings-of-concordism.

14. See especially Conrad Hyers's very accessible article, "Dinosaur Religion: On Interpreting and Misinterpreting the Creation Texts," *Journal of the American Scientific Affiliation* 36, no. 3 (September 1984): 142–48, https://www.asa3.org/ASA/PSCF/1984/JASA9-84Hyers.pdf. "It may surely be said that the Genesis

Interacting with other assumptions, concordism can lead to a surprising variety of interpretations. Both Ken Ham (a prominent Christian leader of the largest young-earth creationism ministry in the USA)[15] and Richard Dawkins (a prominent British atheist and evolutionary biologist) are concordists. Ham and Dawkins both believe that the inspiration of Genesis entails its scientific nature and accuracy.

For Dawkins, since Genesis does not match the science of an old earth and biological evolution, it cannot be true or inspired.[16] Ham, on the other hand, begins with the additional assumptions that God exists and inspired Genesis, and therefore Ham's concordism runs the other direction. "Scripture *must* control our interpretation of the scientific evidence," writes Ham.[17] Since God inspired Genesis, he argues, it contains true science which should dictate our understandings of the natural world, instead of fallible *human* science. Mainstream science can thus be written off as inspired by the devil or a conspiracy. But both Ham and Dawkins agree that to qualify as inspired and true, Genesis must match science. This is the diversity of concordism, and Latter-day Saints tend to fall into both extremes—science should control scriptural interpretation, or scripture should dictate scientific conclusions—as well as a muddled middle.

Put another way, because concordists link science and scripture and expect them to say the same thing, they tend to (1) force science to fit what they think scripture says (per Ham's young-earth creationism), (2) force scripture out of its historical and

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accounts of creation are not in conflict with scientific and historical knowledge. Yet this is not because they can be shown to be in conformity with this knowledge, but precisely because they have little to do with it."

15. This includes the young-earth anti-evolution group "Answers in Genesis," (https://answersingenesis.org/creationism/young-earth/) as well as the flood museum "Ark Encounter," with a full-size reproduction of Noah's ark in Kentucky (https://arkencounter.com/).

16. Richard Dawkins, *The God Delusion* (Boston: Mariner Books, 2008), 268–82.

17. Ken Ham, Hugh Ross, Deborah B. Haarsma, and Stephen C. Meyer, *Four Views on Creation, Evolution, and Intelligent Design,* ed. J. B. Stump and Stanley N. Gundry (Grand Rapids, Mich.: Zondervan, 2017), 31, emphasis added.

cultural context by interpreting it as modern science in figurative language (that is, Genesis must be teaching an old earth somehow because that's what science says),[18] or (3) reject scripture as inspired because it fails to match what current science says (per Dawkins).

The dominance of concordism, however, seems to be fading. Since 1954, religious scholars from a variety of traditions—inerrantist Evangelicals,[19] as well as Catholics,[20] Jews,[21] and Latter-day Saints[22]—have come to reject concordism as a reasonable or valid interpretive assumption.[23] The reasons for this rejection are complex, but there are three primary factors.

The first and most significant factor for rejecting concordism is the rediscovery, translation, and maturing understanding of ancient Near Eastern texts from Israel's neighbors in Egypt,

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18. On the "days" in Genesis, see "2 Peter and the Days of Genesis," Ben Spackman (blog), November 27, 2023, https://benspackman.com/2023/11/2-peter-and-the-days-of-genesis/.

19. See John Walton's *Lost World* series of books, including *The Lost World of Genesis One: Ancient Cosmology and the Origins Debate* (IVP Academic, 2009). Even Walton's title alludes to his rejection of concordism. The *cosmology* in Genesis 1 is not a modern heliocentric solar system but an ancient concept: a flat disc earth surrounded by the chaotic cosmic waters, with the solid domed sky restraining them above, Hebrew *raqia* or KJV "firmament." Although he is now an emeritus professor, as part of his continued employment at Wheaton College, Walton signed a doctrinal statement every year which includes an affirmation of biblical inerrancy. See Wheaton College, Statement of Faith and Educational Purpose, https://www.wheaton.edu/about-wheaton/statement-of-faith-and-educational-purpose.

20. For example, Mark S. Smith, *The Priestly Vision of Genesis 1* (Fortress Press, 2010).

21. For example, Nahum Sarna was chosen to author the volumes on Genesis and Exodus for the Jewish Publication Society commentary series. Nahum M. Sarna, *The JPS Torah Commentary: Genesis* (Jewish Publication Society, 2001); Nahum M. Sarna, *The JPS Torah Commentary: Exodus* (Jewish Publication Society, 2003).

22. I would include Joshua Sears and Avram Shannon in this category with me, as well as numerous other committed Latter-day Saint scholars. See Joshua L. Sears, "From Biology Major to Religion Professor: Personal Reflections on Evolution," *BYU Studies* 63, no. 1 (2024): 71–94, https://byustudies.byu.edu/article/from-biology-major-to-religion-professor, reprinted herein, 23–46; and Avram R. Shannon, "The Genesis Creation Account in Its Ancient Context," herein, 61–75.

23. The turning point for American Protestants occurred with the 1954 publication of Bernard Ramm's *Christian View of Science and Scripture* (Grand Rapids, Mich.: William B. Eerdmans, 1954). See Spackman, "Scientist," 111–16, 193–94.

Mesopotamia, and Canaan.[24] These provide us with the polytheistic cultural, literary, and religious contexts the Israelites knew, which allow us to reconstruct the Israelite needs and questions to which Genesis is an inspired answer. In particular, the creation accounts from these neighboring cultures strongly suggest that for ancient Israelites, creation accounts did not function in the genre of "scientific report" or "historical documentary," but served purposes other than recounting natural history.[25] These ancient texts give us strong clues as to how to understand Genesis *literally*—that is, as ancient Israelites understood Genesis and the purpose(s) it served in their time.[26]

This rediscovery has other implications for our topic. We are neither Iron-age Israelites nor Greco-Roman Jews nor Nephites; the *words* of scripture, even well translated, simply don't mean the same things to us because words alone do not convey meaning; they exist within social, cultural, literary, and historical contexts which often go "without being said." Even the best translation will fail to communicate a complete understanding because it can't translate what the author didn't think needed to be said and thus did not explicitly say. This is why many translations now include contextual notes with information recovered

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24. See my brief video presentation at "The Rediscovery of the World of the Old Testament Screencast," Ben Spackman (blog), January 9,2014, https://benspackman.com/2014/01/the-rediscovery-of-the-old-testament-screencast/

25. See Ben Spackman, "Science and Scripture: Friends, Enemies, or Other?" (FAIRMormon presentation, Gothenburg, Sweden, June 15, 2024), posted July 27, 2024, by Good Hope Media, YouTube, https://www.youtube.com/watch?v=C-tQ_YhUZLg.

26. Latter-day Saint scholars Richard Neitzel Holzapfel, Dane M. Pike, and David Rolph Seely explain, "In the last 150 years, archaeologists working in the Near East have uncovered hundreds of thousands of records from the ancient world. Scholars have identified in these records many examples of creation stories from Mesopotamia, Egypt, and Canaan that give us insight and understanding of the ancient worldviews about creation . . . the power and significance of these stories [in Genesis] can be best appreciated when they are compared with the ancient creation stories that were known in cultures surrounding ancient Israel." Richard Neitzel Holzapfel, Dane M. Pike, and David Rolph Seely, *Jehovah and the World of the Old Testament: an Illustrated Reference for Latter-day Saints* (Salt Lake City: Deseret Book, 2009), 22–23.

through linguistics, archaeology, anthropology, and the discoveries of relevant ancient texts.

A second factor is a better understanding of intellectual history of the last few hundred years—how ideas, knowledge, and conceptions have grown and shifted. This has made clear why people were prone to assuming Genesis provided "natural history" or science.[27] It also demonstrated that concordism is a modern imposition on ancient texts, not something native to them.

Lastly, to a much lesser extent, new discoveries across dozens of fields from the late 1400s onward have called traditional understandings of ancient texts into question. These included the discovery of inhabited lands with ancient cultures, texts, and varieties of humanity that the Bible knew nothing about; the potential existence of human-like beings in the distant past; the nature of fossils and their relationship to living animals; and the age of the earth. One influential interpreter in the 1600s, Isaac La Peyrère, reacted to these by reconceptualizing Genesis as only a history of the Jews, not the entire world, and arguing that the Bible taught preadamites.[28]

Today, some like Ham accuse nonconcordist interpreters of letting the tail of science wag the dog of scriptural interpretation, subordinating divine scripture to human science. Such an accusation presupposes that all fallen or human aspects lie on the science side of this issue, because there are no real human aspects to revelation, scripture, or interpretation. For concordists, scripture

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27. This question is also tied up with the historical changes in the conception of science and conceptions of inspiration.

28. Richard H. Popkin, *Isaac La Peyrère (1596–1676): His Life, Work, and Influence* (Leiden, Neth.: Brill Academic, 1987); David N. Livingstone, *Adam's Ancestors: Race, Religion, and the Politics of Human Origins* (Baltimore: Johns Hopkins University Press, 2008), 26–51; David N. Livingstone, "Preadamites: The History of an Idea from Heresy to Orthodoxy," *Scottish Journal of Theology* 40, no. 1 (February 1987): 41–66; Michael J. Lee, *The Erosion of Biblical Certainty: Battles over Authority and Interpretation in America* (New York: Palgrave MacMillan, 2013), 14–22; Jeffery L. Morrow, "French Apocalyptic Messianism: Isaac La Peyrère and Political Biblical Criticism in the Seventeenth Century," *Toronto Journal of Theology* 27, no. 2 (Fall 2011): 203–13.

is both perfectly accurate and entirely clear (which foreshadows the next two assumptions). It also does not take account of the historical record. Charles Darwin and evolution, for example, demonstrably had very little impact on biblical studies or interpretations of Genesis compared to the rediscovery of scripture's ancient contexts.[29]

If science is not controlling, neither is it entirely irrelevant. If vast amounts of scientific data call a particular interpretation of scripture into question, we should be humble enough to at least revisit our certainty about the interpretations we have made and their basis. Historian Aaron Smith describes the

> long-standing Christian practice of rereading the text from within an expanding horizon of meaning [that is, as new contexts of Genesis were discovered and understood, they shaped new understandings of Genesis]. Their interpretation of the Bible progressed with enhanced understanding of both the world that the biblical authors inhabited and their own time and place. That does not mean that they uncritically saw their task to be to amend the truths of Scripture in view of the higher authority of new science. Rather, with a humility that surely ought to count for something, they allowed that their understanding and interpretation of Scripture might not fully represent the meaning of Scripture.[30]

Elder Stephen L Richards preached the same principle in the April 1932 general conference when he said, "Old conceptions

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29. See the essays in Stephen C. Barton and David Wilkinson, eds., *Reading Genesis after Darwin* (New York: Oxford University Press, 2009), particularly John Rogerson, "What Difference Did Darwin Make? The Interpretation of Genesis in the Nineteenth Century," 75–92. Note, however, that some scholars who reject concordism can nevertheless make explicit use of science in interpreting Genesis. See for example, J. Richard Middleton, "Reading Genesis 3 Attentive to Human Evolution: Beyond Concordism and Non-Overlapping Magisteria," in *Evolution and the Fall,* ed. William T. Cavanaugh and James K. A. Smith (Grand Rapids, Mich.: William B. Eerdmans, 2017), 67–97.

30. Aaron T. Smith, "Post-Darwinian Interpretations of Genesis 1–2," in *Since the Beginning: Interpreting Genesis 1 and 2 through the Ages,* ed. Kyle R. Greenwood (Grand Rapids, Mich.: Baker Academic, 2018), 240–41.

and traditional interpretations [of scripture] must be influenced by newly discovered evidence. Not that ultimate fact and law change, but our understanding varies with our education and experience."[31]

Although concordism has been declining, it has been the dominant assumption among Church members in nearly every Latter-day Saint attempt at reconciling scripture with science. As one example of concordism that illuminates Elder Smith's thinking, he wrote in 1954 that "these theories [such as an old earth] are man-made deductions but the testimony of the prophets are actual facts."[32] For Smith, Genesis and 2 Nephi provided absolute scientific facts from God, whereas human science was partial, fallible, and less reliable.

This assumption of concordism was generally shared by Elders Widtsoe, Talmage, Smith, and McConkie, but they diverged on two other key assumptions termed *perspicuity* and *inerrancy.*

Second Assumption: Perspicuity

In the Protestant Reformation of the 1500s, Martin Luther and others asserted that, at least when it came to what was necessary for salvation, scripture was plain and clear. Indeed, so clear was scripture on this topic that any reader could understand and be saved without the interpretive intermediary of church, priest, pastor, or scholar. Scripture's plainness—at least on this topic—is termed *perspicuity*.[33]

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31. For reasons unrelated to this quote, Elder Richards talk "Bringing Humanity to the Gospel" was not published in the April 1932 Conference Report. The text and marked-up drafts exist in both his papers and James E. Talmage's. See Stephen L Richards Papers, MSS 5950, box 8, L. Tom Perry Special Collections, Brigham Young University; compare "Address of Elder Stephen L Richards at the 102nd Annual Conference of the Church, April 9, 1932," Topical Files, James E. Talmage Collection, 1879–1933, Church History Library, https://catalog.churchofjesuschrist.org/assets/895efa51-e521-4feb-8158-734d54a7c03c/0/0.

32. Joseph Fielding Smith, *Man, His Origin and Destiny* (Deseret Book, 1954), 5.

33. Perspicuity is sometimes also called "clarity," as in "the doctrine of scripture's clarity." See Alister E. McGrath, *Reformation Thought: An Introduction,* 5th ed. (Hoboken, N.J.: Wiley Blackwell, 2021), 126–41. Beyond the topic of salvation,

In the 1800s, many American Protestants expanded the scope of perspicuity far beyond the subject of salvation. Rather, in keeping with American ideals, perspicuity became populist, with the meaning of scripture on every topic immediately available to any reader. Sociologist of religion Christian Smith terms this expansion *democratic perspicuity,* the idea that "any reasonably intelligent person [could] read the Bible in his or her own language and correctly understand the plain meaning of the text."[34] To continue our glasses metaphor above, *democratic perspicuity* denies that modern readers are wearing different glasses than ancient Israelites, and so presumes that modern readers can simply read translated scripture at face value and yet come away with the same understanding as ancient Israelites.

Coming predominantly from Protestant American stock in the mid-1800s, Latter-day Saints inherited this assumption of *democratic perspicuity* from their intellectual surroundings, though it was then magnified particularly by Elder Joseph Fielding Smith.[35] He argued that scripture was so plain that no interpretive or contextual work was needed; you could only misunderstand scripture if you willfully denied the plain meaning or lacked the Spirit.[36] By contrast, Elders James E. Talmage, John Widtsoe, and a number of other Apostles like Elder Richards above, rejected this approach. They argued that understanding scripture required careful attention to languages and translation,

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however, the Reformers maintained the necessity of learned clergy to translate, teach, and explain the Bible because it was an ancient book of different cultures, mores, etc.

34. Christian Smith, *The Bible Made Impossible: Why Biblicism Is Not a Truly Evangelical Reading of Scripture* (Brazos Press, 2011), 4.

35. See Philip L. Barlow, *Mormons and the Bible: The Place of the Latter-day Saints in American Religion* (New York: Oxford Press, 1991); Gordon Irving, "The Mormons and the Bible in the 1830s," *BYU Studies* 13, no. 4 (1973): 473–88, https://byustudies.byu.edu/article/the-mormons-and-the-bible-in-the-1830s; and Spackman, "Scientist," 34.

36. Joseph Fielding Smith, "Entangle Not Yourselves in Sin," *Improvement Era* 56, no. 9 (September 1953): 647, 677.

history, culture, and genre.[37] They further argued that scripture was not plain, everyone was interpreting, and thus some intellectual humility is necessary; despite their inspiration and calling, they argued, Church leaders could misunderstand scripture just as they could misunderstand science.[38]

At this point, it may be useful to reframe this assumption in terms readers might be more familiar with. Elder Smith's approach matches up with *democratic perspicuity* (hereafter just *perspicuity*) as well as what many readers would call a "literal reading." That is, he thought he could understand the original authorial meaning—the meaning ancient audiences would have understood—in English translation, without any kind of reference to contexts known to the original audiences but not explicitly present *in* scripture. Because Smith often spoke of scripture being "plain," I term his approach "plain reading."

By contrast, an understanding of scripture which truly is literal requires active work to recover those contexts that scriptural authors did not include because they could go without being said to their audiences.[39] A face-value reading is not a literal reading, because face-value reading does not seek out context. Latter-day Saint Bible scholar Joshua Sears provides a modern analogy

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37. On genre, see Amanda Brown, host, *Latter-day Saint Perspectives,* podcast, episode 45, "Genre in the Bible with Benjamin Spackman," July 19, 2017, https://ldsperspectives.com/2017/07/19/genre-bible/.

38. For example, James E. Talmage said, "Man's interpretation of either [science or scripture] may be at fault." See the Church reprint of "Earth and Man," in *Instructor* 100, no. 12 (December 1965): 474–77, https://archive.org/details/instructor10012dese/page/474/mode/2up.

39. On literal reading, see "Literal Interpretation of the Scriptures: Why We Need More," Ben Spackman (blog), May 4, 2020, https://benspackman.com/2020/05/literal/; and "D&C 20:1, Plain Reading, and Literal Reading; or, Chexegesis before You Wrexegesis," Ben Spackman (blog), March 3, 2021, https://benspackman.com/2021/03/dc-201-plain-reading-and-literal-reading-or-chexegesis-before-you-wrexegesis/. On implicit contexts and how to teach them, see "Implicit Contexts in the Scriptures, but Especially Genesis," Ben Spackman (blog), February 1, 2022, https://benspackman.com/2022/02/implicit-context-in-the-scriptures/; and "Implicit Context Revisited: Genesis and Sports Analogies," Ben Spackman (blog), February 8, 2022, https://benspackman.com/2022/02/implicit-context-revisited-now-with-more-football/.

illustrating this idea of contexts left implicit and unstated because the audience shares the cultural, linguistic, and other contextual worlds of the speaker.

> Imagine someone giving a sacrament meeting talk today and saying, "Captain America may have beat the Nazis in World War II, but he's no Captain Moroni." That statement draws upon (1) Latter-day Saint insider knowledge, (2) American pop culture, and (3) world history, but it makes sense to any American Latter-day Saint because of our shared cultural references. Someone three thousand years from now, however, might not understand how these two captains are not alike when they share the same rank, and they might not appreciate that Captain America's exploits are fiction even though the Nazi defeat in a world war is real history.[40]

Elder Smith was effectively advocating a face-value reading of scripture, which denies the distorting effects of reading in translation, through modern lenses that differ significantly from ancient ones, and without attempts to recover scripture's fullest contexts. (Perspicuity and plain reading in effect, deny that we are wearing glasses, and so we don't need to consider assumptions, whether our own or those of ancient Israelites.) Note, for contrast, how Elder Widtsoe quoted President Brigham Young on the interpretive necessity to try to understand like an ancient writer of scripture. "To read the Bible fairly, it must be read as President Brigham Young suggested: 'Do you read the scriptures, my brethren and sisters, as though you were writing them a thousand, two thousand, or five thousand years ago? Do you read them as though you stood in the place of the men who wrote them?' This is our guide. The scriptures must be read intelligently."[41] Whereas

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40. Sears, "From Biology Major to Religion Professor," 80.

41. First published in John A. Widtsoe, "Did the Waters of the Flood Cover the Highest Mountains of Earth?," *Improvement Era* 43, no. 6 (June 1940): 353, https://archive.org/details/improvementera4306unse/page/353/mode/1up, and later reprinted in John A. Widtsoe, *Evidences and Reconciliations* (Salt Lake City: Deseret Book, 1943), 128.

this kind of literal reading—seeking out the authors' contexts from thousands of years ago—required active effort, if not scholarly attention, Widtsoe clarified when it came to "the essential moral doctrines" of scripture, those were "presented . . . clear without [the necessity of] such scholarship, to every reader."[42]

If Talmage and Widtsoe agreed with Smith on concordism, perspicuity represents a major divergence. Talmage thought the scientific truths in scripture were revealed not by plain reading but through scientific discovery by geologists, chemists, physicists, and so on (that is, in Talmage's concordism, if science revealed that the world was very old, then Genesis must also be saying the world is very old). Thus, Talmage argued that to interpret scripture on the basis of nothing but scripture was to deny the truths that God was revealing through human discovery and taking scripture out of context. He wrote to one questioner,

> We should be very careful in taking what we consider the one and only interpretation or application of a passage of scripture, and sweeping away as utterly wrong all accumulated knowledge that may seem to point to another interpretation. . . . We have to recognize fact whether it be called scripture or science; and it is unwise to attempt to pass upon demonstrated fact and call it false because it has been brought forth through the labors of trained men in the field of science.[43]

Talmage further argued that difficulty in squaring science and scripture arises "when we compare *isolated* statements from scripture with demonstrated facts that are not of scriptural record."[44] This was, in part, Talmage's form of concordism; since science was one of those necessary contexts needed to understand scripture fully, scriptural interpretations which derived

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42. John A. Widtsoe, *In Search of Truth: Comments on the Gospel and Modern Thought* (Salt Lake City: Deseret Book, 1930), 87.

43. James E. Talmage to Heber Timothy, January 28, 1932, image 65, James E. Talmage Collection, 1879–1933, Church History Library, https://catalog.churchofjesuschrist.org/assets/c40ebd1d-8381-4d0f-8140-425828ec49c3/0/62.

44. Talmage to Timothy, image 63, italics added.

from scripture alone, read in isolation, could not be used to overturn science. "We cannot sweep aside all the accumulated knowledge in geology, archeology or any other branch of science simply because our interpretation of some isolated passage of scripture may seem to be opposed thereto."[45]

Elder John Widtsoe similarly wrote that one could "easily find himself in mistaken notions if he attempts the interpretation of the scriptures without getting a full perspective of the subject and adequate knowledge of human events that led to the giving of the scriptures, including origins and translations." That "full perspective," for Widtsoe and Talmage, entailed much more than simply reading English scriptures at face value.

Third Assumption: Inerrancy

The third and last key assumption in the NDBF question involves ideas about the nature of revelation, prophets, and scripture. Elder Smith held that revelation through prophets, recorded in scripture, lacked any significant human aspects; scripture was not only plain but, practically speaking, its content was dictated and micromanaged by God. Consequently, scripture's content consisted of nothing less than excerpts from God's omniscience and eternal facts, whether of doctrine or science. This assumption—that scripture is purely divine and therefore omnisciently correct in every regard—is generally called *inerrancy.*

Elder Smith expressed this idea most clearly in a letter to Henry Eyring Sr., a prominent Latter-day Saint chemistry professor who held to an old earth and death before the Fall. "No one realizes more than I, that I am 'a fallible man;' and I accord to every other man, including the scientists, the same compliment. There is one place, however, where I feel that men are infallible.[46]

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45. James E. Talmage to F. C. Williamson, April 22, 1933, image 45, Talmage Collection, https://catalog.churchofjesuschrist.org/assets/3d339439-13cf-4ea3-a926-697708c579bc/0/44.

46. Some Protestants make a distinction between *inerrancy* and *infallibility.* When making such a distinction, *infallibility* means that scripture cannot fail in its

That is when they, as prophets, reveal to us the word of the Lord."[47] In Smith's view, since prophets were merely *conduits* of revelation, a prophet's personality, language, ideas, time, place, culture, and setting had no real effect upon that divine revelation. Thus, for Smith, prophetic revelation was inerrant.

Smith invoked another aspect of inerrancy—divine micromanagement of scripture—particularly with 2 Nephi to defend NDBF. He wrote that Lehi's statement "must have been approved by the Lord or it would not be in the Book of Mormon."[48] He repeated this sentiment on multiple occasions. "I accept [2 Nephi] as Gospel truth, otherwise [it] would likely not be recorded in the Book of Mormon."[49]

Elders Widtsoe, Talmage, and other General Authorities, however, had very different views about the nature of revelation, prophets, and scripture. Certainly the Bible, with its tradition of being handed down, recopied, modified, and translated into different languages, entailed human mistakes or interpolations, what Joseph Smith called being "translated incorrectly." But even the Book of Mormon, according to the title page, could contain the "mistakes of men."

Moreover, they believed, because God's ways and thoughts were higher than human ways and thoughts (see Isa. 55:8–9),

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ultimate purpose of teaching the Gospel of salvation, even if it is errant in details of various kinds. Smith's implicit definition lines up much closer to inerrancy in this distinction, not only that scripture cannot fail in its purpose, but that scripture cannot be errant or mistaken in any respect. I will continue to term Smith's assumption *inerrancy.*

47. See Steven H. Heath, "The Reconciliation of Faith and Science: Henry Eyring's Achievement," *Dialogue* 15, no. 3 (1982): 87–99.

48. Joseph Fielding Smith, *Answers to Gospel Questions* (Salt Lake City: Deseret Book, 1966), 5:112.

49. Elder Smith to President J. Reuben Clark Jr., September 27, 1946, L. Tom Perry Special Collections, Harold B. Lee Library, Brigham Young University. To William Lee Stokes, an LDS geologist at the University of Utah, Smith wrote, "The words of Lehi are perfectly clear [perspicuity!] and evidently they carry the endorsement of our Eternal Father, for he approved of what was written and commanded the Witnesses to teach it in all the world." Smith to Stokes, February 4, 1957, MS 0675, box 3, William Lee Stokes Papers, Special Collections, J. Willard Marriot Library, University of Utah.

God had to come down to human level and accommodate revelation to the human condition, communicating to humans in a way they could understand in their time, place, and context (see D&C 1:24 and 2 Ne. 31:3).[50] This meant that even direct revelation might be partial or incomplete, it might temporarily adapt or tolerate human ideas or culture that weren't eternally true.

Jesus implicitly taught the principle of accommodation and gives an example of this in Matthew 19:1–9. When asked why the law of Moses allowed divorce (per Deut. 24:1–4) if it wasn't really God's will, Jesus replied, "It was because you were so hard-hearted that Moses allowed you to divorce your wives" (Matt. 19:8, NRSV). Jesus thus implies that revelation did not entail eternal correctness; divorce was a divine accommodation to the hard-heartedness of humans.

Recent careful attention to the Doctrine and Covenants and the Joseph Smith Translation has led Latter-day Saint scholars further away from the idea that revelation entails something like divine dictation of ultimate facts free from any prophetic effort or human elements. It also appears that Joseph Smith himself did not understand revelation that way! For example, one of the pioneering scholars of the Joseph Smith Translation, Robert J. Matthews, wrote that the Prophet's translation of the Bible "was not a simple, mechanical recording of divine dictum, but rather a study-and-thought process accompanied and prompted by revelation from the Lord."[51] Steven Harper, a BYU Church History professor as well as one of the former editors of the Joseph Smith Papers and current editor for *BYU Studies,* wrote that revelation

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50. For more explanation and citations on the principle of accommodation, see Ben Spackman, "Truth, Scripture, and Interpretation: Some Precursors to Reading Genesis," address, FAIRMormon conference, 2017, https://www.fairlatterdaysaints.org/conference/august-2017/truth-scripture-and-interpretation. For a more recent publication, see Richard Neitzel Holzapfel, "The Lord Guides His Church According to Our Language and Understanding," *Liahona* (August 2022, online only), https://www.churchofjesuschrist.org/study/liahona/2022/08/digital-only/the-lord-guides-his-church-according-to-our-language-and-understanding.

51. As quoted in David Rolph Seely, "The Joseph Smith Translation: 'Plain and Precious Things' Restored," *Ensign* 27, no. 8 (August 1997): 11.

was not a singular event of passive reception but a process over time, with human aspects:

> Joseph knew better than anyone else that the words he dictated were both human and divine, the voice of God clothed in the words of his own limited, early American English vocabulary. He regarded himself as a revelator whose understanding accumulated over time. Joseph recognized as a result of the revelatory process that the texts of his revelations were not set in stone. Rather, he felt responsible to revise and redact them to reflect his latest understanding.[52]

If Joseph Smith passively received God's words as a secretary—Harper details how some early Saints thought this—then he should have known to not change or update the revelations, yet that is what he did.[53]

BYU–Hawaii professor Grant Underwood has taught in a variety of settings about revelation having human elements: a campus devotional,[54] a *BYU Studies* article,[55] and a technical chapter in a non-LDS academic book.[56] He cites numerous General Authorities

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52. Steven C. Harper, "'That They Might Come to Understanding': Revelation as Process," in *You Shall Have My Word: Exploring the Text of the Doctrine and Covenants,* ed. Scott C. Esplin, Richard O. Cowan, and Rachel Cope (Provo, Utah: Religious Studies Center, Brigham Young University; Salt Lake City: Deseret Book, 2012), 31, https://rsc.byu.edu/you-shall-have-my-word/they-might-come-understanding-revelation-process.

53. "A correct understanding of the nature of the revelations the Prophet Joseph Smith received and how he updated them in light of continued revelation explains why many changes occurred." Robert J. Woodford, "How the Revelations in the Doctrine and Covenants Were Received and Compiled," *Ensign* 15, no. 1 (January 1985): 26–33.

54. Grant Underwood, "Relishing the Revisions: Joseph Smith and the Revelatory Process," devotional address, BYU Hawaii, October 13, 2009, https://speeches.byuh.edu/devotionals/relishing-the-revisions-joseph-smith-and-the-revelatory-process/.

55. Grant Underwood, "Revelation, Text, and Revision: Insight from the Book of Commandments and Revelations," *BYU Studies* 48, no. 3 (2009): 67–84, https://byustudies.byu.edu/article/revelation-text-and-revision-insight-from-the-book-of-commandments-and-revelations.

56. Grant Underwood, "The Dictation, Compilation, and Canonization of Joseph Smith's Revelations," in *Foundational Texts of Mormonism,* ed. Mark

from Orson Pratt onwards who did not think revelation consisted of divine dictation and concludes that "clues from [Joseph Smith's] revelation texts suggest that the revelations were not experienced, or intended to be understood as verbatim transmissions" and thus "contained linguistic 'imperfections' and stood in need of 'corrections.'" Thus, "[Joseph's] revelations were not understood as infallible texts written in stone by the finger of God; they came instead through a finite and fallible prophet who, along with his associates, was not shorn of his humanity in exercising his prophetic office. Moreover, the revelation texts were not viewed as fixed and complete, beyond revision, but as articulations that could and should be updated to reflect the ongoing flow of revelation to the church."[57]

Joseph Fielding Smith rejected the idea that revelation or scripture is God's word in human words[58] because he thought revelation was purely divine; prophets had no effect on revelation and the words of God were inerrant. Joseph Smith, Orson Pratt, John Widtsoe, James E. Talmage and others, however, had different conceptions of prophets, revelation, and scripture that did not entail inerrancy.

The Combined Assumptions

Combining all three assumptions produced Smith's final product of NDBF. His assumption of *concordism* meant that 2 Nephi recorded a scientific statement that nothing of any kind died before c. 4000 BC. Smith's assumption of *inerrancy* meant that because it was in inspired scripture, Lehi could not be wrong about this scientific fact, or God would not have allowed it in

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Ashurst-McGee, Robin Jensen, and Sharalyn D. Howcroft (New York: Oxford Press, 2018), 101–23.

57. Underwood, "Dictation, Compilation, and Canonization," 122–23.

58. Kenton Sparks, *God's Word in Human Words: An Evangelical Appropriation of Critical Biblical Scholarship* (Grand Rapids, Mich.: Baker Academic, 2008), is a favorite book of mine for thinking about revelation, scholarship, and tradition. A more accessible version was published as Kenton Sparks, *Sacred Word, Broken Word: Biblical Authority and the Dark Side of Scripture* (Grand Rapids, Mich.: William B. Eerdmans, 2012).

the Book of Mormon. And finally, *perspicuity* meant that, since Smith did not consider himself to be interpreting as much as echoing the obvious and plain meaning of inerrant scientific scripture, he could not be wrong. As he argued before the First Presidency in 1931 on this topic, "If I am wrong, then the revelations are wrong—I have not placed private interpretation upon them. . . . There is no alternative."[59]

For the sake of illustration, let us ask some open-ended questions that come from inverting these three assumptions.

- *Concordism*: Could Lehi be saying something non-scientific or making some other kind of argument?
- *Perspicuity*: Do we really understand what meaning Lehi intended to convey? Does Lehi actually mention death or claim that there had never been death anywhere, of any kind? Is Lehi himself interpreting? Are there alternate readings which better match the fullest context of Lehi's time, place, culture, and knowledge?
- *Inerrancy*: Even if we were to grant that we understand Lehi correctly[60] in saying that he is making assertions about natural history, science, or NDBF, is it necessarily correct simply because it is scripture? Is it possible, given our other data, that Lehi's statement might be understood as a partial and accommodated understanding, or as one of the "mistakes of men" the introduction to the Book of Mormon acknowledges? If not, why not?

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59. Smith address, 55.

60. For example, 2 Nephi 2:23 is often read as a declaration that reproduction in the garden was impossible. However, BYU professor Daniel Ludlow, at the time serving as the head of the Church's committee to assure doctrinal correctness in publications, interpreted it differently. He wrote, "The scriptures do not say Adam and Eve *could not* have children; they say Adam and Eve *would not* have had children if they had remained in a state of innocence, not knowing good from evil. . . . This scripture seems to indicate that Adam and Eve were physically capable of having children in the Garden of Eden (thus they could have had children), but so long as they remained in their state of innocence, they never would have had children." Daniel H. Ludlow, "Q&A," *New Era* 3, no. 9 (September 1973): 13–14. For more information about Ludlow's committee calling, see "Correlation," Church History Topics, The Church of Jesus Christ of Latter-day Saints, accessed March 19, 2025, https://www.churchofjesuschrist.org/study/history/topics/correlation.

Twentieth Century History of Divergent Interpretations

Having laid out the three key assumptions—concordism, perspicuity, inerrancy—let us look at the history of how those assumptions have been manifest regarding NDBF.

The 1930–1931 Debate

First, an internal controversy extending from 1930 to 1931 led to then-Elder Smith and B. H. Roberts (of the Presidency of the Seventy) both presenting lengthy written arguments to the Quorum of the Twelve and First Presidency.[61] Elder Smith had preached NDBF in public and asserted that science was irrelevant to the question. "I do not care," he preached, "what the scientists say in regard to dinosaurs and other creatures upon the earth millions of years ago that lived and died and fought and struggled for existence."[62] Why? "Naturally, since I believe in modern revelation, I cannot accept these so-called scientific teachings, for I believe them to be in conflict with the simple and direct word of the Lord that has come to us by divine revelation."[63]

While Elder Smith preached the irrelevance of science in public, Elder Roberts had acted with First Presidency support and funding to write a book which could serve as a new Church

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61. For more on B. H. Roberts, see Truman G. Madsen, *Defender of the Faith: The B. H. Roberts Story* (Salt Lake City: Bookcraft, 1980). See also "B. H. Roberts," Church History Topics, The Church of Jesus Christ of Latter-day Saints, accessed March 19, 2025, https://www.churchofjesuschrist.org/study/history/topics/b-h-roberts.

62. His talk to the Utah Genealogical Society was published as Joseph Fielding Smith, "Faith Leads to a Fulness of Truth and Righteousness," *Utah Genealogical and Historical Magazine* 21, no. 4 (October 1930): 148, https://archive.org/details/utah_genealogical_and_historical_magazine_oct_1930/page/n4/mode/1up

63. Earlier in the same publication, Smith had made clear his subject. "I am opposed to the present biological theories and the doctrine that man has been on the earth for millions of years. I am opposed to the present teachings in relation to the age of the earth which declare that the earth is millions of years old. Some modern scientists even claim that it is a billion years old. Naturally, since . . ." Smith, *Answers to Gospel Questions,* 5:112.

manual. His draft asserted the existence of humans or human-like beings before Adam ("preadamites"), an old earth, and death before the Fall.[64] Taking such opposite positions, based on differing assumptions, Elders Smith and Roberts made their best arguments first before the Quorum of the Twelve and then the First Presidency, trying to hash out who was correct, or at least, who better represented scripture, science, and Church doctrine. It was at this time that Elder Smith argued, based on 2 Nephi,[65] that NDBF was "a fact . . . and no amount of sophistry can change this fact. . . . If I am wrong, then the revelations are wrong—I have not placed private interpretation upon them. . . . There is no alternative."[66]

After hearing their arguments (and consulting Elder James E. Talmage privately for his scientific expertise), the First Presidency decided that Elder Roberts' book should not be published but also ruled against Smith's assumptions and the conclusions they led to. The Church, said the First Presidency, had no doctrine one way or the other on death before the Fall (nor on preadamites).[67] They showed disagreement with and undermined Smith's assumptions when they wrote a memo to all General Authorities to "leave geology, biology, archaeology and anthropology, no one of which has to do with the salvation of the souls of mankind, to scientific research."[68]

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64. See James B. Allen, "The Story of *The Truth, the Way, the Life,*" *BYU Studies* 33, no. 4 (1993): 690–741, https://byustudies.byu.edu/article/the-story-of-the-truth-the-way-the-life.

65. Smith also drew heavily on George McCready Price, a Seventh-day Adventist with no scientific training, to argue that science proved a young earth. See Spackman, "Scientist," 5–9.

66. Smith address to President Rudger Clawson and Members of the Council of Apostles, 55; Spackman, "Scientist," 90.

67. This is implied by the memo sent out by the First Presidency but made explicit in letters and journal entries from those involved. See Spackman, "Scientist," 81–82.

68. This and some other relevant documents are published in William E. Evenson and Duane E. Jeffery, *Mormonism and Evolution: The Authoritative LDS Statements* (Salt Lake City: Greg Kofford Books, 2005).

Questions of science belonged to the realm of scientists, they ruled, and scientific facts could not be extrapolated from scripture in the way Elder Smith claimed based on concordism, perspicuity, and inerrancy. Moreover, the First Presidency held that death before the Fall was not an issue that had "to do with the salvation of the souls of mankind."[69]

To counterbalance Elder Smith's public preaching, which made it seem like the Church rejected science (a major concern of young adults at the time), the First Presidency appointed Elder James E. Talmage, geology PhD, to address the matter in public. Elder Talmage prepared a speech titled "Earth and Man," which he delivered in the Salt Lake Tabernacle on August 9, 1931. As a geologist and an Apostle, Talmage taught that science was generally reliable, that the earth was very old, that fossils belonged to the history of this earth and attested to a general progression from less to more complex, and that death had been operative for a very long time. Fossils represented extinct plants and animals which "lived and died, age after age, while the earth was yet unfit for human habitation."[70]

Elder Talmage's response to later questions about "Earth and Man" makes very clear that his talk did indeed assert the operation of death long before 4000 BC.

> I cannot agree with your conception that there was no death of plants and animals anywhere upon this earth prior to the transgression of Adam, unless we assume that the history of Adam and Eve in Eden dates back many hundreds of thousands of years. The trouble with some theologians—even including many of our own good people—is that they undertake to fix the date of Adam's transgression as being approximately 4000 years before the birth of Christ and therefore

69. Elder Smith, however, continued to assert that NDBF was a central doctrine. For example, he wrote in a 1940 letter that "the fundamental doctrine of the church is that death was brought into the world through the transgression of Adam. See 2 Nephi 2:22." Joseph Fielding Smith to David S. King, January 5, 1940, transcript in my possession.

70. Talmage, "Earth and Man," 475.

> about 5932 years ago. *If Adam was placed upon the earth only that comparatively short time ago, the rocks clearly demonstrate that life and death had been existent and operative in this earth for ages prior to that time.*[71]

Before publication, Elder Talmage insisted the First Presidency vet "Earth and Man" carefully. They did so and published it with their approval in the *Deseret News,* then as an official Church pamphlet (more than ten thousand copies printed!), then in the British Church magazine, and then even translated for the German Church magazine. The 1931 First Presidency clearly wanted Elder Talmage's general message, including his teaching of death before 4000 BC, spread widely.

President J. Reuben Clark

A decade later, President J. Reuben Clark Jr.—a lawyer and diplomat who served in the First Presidency from 1938 until his death in 1961—prepared a talk. He sent the draft for feedback to his friend Elder Smith, who criticized it sharply because it asserted an old earth. (This, Elder Smith said, was incompatible with believing scripture, citing 2 Nephi and invoking the temple account.)

In his reply, Clark set forth a useful principle.

> You [Elder Smith] seem to think I reject the scriptures, or some of them. I do not intend to do so, but obviously I am no more bound by your interpretation of them than you are by mine. . . . As to what the earlier brethren have said,—where they have declared themselves as speaking under inspiration and by the authority of the Lord, I bow to what they say. But where they express views based on their own reasoning and interpretation, then none of us are foreclosed from exercising our own reasoning powers, inadequate though they may be; but the earlier views do not foreclose us from thinking. This is particularly true, where we come to interpreting their interpretations.

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71. Talmage to Timothy, image 65, emphasis added.

President Clark pointed out further that Elder Smith was attributing technical meanings to general words and that Smith was—importantly—interpreting.

More significantly, this letter reveals that for President Clark, the Garden of Eden implied death operating prior to Adam's Fall, at least the death of the plants and perhaps even animals in the garden, unless they were vegetarian. Regarding "the time when death came into the world," President Clark wrote that "its application might normally be applied to humans. Clearly, unless the animals [in Eden] lived on air, they consumed something, and *even if they were all vegetarians, the plant life they ate died.*"[72]

President Clark rejected Elder Smith's position that believing scripture entailed rejecting an old earth or death before the Fall; he thought Smith was interpreting incorrectly based on his own assumptions and understandings. For Clark, he believed in death before the Fall *because* of the Garden of Eden account. He also thought it necessary to take conscious care in defining scriptural terms, and to be aware of the nature of tradition as potentially "based on [human] understandings and interpretations" instead of revelation.

President David O. McKay

During his presidency in 1951–1970, President David O. McKay also asserted the existence of death before the Fall in several ways. In the October 1963 general conference, President McKay provided an interpretation of the Garden of Eden story that strongly implied it. During his talk, he quoted approvingly from a non-LDS book about the development of the human conscience.[73] Notably, when one reads the pages President McKay

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72. J. Reuben Clark Jr. to Joseph Fielding Smith, October 2, 1946, Perry Special Collections, emphasis added.

73. David O. McKay, in *One Hundred Thirty-Third Semi-annual Conference of The Church of Jesus Christ of Latter-day Saints* (Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 1963), 5–9, https://catalog.churchofjesuschrist.org/assets/d2e2f276-ed2a-4b8e-8171-463ce58f1030/0/7.

cited, one finds an interpretation of Genesis from an evolutionary perspective. The commandment to not partake of the fruit of the tree of life represented that moment in evolutionary history when—unlike animals operating solely on instinct—humans had learned to resist impulses; they had evolved to the point where in spite of being hungry, they could choose to not eat.[74] A decade earlier, when asked about Elder Smith's *Man, His Origin and Destiny,* which argued for a young earth and NDBF, McKay expressed his dissatisfaction with Smith's book but named this non-LDS evolutionary book as one of the "outstanding books of the century."[75]

Under President McKay, Elder Talmage's "Earth and Man" was reprinted in *The Instructor,* one of the Church magazines, in 1965 as part of a series of proscience articles.[76] Another of these articles, "The Relatedness of Living Things," made a detailed pro-evolution argument, invoking Charles Darwin, natural selection, and the accompanying long operation of death before 4000 BC.[77] Notably, this article carried a small box at the beginning stating that the article had been read and approved by the editor (and associate editors) of the magazine. The editor was listed as "President David O. McKay," and other sources confirm that McKay read and approved the article.[78] From these and other sources, it

74. See "David O. McKay, Genesis, and Evolution: Part 2," Ben Spackman (blog), August 3, 2016, https://benspackman.com/2016/08/david-o-mckay-genesis-and-evolution-part-2/; McKay cites the book Lecomte Du Nuoy, *Human Destiny* (New York: Longmans, Green and Co., 1947), 16.

75. As recorded by Richard D. Poll, "Notes on a conversation with President David O. McKay in his office . . . December 29, 1954, on the Subject of" *Man, His Origin and Destiny,* Robert L. Miller Papers, 1832–2008, ACCN 2064, box 52, folder 3, Special Collections, J. Willard Marriott Library, University of Utah.

76. Talmage, "Earth and Man."

77. BYU Botany professor Bertrand F. Harrison, "The Relatedness of Living Things," *Instructor* 100, no. 12 (July 1965): 272–76, https://archive.org/details/instructor1007dese/page/272/mode/2up.

78. See "David O. McKay on Evolution and Reading Genesis," Ben Spackman (blog), June 28, 2016, https://benspackman.com/2016/06/david-o-mckay-on-evolution-and-reading-genesis/.

seems clear that President McKay believed death had been operative for millions of years of the earth's existence.

The Bible Dictionary and Church Magazines

When the Church published the *Bible Dictionary* in 1979, several entries reflected President Smith's assumptions in asserting no death before the Fall. "Before the fall . . . there was . . . no death . . . among any of the earthly creations."[79] Elder McConkie, who supervised the production of the *Bible Dictionary*, shared President Smith's assumptions, and so his writings were a key resource in producing its entries.[80] However, the Bible Dictionary carried—and still carries (though modified)—a disclaimer. "[The Bible Dictionary] is *not intended as an official or revealed endorsement* by the Church of the doctrinal, historical, cultural, and other matters set forth. Many of the items have been drawn from the best available scholarship of the world and are subject to reevaluation based on new research and discoveries or on new revelation."[81] This introduction echoed Elder Richards's statement (quoted earlier) in that the information provided was subject to further discovery and reevaluation. It also disavowed any claim to official or revealed status.

The Bible Dictionary's framing about death before the Fall has not been maintained in all subsequent Church publications. Just seven years later, Church leaders solicited a BYU geology professor and stake president to write an *Ensign* article on fossils.[82] Church leaders and administrators reviewed it extensively

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79. Bible Dictionary, in *Holy Bible* (The Church of Jesus Christ of Latter-day Saints, 1979), s.v. "Fall of Adam," 670. See also the entries for "Flesh," "Death," and "Restitution; Restoration." Note that some of these entries have now been modified.

80. The reasons for Smith's assumptions becoming widespread and written in the Bible Dictionary are complex and beyond the scope of this paper. See Spackman, "Scientist," 241–60.

81. Bible Dictionary, "Preface," 599, emphasis added.

82. See Morris S. Petersen, "Do We Know How the Earth's History as Indicated from Fossils Fits with the Earth's History as the Scriptures Present It?," *Ensign* 17, no. 9 (September 1987): 28–29.

for a year and then published it with minimal changes. In that approved form, it quoted Elder Talmage's "Earth and Man" and reaffirmed that dinosaurs and other animals now represented as fossils had lived and died over hundreds and millions of years of the Earth's existence.

More recently, two articles in the *New Era* also asserted the long operativity of death. In 2016, an article titled "What Does the Church Believe about Dinosaurs?" asked, "Did dinosaurs live and die on this earth long before man came along? There have been no revelations on this question, and the scientific evidence says yes. (You can learn more about it by studying paleontology if you like, even at Church-owned schools.)"[83]

The statement that there have been no revelations on this question and science affirmed "yes" echoes the 1931 First Presidency decision discussed above and implicitly rejects the interpretive assumptions of Smith that rendered 2 Nephi an inerrant scientific fact revealed by God.

A second 2016 *New Era* article, titled "What Does the Church Believe about Evolution?" took a similar position. Quoting Elder Holland's careful wording in the April 2015 general conference, it said Adam and Eve lived alone in the garden where there was not "*human* death." Moreover, it said, "the details of what happened on earth before Adam and Eve, including how their bodies were created, have not been revealed."[84] This seems to echo President Clark's understanding of plant (and animal?) death in the garden and also allows for preadamite death *before* the time in the garden.

All of this allows for a variety of hypothetical scenarios reconciling scripture with science, even retaining concordist assumptions, should one wish to. In one simple example, at some point in the long history of the earth and humanoids, God either creates

83. "What Does the Church Believe about Dinosaurs?," *New Era* 45, no. 2 (February 2016): 41, reprinted herein, 349.

84. "What Does the Church Believe about Evolution?," *New Era* 45, no. 10 (October 2016): 41, emphasis added, reprinted herein, 347.

two humans from the dust of the earth or chooses an advanced pair from the evolving population of humanoids.[85] Now, the pair is known as Adam and Eve (or rather "Human" and "Life," the typological meaning of their names in Hebrew).[86] God places them in the special environment of the garden wherein certain natural laws such as human death are held at bay. God teaches them the gospel and makes covenants with them before they fall, leaving God's presence and the garden behind to (re)join the others and teach the gospel to them. This scenario even preserves the traditional concordist reading of 2 Nephi where Adam and Eve fall from a non-mortal state, while also allowing for the reality of the scientific evidence. It is, of course, merely one hypothetical possibility among several, which depend entirely on which assumptions one makes. The rejection of concordism opens even more possibilities.

Another possible scenario arises from the combination of President Clark's view—nonhuman death in the garden—with Daniel Ludlow's careful interpretation in the *Ensign* that Adam and Eve were indeed physically capable of reproduction in the garden. "The scriptures do not say Adam and Eve *could* not have children; they say Adam and Eve *would* not have had children if they had remained in a state of innocence, not knowing good from evil. . . . [2 Nephi] seems to indicate that Adam and Eve were physically capable of having children in the Garden of Eden (thus they could have had children), but so long as they remained in their state of innocence, they never would have had children."[87]

If, as President Clark believed, the consumption of plants in the garden constitutes a form of death, then plants regrowing their fruits certainly constitutes a form of reproduction. (If

85. Recall that this is essentially what the book advocated which President McKay quoted in the 1963 general conference.

86. See Ben Spackman, "'Adam, Where Art Thou?': Onomastics, Etymology, and Translation in Genesis 2–3," in *Fleeing the Garden: Reading Genesis 2–3,* ed. Adam S. Miller (Provo, Utah: Neal A. Maxwell Institute for Religious Scholarship, 2017), 31–47.

87. Ludlow, "Q&A," 13–14.

plants were not reproducing, then we must understand the garden as being slowly denuded and stripped as Adam, Eve, and the animals consume the fruits and leaves which could not grow back.) Given Ludlow's argument that the lack of human reproduction was not due to an inherent physical limitation, then it seems reasonable that there would be no physical limitations on plant reproduction. Thus, we might assume that reproduction in general was possible and happening in the garden, but not for Adam and Eve because of their child-like nature.

Further, if plant (and, as President Clark intimates, perhaps animal) death was active in the garden, why was there no *human* death? Notably, the scriptures do not specify the cause of the lack of human death in the garden, only that eating the fruit from the tree of knowledge of good and evil would result in their death. Genesis does not offer any explicit explanation of this, and Latter-day Saints have traditionally assumed it was some kind of divinely imposed *state* that was reversed at the Fall. Note, however, after the expulsion from the garden, the reason for keeping them out is so they would not eat of the tree of life "and live forever" (Alma 42:3). This implies that access to the tree of life granted life. Since the tree of life was one of the trees they could eat from, perhaps they consumed from the tree of life regularly, renewing or preserving their amortal state. Thus, when expelled from the garden, it is not a divinely imposed amortal status that is revoked, but that their access to the tree of life is cut off, which means that they will eventually die.

This scenario is also based upon certain assumptions—including concordism—but is significant and demonstrates again the effect of differing assumptions and the importance of recognizing them, something Elder Widtsoe acknowledged. "We set up assumptions, based upon our best knowledge, but can go no further."[88] The views of Clark and Ludlow invite a rethinking of

88. John A. Widtsoe, *Evidences and Reconciliations* (Salt Lake City: Deseret Book, 1943), 126.

Genesis, which entails a different understanding of 2 Nephi. If both reproduction and death were possible—and active in the case of plants and perhaps animals—in the garden, they would form an inherent part of what Lehi terms "the same state in which they were after they were created; and they must have remained forever" (2 Ne. 2:22).[89] But Adam and Eve chose to eat from the fruit of the tree of knowledge and leave the garden, embracing knowledge, experience, reproduction, and death.

Conclusions

I will summarize the arguments I have made and then offer what I hope is a useful analogy from the experience of the Apostle Paul. First, our positions and interpretations are downstream of the assumptions we make; change the assumptions, and you change the resulting interpretation. Faithful and orthodox people can differ on what assumptions they find reasonable, but it is important to examine and interrogate our assumptions instead of operating in ignorance of them. We must try to recognize the glasses we wear.

Second, Joseph Fielding Smith made three key assumptions in asserting that 2 Nephi 2:22 proved that there was no death of any kind before 4000 BC. *Concordism* is the idea that scripture primarily describes nature—meaning, the material universe—and that scripture and science must be in concord or say the same thing. *Perspicuity* is the idea that scripture's meaning remains clear and obvious to any sincere reader, and that no real attention to linguistic, cultural, or other contexts is necessary. And *inerrancy* is the idea that scripture's inspired nature entails its ultimate correctness and lack of real human characteristics.

Third, the historical evidence indicates that a number of First Presidencies, high-ranking Church leaders, and approved

89. I explore this from a different angle in "'We Don't Know How Long Adam and Eve Were in the Garden': Genre and the Temple, Part 3," Ben Spackman (blog), July 26, 2020, https://benspackman.com/2020/07/howlong/.

Church publications like "Earth and Man" rejected inerrancy and perspicuity. These publications represent an implicit and explicit rejection of a NDBF interpretation of 2 Nephi 2:22, as evidenced by their statements that dinosaurs and other animals lived and died for millions of years on this earth.

Where then do we go from here? If God inspires scripture as well as scientific discovery and progress—and Church leaders have repeatedly affirmed that this is the case—then what we have is something akin to Paul's paradoxical learning experience on the road to Damascus. Paul had persecuted Christians based on his scriptural conviction[90] that Jesus could not be the Messiah, because the Messiah could not be crucified. Yet here was the glorified resurrected Jesus in front of him on the road, declaring himself to be the Son of God. Crucially, Jesus did not explain to Paul how to reconcile this new information with the scriptures. Rather, Paul was left to himself to work through his cognitive dissonance and figure it out.

Whether through divine revelation, visions, or human-but-inspired means like science, God gives us new information but rarely tells us how to make sense of it, how to make it square with what we thought we knew. Being able to productively work through and live with that ambiguity, contradiction, or cognitive dissonance is an important spiritual skill and connected to intellectual humility. Paul eventually realized that his understanding of scripture had been, at best, incomplete and was able to make sense of what had appeared to be contradictory.

In the same way, none of the *Ensign* or *New Era* articles or "Earth and Man" explain in detail how to square things. We are

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90. Paul likely had in mind Deuteronomy 21:21–23, which stated that any Israelite who committed a capital crime was under God's curse and should be executed and "hung on a tree." By Paul's day, Jews apparently understood crucifixion as representing this curse. A crucified Jew was understood as being under God's curse. This is why a crucified Messiah presented a "stumbling block to the Jews" (1 Cor 1:23) and was likely the basis for Paul persecuting Christians; after all, how could God's Messiah be cursed? Paul eventually works this out in Galatians 3:13, where he quotes Deuteronomy 21:23, stating that Jesus became the curse in our place.

left with two traditions: one operating with a set of three assumptions that generated a scriptural interpretation—NDBF—which forces a hard confrontation with science, and another which does not make those assumptions and recognizes extra-scriptural contexts—whether science, history, or biblical studies—as a part of the body of knowledge which can rightfully shape our understanding of scripture. It falls upon each reader to decide what interpretive assumptions are reasonable, the relevance of the history set forth here, and whether scientific information and other contexts provide valid information for interpreting scripture, or whether scripture is to be read only at face-value.

Finally, I wish to leave the reader with two quotations which I think about frequently. Elder Stephen L Richards believed "that there never will be discovered a fact in science, which is really truth, which will not comport with the revealed word of God, if the revealed word of God is understood and properly interpreted. . . . When the truth of Scripture can be correctly interpreted there will be no clash between any revealed word of Scripture and the facts of science."[91] While Richards almost certainly intended this in a concordist way, it is equally true if concordism is rejected; science and scripture will not clash because they are not necessarily describing the same phenomena.

Darrel Falk, a Christian biologist, wrote this about the approach generated by assumptions of concordism, perspicuity, and inerrancy. "The problem with this approach is that it is pitting Christianity against a vast expanse of widely tested scientific data and likely doing so for reasons that are *theologically unnecessary.*"[92] I do not see strong Latter-day Saint justifications for concordism, perspicuity, or inerrancy; they seem to me theologically unnecessary, and there are significant examples of

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91. Stephen L. Richards, "Materialism and Christianity of To-day," *Millennial Star* 93, no. 50 (December 10, 1931): 806, https://archive.org/details/millennialstar9350eng/page/806/mode/2up.

92. Darrel R. Falk, "Human Origins: The Scientific Story," in Cavanaugh, *Evolution and the Fall,* 18, emphasis added.

Church leaders rejecting them. Moreover, all other things being equal, I prefer interpretations which generate less conflict with external data, since such conflict can lead to loss of faith. Instead of simply choosing one side and abandoning the other, then, let us be like Paul—engage in the duties of discipleship, and carry out the hard but constructive work of study, prayer, research, and reflection.

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What Do We Know from a Scientific Epistemology?

Why the Latter-day Saint Community Can Trust Science

(in the Same Way Scientists Do)

Steven L. Peck

On June 30, 1860, Samuel Wilberforce, a fiery Anglican bishop, addressed the British Science Association at the Oxford University Museum of Natural History on the subject of Darwin's recent publication, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favored Races in the Struggle for Life.* This was the famous encounter between Bishop Wilberforce and Thomas Huxley, Darwin's "Bulldog," in which the bishop inquired of Huxley whether it was from his mother's or his father's side that he was descended from a monkey? And Huxley quipped back something like, "Better a monkey than a bishop who used his talents to obscure the truth." There might be some surprise to learn that Wilberforce had not been arguing from a religious perspective that the book was dangerous (although there may have been an element of that). He was arguing it was bad science and that the facts did not warrant the conclusions.

Something else happened at the meeting worth noting. During the gathering, an old man stood and held over his head a large, weathered copy of the Bible. He begged the audience to "believe God rather than man," telling the assembled spectators that *The*

Origin had given him "acutest pain."[1] The audience shouted for him to be silent and sit down.[2]

The man was Robert FitzRoy, a former member of parliament, a one-time governor of New Zealand, and, in his most celebrated role, the captain of the history-changing expedition of the HMS *Beagle,* aboard which Darwin had his first intimations of the evolutionary theory that would change the world. Since his famous voyage, FitzRoy had become a biblical literalist. Still a man of science and member of the Royal Society at the time of this incident, he felt a growing discomfort at the implications of his former companion's book that threatened his view of God and the inerrancy of the Genesis accounts of the Creation and the Great Flood.

He would not be alone. Darwin's book became one of the principal targets in the rise of biblical fundamentalism in the late nineteenth and early twentieth centuries. Darwin's *Origin* seemed to intrude on the territory mapped out as the provenance of God's creation. As a result, the relationship between science and religion has been and continues to be complex and often fraught. Recently, however, some scientists who embrace both science and religion have begun to argue that this conflict model is unnecessary.[3]

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1. Derek Barlow, "The Devil Within: Evolution of a Tragedy," *Weather* 52, no. 11 (1997): 338. *Weather* is a publication of the Royal Meteorological Society.

2. Diane B. Paul, John Stenhouse, and Hamish G. Spencer, "The Two Faces of Robert FitzRoy, Captain of HMS *Beagle* and Governor of New Zealand," *Quarterly Review of Biology* 88, no. 3 (2013): 219–25, https://doi.org/10.1086/671485.

3. For more information, see M. Elizabeth Barnes, James Elser, and Sara E. Brownell, "Impact of a Short Evolution Module on Students' Perceived Conflict between Religion and Evolution," *American Biology Teacher* 79, no. 2 (2017): 104–11; William S. Bradshaw and others, "A Longitudinal Study of Attitudes toward Evolution among Undergraduates Who Are Members of The Church of Jesus Christ of Latter-day Saints," *PLOS One* 13, no. 11 (2018), https://doi.org/10.1371/journal.pone.0205798; Jamie L. Jensen and others, "Religious Affiliation and Religiosity and Their Impact on Scientific Beliefs in the United States," *BioScience* 69, no. 4 (2019): 292–304, https://doi.org/10.1093/biosci/biz014; Katie F. Manwaring and others, "Scientific Reasoning Ability Does Not Predict Scientific Views on Evolution among Religious Individuals," *Evolution: Education and Outreach* 11, no. 2 (2018): 1–9, https://doi.org/10.1186/s12052-018-0076-8; Peck, *Science the Key to Theology*; Johan De Smedt and Helen De Cruz, *The Challenge of Evolution to Religion*, Elements in the Philosophy of Biology (Cambridge, Eng.: Cambridge University Press, 2020), https://doi.org/10.1017/9781108685436; and Ethan R. Tolman

To consider this conflict more thoroughly, a more complete understanding of science as practiced in the twenty-first century is useful. Often, science gets reduced to this simple four-step method: (1) find a falsifiable hypothesis; (2) test that hypothesis through experimental methods designed to detect or expose whether the hypothesis is false; (3) if the experiment fails to confirm, reject the hypothesis and start again at (1); or (4) try another experiment and see if one can reject the hypothesis this time. As it turns out, however, this is a far cry from the way science is practiced.

Scientific practice is more nuanced than this simple model would suggest. Science, although it has ancient origins, is an invention that appeared from investigative developments beginning in the sixteenth century and extending into the mid-eighteenth century. It framed a set of practices and attitudes that would generate knowledge about the physical universe.[4] It is a complex human activity that demands the very best humans have to offer in terms of trying to understand the world in all its complexity and generate knowledge about the physical world. Here's a short list of what science is: it is a human social activity based upon programs of study; the collective agreement on what counts as evidence;[5] research paradigms that define the theories and gather and present evidence obtained through various natural and apparatus-assisted observations or experimental manipulation of the same; the willingness to be open to criticism and critique by others who are qualified to examine what a researcher and those working with her have done;[6] a commitment to uncertainty;[7] the

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and others, "Reconciling Evolution: Evidence from a Biology and Theology Course," *Evolution: Education and Outreach* 13, no. 19 (2020): 1–8.

4. David Wootton, *The Invention of Science: A New History of the Scientific Revolution* (London: Penguin UK, 2015).

5. Michael Strevens, *The Knowledge Machine: How Irrationality Created Modern Science* (New York: Liveright, 2020), 119.

6. Jonathan P. Tennant, "The State of the Art in Peer Review," *FEMS Microbiology Letters* 365, no. 19 (2018), https://doi.org/10.1093/femsle/fny204.

7. Kostas Kampourakis and Kevin McCain, *Uncertainty: How It Makes Science Advance* (New York: Oxford University Press, 2020).

skeptical examination of the work that has proceeded and motivated what's been done before; years of education, training, and apprenticeships; and then presenting that work in papers that are scrutinized by peers and publicly published, with all comers able to examine the merits of all aspects of the science engaged to create the paper.[8] As a human enterprise, science is committed to certain values and subject to all the strengths and weaknesses that define what it means to be human—for example, bias, conceptual blindness, fear of being wrong, holding to certain opinions long after they should have been abandoned, and all the other limitations and missteps found in being human. I've done a bit of handwaving, so let me give some details to help structure what I've just claimed for an abstract of what science entails, at least in part. In what follows, for ease or readability "science" is used as a personified shorthand for what the practice of science entails. For example, "Science says" should be read as general practices and activities of trained scientists, not as a free-floating entity dictating scientific practices.

Science as a Way of Knowing?

It is helpful to pause in order to examine what science is not. It is not a formal monolithic activity with clear boundaries, procedures, and methods. Science is not a method, although it embraces certain methods. It is not a set of procedures that if one unfailingly follows, then one is doing science. It is not just a precise way of doing experiments, testing hypotheses, or framing questions, although all these things play a role. Science is a social activity performed by humans for humans that carries with it certain cognitive, perspectival, and other limitations from which we cannot escape.[9] We are limited creatures in so many ways. To ignore this would be profound hubris. In addition, science is also

8. Naomi Oreskes, *Why Trust Science?* (Princeton, N.J.: Princeton University Press, 2019), 56.

9. Thomas S. Kuhn, *The Structure of Scientific Revolutions,* 4th ed. (Chicago: University of Chicago Press, 2012); Ludwik Fleck, *Genesis and Development of a Scientific Fact,* trans. Thaddeus J. Trenn and Robert K. Merton (Chicago: University

a set of ethical practices that are committed to a careful examination of the world and its processes. It is this set of ethical practices that garner trust in its findings.[10]

In these ways, being a scientist is, in part, taking a particular ethical stance toward the world, with specific assumptions and values that condition your activities. These provide an agreed-upon certification of your findings. Science has been wildly productive, with major advancements in everything to which it has turned its attention, from establishing a basic understanding of how the large-scale universe works to discovering important insights into the microworld of quarks and electrons. Scientific practices have helped create everything from cell phones to frozen peas.[11] Not that this productivity has been a linear and constantly forward march in the advancement of knowledge. It has not been. Setbacks are common, reversals abundant, missteps and dead ends almost the order of the day. But despite these, science continues to advance, sometimes painstakingly slow of pace, but on it goes. Why is that? Why does it work so well?

To understand science, we must first understand its values, tools, assumptions, and guiding ethics. Practicing scientists generally hold that the universe is real and that the behavior of its constituting objects and processes can be rationally described with representations that aim at shedding light on that reality. In some fields, like physics and chemistry, there are law-like descriptions of nature. In others, like biology, the focus is on regularities and patterns that we find repeated in the natural world. These systems might be deterministic, bathed in chaos, or statistical distributions of genuinely random variables, but there are assumed to be rules we can discern and discover.

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of Chicago Press, 1979); and Helen E. Longino, *The Fate of Knowledge* (Princeton, N.J.: Princeton University Press, 2002).

10. Robert T. Pennock, *An Instinct for Truth: Curiosity and the Moral Character of Science* (Cambridge, Mass.: MIT Press, 2019).

11. Susan Lindee, "The Epistemology of Frozen Peas: Innocence, Violence, and Everyday Trust in Twentieth-Century Science," in Oreskes, *Why Trust Science?*, 163–80.

Values of Science

Truth

Science embraces several values that speak to our ability to confirm that we have an adequate grasp (always incomplete) on the things we study. Its primary value is truth. Uncovering the reality that underlies the objects and processes inhabiting the world, and getting the story right insofar as is possible given the limits of our perceptual abilities, is the target of the scientific enterprise. Science seeks knowledge that creates a match between our understanding of the world and whatever reality underlies our capacities for discovery. This is reflected nicely in Doctrine and Covenants 93:24: "And truth is knowledge of things as they are, and as they were, and as they are to come." In science, this is defined as a representation that reflects an aspect of the world that we are interested in understanding more fully. Science is committed to lining up our beliefs about the world with ontological realities or, as just stated, "things as they are."

Explanation, Prediction, and Objectivity

Objectivity embraces the idea that different observers can be led to the same conclusions about facts that scientific studies are trying to elucidate. If one scientist discovers how far a tsetse fly can move in certain types of savannah river forests in Burkina Faso, another independent investigator will come to the same conclusion about flight distances under the same conditions. Conversely, subjective truths broker more flexible and personal perspectives. For example, we might disagree on the beauty of a sunset, the worth of a painting hanging in the Musée d'Orsay, or how we have come to a testimony of the Book of Mormon. Objectivity is described nicely by John Nolt: "Objectivity is a collection of virtues that aim to transcend self-centeredness toward a wider and truer understanding. To be objective is, among other things, to: seek to understand and compensate for one's own prejudices; accept the findings of adequately conducted scientific research; strive for consistency; suspend judgment on factual issues when the evidence is inconclusive; cultivate

awareness of your own fallibility; and seriously consider the well-informed opinions of others."[12]

Objectivity is related to two other values of science: causal explanation and prediction. If the rules we propose are operating in the universe, we should be able to confirm it by making predictions about the phenomena we study. If we have causal explanations for the way things behave, then those explanations should allow repeatable and useful manipulations by others based on the causal structure we propose.[13]

Simplicity

Another value of science is simplicity of explanation. Simple explanations tend to be more useful and make it easier to find principal regularities and patterns. For example, if I want to explain the relationship between a volume of gas, its temperature, and the pressure that it exerts, I might try to simulate the momentum of every atom present and calculate the impacts of those moving particles on the container, which creates pressure. This might explain the entire process, but it is easier to use the equation $P = \rho RT$, which gives the pressure P as a relationship between ρ the density, a universal constant R, and the temperature T. The equation is more parsimonious than a massive accounting of each and every atom in the container and therefore favored in most cases. If there are two explanations for the same phenomenon, the simpler is preferred if both capture all of the relevant facts, as in this equation capturing pressure exerted by a gas.

Repeatability

Repeatability captures a value based on the assumption that the rules that structure the universe hold anywhere in the universe where similar conditions obtain. Repeatability should be

12. John Nolt, *Environmental Ethics for the Long Term: An Introduction* (New York: Routledge, 2015), 31.

13. Peter Godfrey-Smith, *Theory and Reality: An Introduction to the Philosophy of Science* (Chicago: University of Chicago Press, 2003), 190–201.

achievable at both different times (if my experiment works today, all things being equal, it should work tomorrow) and diverse locations (other researchers should get the same result when they try it under the same conditions—even if they live on different planets located on opposite sides of the galaxy).

Fallibility

Science values the ability to falsify predictions and explanations. When a scientist is exploring some aspect of the world, it is best practice to make some prediction in the form of a hypothesis about what she expects. If a hypothesis is falsifiable, when it is not rejected through some appropriate test, it lends some credence that the hypothesis might be on the right track. A rejection is evidence that the hypothesis is false.

Keep in mind, however, when it is not rejected, scientists often speak of the hypothesis not as being true but of having not been disconfirmed yet. It is also not usually just a matter of rejecting it out of hand. If a well-confirmed hypothesis fails a particular test, usually the matter is not put to rest on that instance alone. Other things could have gone wrong. The apparatus the experimenter was using might not have been set up properly; a student might have been singing loudly in the lab, causing vibrations unaccounted for; or a loose rat might have crept in and made some mischief. There are usually several ancillary hypotheses and assumptions that go into any experimental setup. One must be careful that it was not one of these other possibilities that is responsible for the experiment's failure to confirm a hypothesis.

Diversity

Another value is diversity.[14] It has been found again and again that diversity of race, gender, or age, along with other aspects of human diversity, add to the success, originality, and advancement

14. Oreskes, *Why Trust Science?,* 55–59.

of science.[15] Science relies on creativity. Finding questions often turns out to be more important to the enterprise of science than the answers that it ultimately provides. Diversity probes problems with more varied eyes, leading to better questions and ways of thinking.

Tools of Science

To realize the values above, science uses a standard set of tools. These have been embraced largely for pragmatic reasons: they work. Let's look at some of the most common tools used by a number of disciplines in science. This is not an exhaustive list.

Experimentation

Roger Bacon is credited with one of the first articulations of science's most ubiquitous tool—experimentation. The world is complex, but if one can simplify it enough that much of the complexity is tamed, eliminated, and controlled; if all the extraneous influences on the system are handled; and if one can manipulate just a few of the suspected causes and observe their effects, greater clarity on the role those causes play can be ascertained. This is complicated to be sure, but experimentation has been one of the hallmarks of good science. By controlling all the important variables possible, randomizing what cannot be controlled, and noting the resulting effects, scientists have been able to verify some causal aspect of the world. Again, the way this typically proceeds is that one sets up experiments, based on falsifiable hypotheses, and tries to find ways to reject those hypotheses. The longer an individual hypothesis survives under this assault of repeated attempts to falsify it, the more warrant one has to suspect it is true.

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15. Laurel Smith-Doerr, Sharla N. Alegria, and Timothy Sacco, "How Diversity Matters in the US Science and Engineering Workforce: A Critical Review Considering Integration in Teams, Fields, and Organizational Contexts," *Engaging Science, Technology, and Society* 3 (2017), https://doi.org/10.17351/ests2017.142.

Notice there is a severe weakness in this. When we abstract and isolate processes, we never get the full story because often—and in fact, I'd argue usually—the processes we isolate do not behave the same way they would in the presence of all the variables we restricted to make the experiment manageable. Nancy Cartwright has written an influential book on the philosophy of science, *How the Laws of Physics Lie.*[16] She points out that even in the most law-like processes, we only get information about the particular regularities we are studying in a given situation. The laws we discern are likely only incomplete abstractions of processes reflecting multiple influences. She prefers the idea of regularities and capacities rather than "laws." Experiments always leave things out, so we are left with incomplete information. Still these experiments can be useful. They can offer a high probability of representing a sound way to view the world, but it must be recognized that the factors being investigated might have other stories to tell in a different set of circumstances or under the influence of a larger set of factors.

This suggests we should have some humility in the presence of our experiments, but it does not let us get away with the sort of skepticism that would allow us to label it all worthless or uninformative. A well-designed experiment should eliminate many possibilities. If I drop cannonballs from towers and measure the rate of acceleration under gravity, it is not advisable to argue we've learned nothing about gravity because there might be other forces at play—for example, nearby mountains, wind, surface anomalies on the cannonballs, a certain spin on the hunk of metal, inaccuracies in our timing device, and so on and so on. Although we don't get the full picture, we still learn something about gravity. The skeptical claim that we have learned nothing because we did not capture everything is flat out wrong. We have learned much about the general way gravity works under *ceteris paribus*[17] conditions

16. Nancy Cartwright, *How the Laws of Physics Lie* (Oxford: Oxford University Press, 1983).

17. All things being equal.

as well as about the overall tendencies of things in a gravitational field. We also get a sense in the measurement of error about how much deviance from the norm we can expect. All of this contributes to our knowledge of gravity.

Observation

Observation is also critical to science, especially for systems to which we do not have direct access like distant stars and galaxies. In these kinds of studies, the variables are not controllable in the same sense as in a typical laboratory experiment. For these systems, patterns are noted and quantified. Hypotheses take the form of speculating about how processes create the pattern, then looking for observations that support that possibility. For example, a hypothesis on how a galaxy of a particular kind forms might be confirmed by further observations that subsequently find a galaxy of the type predicted. As such are located, they provide evidence that a researcher is onto something. As further confirmatory observations of galaxies of the predicted type are found floating in the cosmos, they add weight to the hypothesis. Evolution by natural selection is like this. Such evolution is one of our most well-established theories and has contributed more to our understanding of life than any other single idea in the life sciences. Darwin predicted that fossils would continue to be found in a certain order from most primitive to more advanced, and that species ought to be more closely related if they are not separated by great distances from each other. DNA as the genetic code of life on earth was a vital discovery confirming evolutionary descent from common ancestors. Geology and many of the ecological sciences also rely on this kind of observation and prediction strategy.

Modeling

Modeling is an important tool in science. It is often a form of theory generation and has been highly productive. Newton, for example, by making simple assumptions, was able to model the motion of heavenly bodies and make stunningly accurate

predictions of planetary motion with some simple equations. Mathematical modeling (and its more recent sister tool, computer simulation modeling) has been very useful in performing quantitative experiments in systems that would be too messy otherwise. Modeling brings together observation and experimentation in important ways, allowing clearer mathematical, statistical, and other quantitative assessments of the universe's behavior.

Peer Review

Peer review is one of the chief tools that helps science maintain its robustness and productivity. When a scientific paper is ready to be exposed to the world, the editor of a journal will send it to several others (usually three to five) in the same disciplinary area, often to those with whom the paper's authors are intellectually in disagreement, to evaluate the scientific work displayed in the paper. The reviewers will examine the methods to make sure institutional norms were observed or, if they were not, to validate the reasons for deviation (not everything is neat in science, and sometimes innovative approaches are necessary). The reviewers will also examine models used, how the data were analyzed, the rigor of the reasoning used by the researchers to argue for their conclusions, and how those conclusions impact and improve the discipline. Studies found wanting in any of these areas or findings that make trivial or too minor advances are rejected or sent back to the author for clarifications or improvements, sometimes with the request for more data to be gathered. This can be a brutal process, but this policing ensures that best practices are followed and that each paper makes a genuine contribution to advancing open questions within the discipline.

The process is not perfect. Friends can end up as reviewers, despite the process being blind, and often one can recognize the paper's author from familiarity with their previous papers and not apply the rigor expected from peer reviewers. Detractors from a body of work might argue against a paper that threatens their own position. Or reviewers might not understand the discipline

well enough to make a good assessment. But overall, peer review provides a screen that prohibits unworthy work from calling itself science. High-prestige journals might accept only from 2 to 5 percent of those submitted, with lower-regarded journals accepting 50 percent of papers offered. This creates a healthy hierarchy of scientific worth that militates against mediocrity. Often the number and prestige of journals in which one publishes weighs in academic advancement and retention decisions. This creates an environment in which scientists are highly motivated to produce excellent work that passes the significant hurdles that scientific claims need to leap to enter into scientific discourse.

A Final Word on Epistemological Stances in Science: How Science Creates Knowledge

Ultimately science is about gaining knowledge. Jürgen Renn provides a description of how knowledge is acquired, used, and stored:

> Knowledge is a problem-solving potential, that is, the capacity of an individual or a group to solve problems and to mentally anticipate corresponding actions. Knowledge is based on experience and encoded in mental, material, and social structures. It is generated by reflection on environmentally embedded actions and serves as a potential for the anticipation and control of actions. Knowledge is internally represented by cognitive structures that enable the connection between past and current experiences. It is shaped (but not determined) by the material culture and existing social relations, and ultimately arises from experiences accumulated in socially constrained material practices.[18]

Two perspectives of scientific engagement with the world are often discussed, each with different assumptions about how science works.

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18. Jürgen Renn, *The Evolution of Knowledge: Rethinking Science for the Anthropocene* (Princeton, N.J.: Princeton University Press, 2020), 64.

Antirealism

One is constructive empiricism. Bas van Fraassen, one of the principal articulators of this view, argues that deep reality is largely unknowable; our models of things like subatomic structure are constructions that allow us to work with whatever realities underlie the observable universe, including observable with instruments.[19] He argues that when we represent electrons in our scientific models, we are only talking about those representations, not actual entities. This view suggests that if, for example, we encountered aliens with very different brains and methods of observation, they might have a different view of the subatomic world of electrons than we do. Their science of electrons might do all the same work that our electron-talk does.[20] They may look at our periodic table of elements and be completely baffled by what we are doing but have, what seems to us, an equally baffling conception of chemistry that works just as well for them, but one of which we can make neither heads nor tails. Our science would play the same role in making explanations and predictions as theirs, but theirs conceives of a universe made of radically different entities and processes.[21]

Realism

The second view, and more common among scientists like biologists, geologists, and engineers, is scientific realism. This is the view that, while our representations are always imperfect, they are capturing the truth of an underlying reality. All representations

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19. Bas C. van Fraassen, *Scientific Representation: Paradoxes of Perspective* (Oxford: Oxford University Press, 2008), 269–90.

20. Ian Hacking, *The Social Construction of What?* (Cambridge, Mass.: Harvard University Press, 1999), 74–75.

21. Emiliano Trizio, "How Many Sciences for One World? Contingency and the Success of Science," *Studies in History and Philosophy of Science* 39, no. 2 (June 2008): 253–58, https://doi.org/10.1016/j.shpsa.2008.03.017. Also see this collection of explorations of science that is contingent on its historical or developmental path: Léna Soler, Emiliano Trizio, and Andrew Pickering, *Science as It Could Have Been: Discussing the Contingency/Inevitability Problem* (Pittsburgh: University of Pittsburgh Press, 2015).

are about something, and in science we hope that we are capturing an accurate, or at least adequate, aspect of the physical world. When we try to represent a rabbit population in our model of the things we see while studying conies in the field, we aim to talk about aspects of genuine rabbit populations, not our model.

Methodological Physicalism

Another assumption science makes is methodological physicalism—that the things we have chosen to study have causal explanations involving matter and its associated fields, such as electromagnetic fields, and that data comes from a physical world that is measurable and objectively observable. Science assumes that there is a world and that its processes, regularities, patterns, capacities, fields, and materials act in ways such that we can discover rules of conduct for the stuff of the universe. By assuming methodological physicalism, science puts up-front its stance that the physical world is causally constructed and that we can gain knowledge about the way it works. Science assumes that no ghosts or fairies or other ethereal powers act on the material aspects of the universe. This assumption is critical for science. If there are divine or genuinely miraculous influences, then they cannot be investigated by science and indeed should not be. However, a caveat is warranted: if there are phenomena in need of explanation, sometimes physical causes might not appear readily at hand, and some humility and patience might be necessary before a physical explanation is proffered. For example, recently an extrasolar object whizzed through our solar system on its journey through interstellar space. Dubbed ʻOumuamua, it had strange behavior not seen before in comets or asteroids. Avi Loeb, former chair of Harvard's astronomy department, prematurely declared the only explanation was an alien spacecraft and wrote a popular book on the subject.[22] However, more patient

22. Avi Loeb, *Extraterrestrial: The First Sign of Intelligent Life beyond Earth* (New York: Houghton Mifflin Harcourt, 2021).

scientists, working with the data collected from the object as it passed by, made a detailed case that a fragment of a Pluto-like dwarf planet containing methane ice rather than water ice completely explained all of the strange behavior of ʻOumuamua.[23] The mystery was solved based on what we know about the universe without resorting to extraordinary and unlikely claims.

Do not confuse methodological physicalism with ontological physicalism, however. The latter assumes that material forces are the only kind of influences that there are—everything that does or can exist is only matter in motion and its associated fields. Methodological physicalism, in contrast, just uses physicalism as a working assumption to allow science to proceed. However, keep in mind that Latter-day Saints should be completely comfortable using methodological physicalism, because they make the same assumption as science in a host of daily activities. I would wager almost everyone fully expects their mechanic to be such a physicalist. When someone takes her car in to find out why it is not running, she is counting on the mechanic to talk in terms of pistons, carbonators, belts, and straightforward mechanical causes of the problem. If the woman repairing the car says the problem is interstitial elves from the land of Fantomia, the customer would likely find a new mechanic. When a customer takes a car in for service, she expects it be handled using only methodological physicalism. So do we in science. This does not mean that things like God, angels, divine interventions, blessings, or the grace we find in our relationship with God are not real. It just means science is not an appropriate way to study these things. They are outside its domain of concern. Harvard paleontologist Steven J. Gould called this idea nonoverlapping

23. Alan P. Jackson and Steven J. Desch. "1I/ʻOumuamua as an N_2 Ice Fragment of an Exo-Pluto Surface: I. Size and Compositional Constraints," *Journal of Geophysical Research: Planets* 126, no. 5 (2021): 1–16, https://doi.org/10.1029/2020JE006706; Steven J. Desch and Alan P. Jackson, "1I/ʻOumuamua as an N_2 Ice Fragment of an Exo-Pluto Surface II. Generation of N_2 Ice Fragments and the Origin of ʻOumuamua," *Journal of Geophysical Research: Planets* 126, no. 5 (2021): 1–20, https://doi.org/10.1029/2020JE006807.

magisterium, which captures the idea that science and religion are often focused on different concerns.[24]

Scientific Ethics

To understand science, one must examine the ethical stances that undergird its activities. The normative activities of science condition how discovery proceeds. It is these, I believe, that give science its power to discover truths about the world and are responsible for the progress we see in science. There are three main stances I want to highlight: (1) a scientist ought to have openness to revision and to hold all results as tentative, allowing for the possibility that findings might be revised in light of new data or better analyses; (2) scientists ought to be a part of discipline-specific research programs that provide institutional standards of rigor and training among its disciplines; and (3) all results should, after peer review, be archived in scientific journals that provide details on all aspects of scientific research. Let's look at each of these in turn.

Transparency and Openness to Revision

Scientists are required to share their findings. All data and their analyses are open for inspection—for public and institutional review—once claims have been made in an appropriate scientific venue. This means that scientists are obligated to reveal how the data were obtained, what experimental protocols were used, how models were constructed and implemented, and how information was statistically analyzed. In short, the procedures for making scientific claims ought to be replicable by other competent scientists. Often, once data are published, they should be made available to other researchers qualified to understand the data, its generation, and its analysis, or at least archived so that such can be done at a later time if desired. Sometimes there are proprietary issues with data, such as when aspects of a scientist's own

24. Steven Jay Gould, *Rocks of Ages: Science and Religion in the Fullness of Life* (New York: Ballantine Books, 1999), 5–59.

analyses might not be completed or when there are patent or security concerns that keep data from being released. This does not mean that hard-won data must be handed over to people who do not have the proper tools for their interpretation. This is especially true when complex datasets are used for multiple analyses, and papers may continue to be written for years on the same dataset. But for the most part, it should be crystal clear what went into making any scientific claim. This openness means that scientific findings never arise out of a black box that hides key features about where the claims come from. Another aspect of openness in science is revealing a research project's sources of funding. This helps ensure there are no hidden biases or influences that might affect outcomes. In addition, there is an especially strong effort to examine startling findings to ensure they are not anomalous and to find and expose attempts at fraud like the one perpetrated in the vaccine-autism deception.[25]

All scientific claims are tentative. This means that scientific claims are continually challenged, reformulated, refined, and nuanced as new studies are made. Because science is a human activity, this is a messy process. People have favorite theories, perspectives, and biases. But as more eyes examine a problem, there is a trend toward progress and a better understanding of the world. In fact, nineteenth-century philosopher Charles Sanders Peirce argued that truth was just the asymptotic convergence of scientists doing their work and coming to an agreement.[26]

Maintenance of Research Programs

All science takes place within disciplinary research programs. These programs often have worldwide scope and stretch across multiple institutions such as schools, universities, private

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25. Sarah Geoghegan, Kevin P. O'Callaghan, and Paul A. Offit, "Vaccine Safety: Myths and Misinformation," *Frontiers in Microbiology* 11 (2020): 2.

26. Charles Sanders Peirce, *Illustrations of the Logic of Science,* ed. Cornelis de Waal (Chicago: Open Court, 2014), 79–107; Francis E. Reilly, *Charles Peirce's Theory of Scientific Method* (New York: Fordham University Press, 1970).

companies, and governmental agencies. These programs establish best practices for the way science is done within a given discipline. These practices are often established after long periods of trial and error and establish traditions of laboratory procedures that have been shown to produce robust scientific results.

These programs also establish how students are trained, apprenticed, and credentialed. These institutions dictate the nature of the formal, rigorous training found in obtaining advanced degrees. Also policed within programs is what counts as proper data gathering protocols, standards of exactness and cleanliness, which instruments are used and how they are calibrated, what constitutes a proper statistical data analysis, and what is to be reported in a standard scientific journal paper under assurances that disciplinary norms have been followed.

There is a temptation among those not involved in science to see these institutional and program boundaries as providing conditions to foster "groupthink." This is possible, and that is not an unreasonable worry. There are examples where such occurs. For well-established research programs, it is often hard to introduce revolutionary thinking that undermines entrenched ideas. For example, when continental drift theory was introduced and data analyses were slowly eating at the boundaries of the idea that continents are static and immobile, there was considerable resistance to change from dominant geological research programs.[27]

Two things protect research programs from this kind of conspiratorial sameness. First, research programs are in constant competition for things like funding, students, research grants, and space in peer-reviewed publications. This creates an interesting dynamic of collaboration and competition that requires constant disciplinary refinement and advancement and that improves every aspect of the scientific enterprise. A Darwinian selection-like process ensures that those institutions and individuals that are most innovative, productive, and able to show

27. Oreskes, *Why Trust Science?,* 80–87.

progress receive the lion's share of scientific research and prestige. Those whose inventiveness allows them to find new results and discoveries or those who can take down prevailing paradigms and expose wrongheaded ideas are generally rewarded with more opportunities for doing science. This selection process ensures that research programs are never static and are constantly making advances that improve our understanding of the world. In fact, one of the important ways that pseudoscience is recognized is by a static research program. For example, when was the last time an academic journal reported that someone discovered a new method or finding or analysis that improved astrological forecasts?

Second, programs are usually self-correcting. When things do not work right, it is from within the institution that corrections are likely to come. They are most aware of problems, and when those problems become obvious enough, investigations specific to the problems are explored. Because institutions are the ones with relevant expertise and are closest to the methods and the data, it is here that problems are most often recognized, tackled, and corrected. The many eyes on the scientific enterprise tend to uncover biases and methodological mistakes.

This is not to say research programs are faultless. They do have challenges. It is often hard to break into their purview with innovative ideas or novel insights and to be recognized if one is tackling problems outside of disciplinary boundaries. These considerations require discussion and acknowledgment within the scientific community.

Archiving

All results, after being peer reviewed, should be archived in scientific journals. This gives access to current researchers and future scientists about what data previous scientists have collected and analyzed. This is how ideas recorded are not lost to history. This is where our arguments, discussions, and thoughts are preserved in perpetuity. This allows scientists to build knowledge and ensure

Aspects of Science That Make It a Powerful Way of Understanding the Physical World

(see the text for an explanation of these aspects)

The Values of Science

Truth
Objectivity
Explanation and prediction of phenomena
Simplicity
Fallibility
Diversity

Tools

Experimentation
Observation
Mathematical and statistical modeling
Peer review

Scientific Assumptions

Antirealism: Scientific representations are useful but not necessarily real
Realism: Scientific representations reflect the real world
Methodological physicalism: Science can only study the material, repeatable, objective aspects of the world

Scientific Ethics

Processes are transparent
Findings are open to revision
Claims are tentative
Knowledge is generated by research programs
Libraries and data archives are maintained

it is maintained and curated in ways such that hard-earned information is not lost. Libraries and data archives play a vital role in all aspects of human knowledge generation. In science this is no exception. Funding for this effort must be maintained if science is to remain the vital practice that it is to culture and society.

Conclusions

I have left out many things in my overview of science. A short list might include creativity, bouncing ideas off others near the water fountain, laboratory manuals, internships, education, pondering, accidents, serendipity, dreams, networking, long hikes in cool mountains, skepticism, doubt, belief, humility, reading groups, staying abreast of the literature, attending scientific meetings to report new work, offering new context or critique for older work, friends, being able to interrogate questions on a long held stance, imagination, integrating knowledge, detractors, understanding other fields, training students, keeping a notebook both formal and informal, and many, many other things that define what it means to be a scientist.

Science, even with all its imperfections, is the best thing people have invented to explain the natural world. Pillars of science—including evolution, major branches of medicine, and even Einstein's theory of relativity—are well established and unlikely to be overturned. As members of The Church of Jesus Christ of Latter-day Saints, we have nothing to fear from good science. I have argued that good science can be trusted by members of the Church[28] at least as much as by scientists. Science is always skeptical in the sense of embracing its findings tentatively, but enthusiastically when warranted, as they show us how to make a reasonable wager about how the world works.

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28. Peck, *Science the Key to Theology.*

for Religious Scholarship. Peck has published over fifty scientific articles in evolutionary ecology, the philosophy of biology, and in the field of religion and science. In addition to several novels, he has published two books exploring science and religion for Latter-day Saints: *Evolving Faith* (Maxwell Institute, 2015) and *Science the Key to Theology* (BCC Press, 2017). In summer 2018, he and Terryl Givens led the Bushman Summer Institute for the Study of Mormon Culture at the Maxwell Institute to explore the relationship between science and the Latter-day Saint thought. For the body of his literary work, he received the 2021 Smith-Pettit Foundation Award for Outstanding Contribution to Mormon Letters.

Based in part on Steven L. Peck, *Science the Key to Theology: Volume One: Preliminaries* (Salt Lake City: By Common Consent Press, 2017).

Accepting Evolution with Joy Is Possible

T. Heath Ogden

I am often asked the question, "Do you believe in evolution?" You may be surprised that I answer with a quick "No, I *do not believe* in evolution." This usually causes a look of confusion from the person asking me because typically they know that I am an evolutionary biologist, and they assume I must surely believe in it. I then follow up with "I *accept* evolution based on the body of evidence that supports it." To further explain the notion of "I do not believe. . . . I accept evolution," I clarify that I use the words "I believe" for many ideas, such as "I believe in God" or "I believe my wife loves me," but I don't think it is appropriate to use the term "believe" when discussing science. I have never heard anyone ask, "Do you believe in gravity?" or "Do you believe in plate tectonics?" These questions sound out of place with the term "believe" because gravity and the movement of continental plates happen, and we have a very good (albeit imperfect) working knowledge of these natural processes.

Seeking Truth

Science is a way of knowing, describing, and explaining the natural, observable world. I subscribe to the notion that science is very powerful, but I also recognize that it is limited in the scope of questions it can address. For example, science describes viruses,

studies their mode of infection, and predicts what particular version of virus parts should be bioengineered and incorporated into vaccines. Yet science currently has no way of addressing issues such as faith in a resurrected being and answering the ultimate question of why the earth was created. Hence, science is a powerful method of gaining knowledge, but it is not all-powerful.

Fortunately, in addition to scientific study, there are other ways of gaining knowledge in this world. Seeing a Michelangelo sculpture, hearing a song from *Les Misérables,* and witnessing a solar eclipse are lived experiences that have given me insights that enlightened my understanding of the world and had nothing to do with empirical data. While science seeks to find explanations for natural phenomena that are independent of the nationality, race, politics, culture, sex, age, faith, or religion of the scientist, other sources of knowledge include and even depend on these human attributes. Moreover, divine inspiration and revelation are particularly important for Latter-day Saint believers and people of other religious denominations. Clearly, science, history, art, music, revelation, authority, consensus, morals, and ethics are just a handful of the many ways in which we humans can gain knowledge and truth.

The leaders of The Church of Jesus Christ of Latter-day Saints have taught that light and knowledge come from a variety of sources. In reference to Joel 2:28, Elder Delbert L. Stapley stated, "Knowledge is not confined to any one nation or people. . . . No nation has a corner on the knowledge God is pouring down from heaven upon all flesh."[1] Furthermore, President John Taylor contributed this sentiment: "In regard to our religion, I will say that it embraces every principle of truth and intelligence pertaining to us as moral, intellectual, mortal and immortal beings, pertaining to this world and the world that is to come. We are open to truth of every kind, no matter whence it comes, where it originates, or

1. Delbert L. Stapley, "Man, a Child of God," devotional address, Brigham Young University, Provo, Utah, January 10, 1962, https://speeches.byu.edu/talks/delbert-l-stapley/man-a-child-of-god/?M=A, quote begins at 19:07 in the audio.

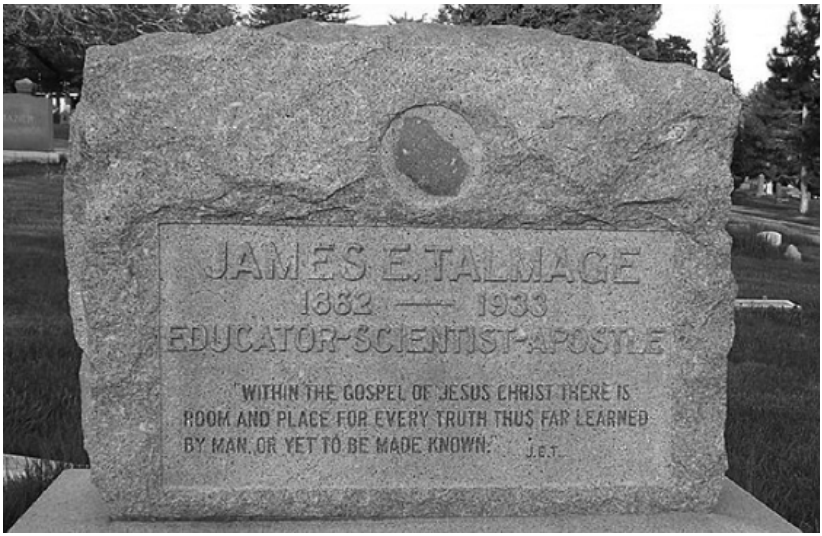

Figure 1. Inscription on the gravestone of James Talmage at the Salt Lake City Cemetery. Photograph by the author.

who believes in it."[2] And on Elder James E. Talmage's tombstone (fig. 1) in the Salt Lake City Cemetery are inscribed the words, "Within the gospel of Jesus Christ there is room and place for every truth thus far learned by man, or yet to be made known."[3]

Reconciling Belief in the Gospel and Scientific Knowledge

When we encounter apparent conflicts between religious and scientific ideas, there are a variety of ways to reconcile our worldviews. Allow me to summarize the principles of reconciliation I employ. *I believe in accepting truth and knowledge, no matter where it originates.* A primary tenet of Latter-day Saint doctrine is the ninth Article of Faith, namely that God "will yet reveal many great and important things." This includes "things of the earth,

2. Quoted in G. Homer Durham, ed., *The Gospel Kingdom: Selections from Writings and Discourses of John Taylor* (Salt Lake City: Deseret Book, 1943), 93.

3. James E. Talmage, "The Earth and Man," in *The Essential James E. Talmage*, ed. James P. Harris (Salt Lake City: Signature Books, 1997), 252.

by which it was made" (D&C 101:33), which could be reasonably interpreted as the history of the organisms that inhabit this earth. Whether this knowledge comes "here a little, and there a little" (Isa. 28:10, 13) or all at once in a "celestial class" is not entirely clear. I do not place a restriction on God regarding the manner by which he reveals this knowledge. He may do so through a prophet, but he may also certainly accomplish it through a fossil, a study of comparative morphology of animals, or an evolutionary analysis of DNA from a group of organisms.

The difficulty in dealing with conflict in scientific and religious ideas seems to be rooted in the notion that the disagreement outweighs any prospect of reconciliation. However, conflicting evidence and noise are part of science, religion, and this earthly experience. Conflict can occur, for example, when (1) incorrect scientific interpretation conflicts with good religious interpretation, (2) good scientific interpretation conflicts with bad religious interpretation; and (3) incorrect scientific interpretation conflicts with incorrect religious interpretation. When there are apparent conflicts, it is crucial to exercise patience and humility while continuing to seek for the truth. It is not important which side provides the correct answer, because the ultimate goal is finding truth.

The highly respected Latter-day Saint scientist and chemist Henry Eyring wrote, "Some have asked me, 'Is there any conflict between science and religion?' There is no conflict in the mind of God, but often there is conflict in the minds of men."[4] Eyring also told about a conversation with a young man: "'In high school we are taught such things as pre-Adamic men, but we hear another thing in Church. What should I do about it?' I think I gave the right answer. I said, 'In this Church, you only have to believe the truth. Find out what the truth is!'"[5]

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4. Henry Eyring, *Reflections of a Scientist* (Salt Lake City: Deseret Book, 1983), 8.
5. Eyring, *Reflections of a Scientist,* 7.

The Church's Official Doctrine Regarding Evolution

So how do we find out what the truth is? Is it okay to ask questions? Of course we should ask questions and search for truth; the Restoration was built upon that essential idea. President Uchtdorf reminds us that "it's natural to have questions. . . . There are few members of the Church who, at one time or another, have not wrestled with serious or sensitive questions."[6] Among Church leaders and members, different interpretations of scriptures relating to the creation of new species and evolution exist on a wide spectrum, from anti-evolution to neutral to pro-evolution. In regard to subjects such as evolution, it is important to ask the question "Does the Church have an official doctrine or even an official position?" A more direct answer to this question is found in the *New Era* article "What Does the Church Believe about Evolution?" which proposes to educate the youth about the position of the Church concerning evolution and the origin of humankind. The first paragraph states that "the Church has no official position on the theory of evolution" and that "nothing has been revealed concerning evolution."[7]

At the time of this writing, the most prominent work addressing evolution and the Church has been "Evolution and the Origin of Man," a four-document packet and cover letter approved by the First Presidency and the BYU Board of Trustees.[8] Since, as the cover letter explains, "there has never been a formal declaration from the First Presidency addressing the general matter of organic evolution as a process for development of biological species," and "formal statements by the First Presidency are the definitive source of official Church positions," the BYU evolution

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6. Dieter F. Uchtdorf, "Come, Join with Us," *Ensign* 43, no. 11 (November 2013): 23.

7. "What Does the Church Believe about Evolution?," *New Era* 45, no. 10 (October 2016): 41.

8. "Evolution and the Origin of Man," Brigham Young University, published June 1992, https://biology.byu.edu/00000172-29e6-d079-ab7e-69efe5890000/byu-evolution-packet.

packet has been the most official position from the Church on these matters.

The first document in the packet, a 1909 First Presidency statement produced on the hundredth anniversary of Charles Darwin's birthday and the fiftieth anniversary of the publication of his *Origin of Species,* is the longest of the four statements and contains language that could be considered marginally anti-evolution. This statement, which was released at a time of growing public awareness and national interest in the apparent conflict between the biblical account of the Creation and the increasingly accepted science of evolution, initially generated considerable discussion on the topic at Brigham Young University and in the Church at large.[9] The Latter-day Saint position on evolution was not settled, and discussions escalated, especially at BYU. Therefore, in 1910 the same First Presidency devoted part of their Christmas message to addressing this conflict between science and religion. They emphasized, "Our religion is not hostile to real science. *That which is demonstrated, we accept with joy;* but vain philosophy, human theory and mere speculations of men, we do not accept nor do we adopt anything contrary to divine revelation or to good common sense."[10]

One mechanism of evolution—natural selection—had been demonstrated by 1910; however, evolution and genetics had not yet been reconciled by scientists. Mutation, another mechanism of evolution, had barely been described in 1909 by Hugo De Vries, and the remaining mechanisms of evolution, including genetic drift, gene flow (migration), nonrandom mating, and evolutionary development, among other things, had not yet been

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9. Gary James Bergera, "The 1911 Evolution Controversy at Brigham Young University," in *The Search for Harmony: Essays on Science and Mormonism,* ed. Gene A. Sessions and Craig J. Oberg (Salt Lake City: Signature Books, 1993), 23–41; William E. Evenson and Duane E. Jeffery, *Mormonism and Evolution: The Authoritative LDS Statements* (Salt Lake City: Greg Kofford Books, 2005).

10. Joseph F. Smith, John R. Winder, and Anthon H. Lund, "The Origin of Man," in "Evolution and the Origin of Man," emphasis added.

discovered. From the 1930s through the 1960s, population genetics, the modern evolutionary synthesis, and molecular biology were developed, and in each case, evolution was corroborated and became more and more robust. It is now considered settled science, similar to other ideas like gravity, the structure of an atom, plate tectonics, and germs as the cause of many diseases. The additional evidence (particularly from fossils and molecular data) accumulated over the last fifty years further solidifies evolution as the best explanation for the diversity of life that has lived and is living on the planet. This is why serious and honest examination of evolutionary biology leads to the scientific consensus: evolution has been *demonstrated* and, therefore, can be "*accepted with joy.*"

In 1925, in the midst of the Scopes, or "Monkey," trial (a Tennessee court case involving evolution and religion and the teaching of these subjects in public schools), the First Presidency published the "Mormon View of Evolution," the third document in the BYU evolution packet. It is a shortened version of the 1909 statement, but essentially all of the anti-science, anti-evolution language was removed. This statement represents the last time the First Presidency formally addressed the issue of evolution to a worldwide audience. And as described above, we have certainly learned a great deal about evolution since the printing of this document.

The last article in the BYU packet is titled "Evolution" and was included in the Church-approved *Encyclopedia of Mormonism.* It restates the important and essential parts from the previous statements and includes an excerpt from the First Presidency meeting minutes from 1931. The idea that humans are the children "of God, formed in the divine image and endowed with divine attributes" is reiterated, and the article explains, "The scriptures tell why man was created, but they do not tell how."[11]

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11. William E. Evenson, "Evolution," in *Encyclopedia of Mormonism,* ed. Daniel H. Ludlow, 4 vols. (New York: Macmillan, 1992), 2:478.

It is important to note that statements show a transition from lengthy and inferentially anti-evolution language to shorter statements characterized by neutral language as time progressed. So the best summary of the Church's current position of evolution is that *there is no official position*; the Church is neutral as to how the diversity of life was created on this planet, including the origin of the physical bodies of humans, or *Homo sapiens.*[12]

Evolution as a Scientific Theory

Scientists, in general, look for patterns in nature through observation and experimentation and try to explain the way that these patterns or phenomena came about by using hypotheses and models. These plausible explanations are supported, refined, or refuted by data resulting from investigations. Strictly speaking, science is in the business of ruling out incorrect explanations; it does not attempt to prove things as correct or true. Hence science is falsifiable but not "true-ifiable." Hypotheses that withstand further rigorous testing and attempted falsification continue to gain more and more support. They are combined with other good ideas that have been similarly tested until the sum of the tested hypotheses and supporting data becomes a theory, which is the end point of scientific explanation. Nothing is better; *a theory is as good as it gets.* So the idea that evolution is "just a theory" is simply a misunderstanding of how science proceeds. Evolution is one of biology's best-supported and longest-lasting theories and is the cornerstone to all biological principles. Indeed, the geneticist Theodosius Dobzhansky was correct when he penned the phrase, "Nothing in biology makes sense except in the light of evolution."[13]

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12. See "Organic Evolution," Church History Topics, The Church of Jesus Christ of Latter-day Saints, https://www.churchofjesuschrist.org/study/history/topics/organic-evolution, reprinted herein, 331–36.

13. Theodosius Dobzhansky, "Nothing in Biology Makes Sense Except in the Light of Evolution," *The American Biology Teacher* 35, no. 3 (March 1973): 125–29.

While most people accept the idea of evolution in other organisms—like all the different breeds of dogs descending from wolf ancestors, bacteria evolving resistance to antibacterial drugs, or insect pests evolving resistance to crop pesticides—the idea of human evolution seems to create added hurdles and biases. I believe, as the BYU evolution packet proclaims, that "man is the literal offspring of God," and at the same time, I completely accept that *Homo sapiens* evolved from a common ancestor with chimpanzees about seven to eight million years ago.

How can these two ideas possibly be reconciled? Well, I believe I am a child of God. This is not because Heavenly Father is the biological father of my physical body, but rather because he is the father of my spirit. Likewise, I believe for the same reason that Adam as Michael (the name associated with his spirit body) was the literal offspring of God, but how Adam's body was created is unknown. At what point *Homo sapiens* became sentient spiritual beings in the likeness of our heavenly parents has yet to be revealed. According to the theory of evolution, all of life, from the smallest bacteria to humans, is related and united by descent with modification. Evolutionary mechanisms have shaped this unified tree of life for the last 3.5 billion years. The evidence that supports these ideas has withstood decades of rigorous questioning and testing and is well developed, astounding, accepted as scientific consensus, and, thus, *demonstrated.*

God Works with Nature

Before highlighting two convincing examples of evolution, I want to introduce my second principle of reconciliation: *I believe that God is not a deceiver. He understands and lives in perfect harmony with natural laws.* I find it hard to accept the idea that kind, loving heavenly parents would leave entire pathways of evidence in the fossils, morphology, and molecules that all point toward evolution when in reality, Creation occurred in an entirely different way.

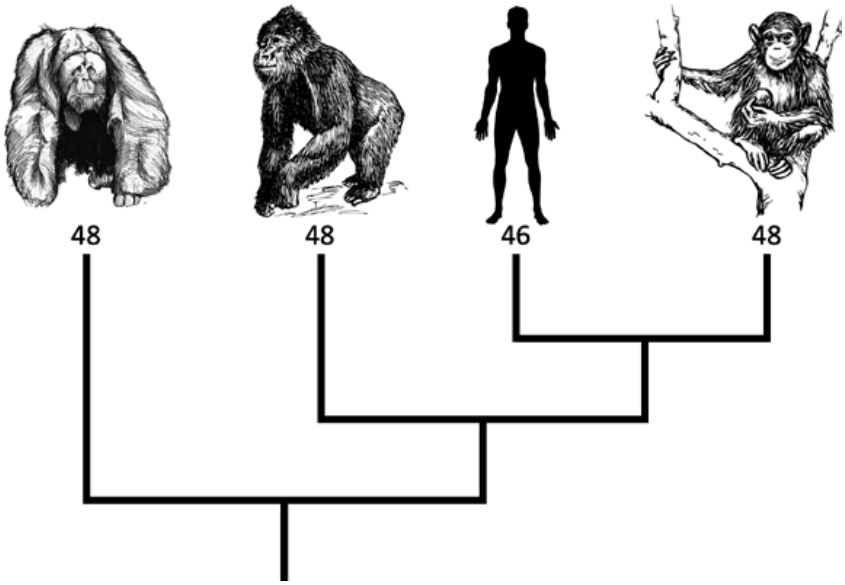

Figure 2. Evolutionary tree depicting relationships of the great apes. The numbers indicate the number of nuclear chromosomes in each species. Orangutan and chimpanzee by Pearson Scott Foresman, released to public domain. Gorilla image in public domain. Human outline by J E Theriot, https://www.flickr.com/photos/jetheriot/7940994640, CC BY 2.0.

Among the mountain of examples that could be discussed, let us look at two particularly convincing ones. Comparing human genes to the genes of different organisms demonstrates humans' relationship to the rest of animal life. Humans share 98 percent of their genes with chimpanzees, 92 percent with mice, 44 percent with fruit flies, and 26 percent with yeast. The evolutionary pattern is clear in the fact that as one compares our genetic makeup with more distantly related organisms, the similarity decreases.

DNA is organized in linear chromosomes for humans, apes, mice, and most other animals and plants as well. Humans have 46 chromosomes (23 pairs), while the other great apes have 48 chromosomes (24 pairs) (see fig. 2). Why do humans have two fewer chromosomes than the other great apes? Could humans have just lost two full chromosomes? Losing one of the chromosomes

in a pair, and all of the genes on that chromosome, is rare but possible. For example, women with Turner syndrome lack the second X chromosome, due to chromosomal nondisjunction events during meiosis, leaving 45 total chromosomes. However, losing a pair of chromosomes, and all of the associated genes, is lethal in nature because the lost genes are essential for life. In other words, a fetus missing both copies of a pair of chromosomes does not survive. Furthermore, if humans had lost two chromosomes, we would not share the high level of similarity in our DNA with other great apes. Therefore, losing two chromosomes is not a viable explanation for the reduced chromosome count in humans.

A better explanation is found in the molecular process of chromosomal fusion, where two chromosomes bind together end to end. We can test this idea by looking for a longer chromosome in humans that matches two smaller chromosomes in the other great apes. And this is exactly what we find. Figure 3 depicts G-banding patterns—a visual representation of the underlying genetic makeup—on chromosomes 2 and 3 from humans and chimps. Chimpanzees (and gorillas and orangutans) have two small chromosomes (now referred to as 2p and 2q) that match up, meaning they have the same sets of genes in the same sequential order, with the long chromosome number 2 in humans.

The implication of these observations is that the two short ape chromosomes (chimpanzee 2p and chimpanzee 2q) pasted together are equivalent to the one long human chromosome 2, because they have the same genetic material in the same order. The process of fusing two chromosomes is one mechanism of molecular change in DNA that contributes to evolution over time. This is a powerful example demonstrating that we share common ancestry with the other great apes and that while we have different numbers of chromosomes, we still have essentially all the same genes. Because I believe that God is not a deceiver, I doubt that he would make our DNA (and the pattern of DNA in all organisms) look like it evolved if it didn't.

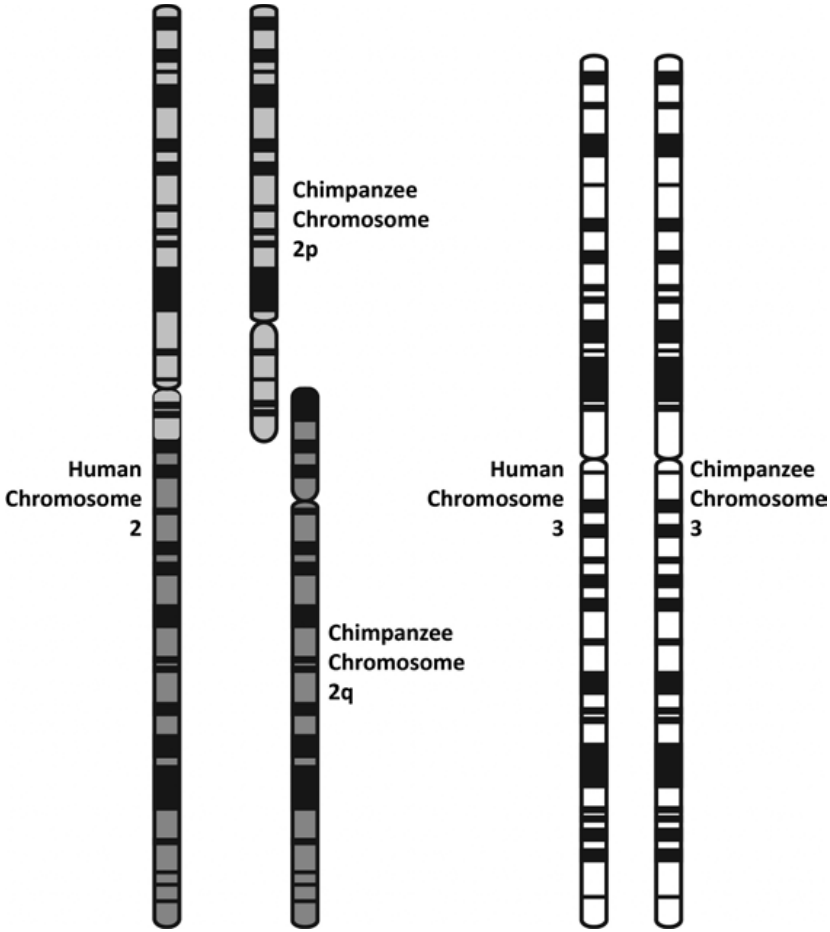

Figure 3. Illustration depicting the fusion of chromosomes 2p and 2q (as found in modern-day chimpanzees) compared to chromosome 2 in humans. The similarity of chromosome 3 in humans and chimps is also depicted. The similarity in the banding patterns represents the underlying similarity of the DNA. Created by author.

Example number two deals with the story of another genome. Human beings (and almost all animals, plants, fungi, and protists, for that matter) actually have two independent sets of genetic material: one in the cell nucleus and another in the mitochondria, an organelle in the cells where energy is generated. Our mitochondrial genome is actually more genetically similar to the complete

genome of certain types of bacteria than it is to any of our nuclear DNA. What does this mean, and how is this possible? According to one theory, about 1.5 billion years ago, aerobic bacteria made their way inside an early eukaryotic cell via endocytosis, or the fusing of two cells, and after many, many years of symbiotically coevolving with the host cell, they eventually became what we now call mitochondria. This is known as endosymbiotic theory, which, interestingly, also explains the presence of the photosynthetic chloroplasts (that were once photosynthetic bacteria) in the cells of modern-day plants. The presence of two separate sets of genetic material that descend from different types of original life forms is convincing evidence for evolution.

It is difficult for me to imagine that God would go out of his way to put patterns like DNA similarity, fused chromosomes, or bacteria genomes inside of us if our physical bodies came from a special creative act that did not involve natural evolutionary processes. For these and an immense multitude of other evidence, I accept that evolution has been demonstrated, even human evolution. At the same time, I believe, because of spiritual witnesses, that I am a child of God, that he lives, and that I can have an eternal relationship with him and with my loved ones.

What about Adam and Eve?

So how do Adam and Eve fit into this picture of human evolution? Science says nothing specifically about the humans Adam and Eve, and the Church has no official position on the subject except that Adam and Eve were first in some way or other, and that they fell. Elder Bruce R. McConkie concluded, "We have been given only enough information about the creation and the fall to enable us to understand the purposes of the Lord, to exercise faith in him, and to gain our salvation."[14] So maybe the exact details of how it all happened are not that important. That said,

14. Bruce R. McConkie, *A New Witness for the Articles of Faith* (Salt Lake City: Deseret Book, 1985), 86.

I will attempt here simply to demonstrate that what the scriptures say about Adam and Eve can be reconciled with evolution.

If all life arose from previous generations of simpler forms, as scientific evidence suggests, how are we to understand the story of Adam and Eve as recorded in the Old Testament, the Pearl of Great Price, and the temple? Reconciling Adam and Eve with science seems to be somewhat problematic in light of the scientific evidence and fossil specimens that continue to accumulate, further strengthening the case for biological evolution. Currently, *Homo sapiens* are proposed to have first evolved in Africa around two hundred thousand years ago (at least). By about seventy thousand years ago, the first *Homo sapiens* began to leave Africa. These populations minimally interbred with other hominid species, such as *Homo neanderthalensis*. (Specifically, descendants from Europe and Asia have between 1.5 and 2 percent Neanderthal DNA in their genomes.) Humans continued to migrate to most parts of the planet, reaching the Americas at least fourteen thousand years ago.

The specifics of when, where,[15] and how Adam and Eve lived are nebulous as described in the Creation stories of our scriptures and the temple. Currently these details are indecipherable. There are a number of possible scenarios that could allow reconciliation of scientific knowledge and official Church doctrine.

As a biologist and as a believing Latter-day Saint, I offer some thoughts to consider. I believe that the "Gods [Father and Son] took counsel . . . [and] went down to organize man in their own image" (Abr. 4:26–27) and "formed man from the dust of the ground, and took his spirit (that is, the man's spirit), and put it into him" (Abr. 5:7). In 1910, the First Presidency listed three basic interpretations for "formed from the dust": "Whether the mortal bodies of man evolved in natural processes to present perfection, through the direction and power of God; whether the

15. See Bruce A. Van Orden, "What Do We Know about the Location of the Garden of Eden?," *Ensign* 24, no. 1 (January 1994): 54–55.

first parents of our generation, Adam and Eve, were transplanted from another sphere, with immortal tabernacles, which became corrupted through sin and the partaking of natural foods, in the process of time; whether they were born here in mortality, as other mortals have been, are questions not fully answered in the revealed word of God."[16] Given the examples presented and knowledge contributed elsewhere since 1910, the physical body evolving in natural processes is the most congruent and likely option.

In order to reconcile the principle that Adam was "the first man of all men" (Moses 1:34)—as highlighted in the BYU evolution packet and in the scriptures—with the scientific understanding that *Homo sapiens* have existed for at least two hundred thousand years, we might further examine the meaning of "first man." For example, consider Adam's designation as the "first man" to mean something other than chronologically the first *Homo sapiens*. Perhaps "first man" in this case refers more to Adam and Eve being the first spiritual offspring of heavenly parents[17] to inherit a physical body of the species, and, perhaps most importantly, to be taught the gospel and make covenants with God. With this definition of "first man," Adam and Eve could have lived at any time during the last two hundred thousand years; the important thing is that they were the first humans, as spiritual offspring of God, to make covenants with God. They began a covenant-making process that will eventually enable spiritual offspring of God, independent of when they occupied their physical bodies, to be exalted through the Atonement of Jesus Christ.

There are other scenarios allowing for reconciliation that, on the one hand, include more scripturally literal interpretations

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16. The First Presidency, "Priesthood Quorums' Table: Origin of Man," *Improvement Era* 13, no. 6 (1910): 570.

17. The First Presidency and Council of the Twelve Apostles of The Church of Jesus Christ of Latter-day Saints, "The Family: A Proclamation to the World," *Ensign* 25, no. 11 (November 1995): 102, https://www.churchofjesuschrist.org/study/scriptures/the-family-a-proclamation-to-the-world/the-family-a-proclamation-to-the-world.

and, on the other hand, allow more symbolic interpretations. I believe that an essential element of any valid interpretation is the covenant making and covenant keeping at the heart of Adam and Eve's role in God's plan.

The role of the Garden of Eden in the Creation account is also not clear. We have no idea how long Adam and Eve lived before being "placed" there. We also do not know how long they lived in the Garden of Eden before entering the lone and dreary world or what the exact boundaries or conditions of the Garden were before and after the Fall.

Accepting evolution does not require one to renounce core Latter-day Saint beliefs; reconciliation is possible. We do not help ourselves or others by hiding from evolutionary knowledge, because in today's world, information—good or bad—is only a click away. We should understand what the scientific consensus is concerning subjects like evolution and actively work to reconcile them with the restored gospel of Jesus Christ. I embrace the idea that Michael F. Whiting stated: "[Evolution] is simply the scientific study of the underlying mechanics of the creative process."[18] Evolution does not decrease the value of faith and belief in a supreme being. It does not help the cause of truth to defend unsupported ideas with bad arguments. Saying that evolution is invalid is a bad argument in light of current scientific theory. Henry Eyring Sr. wrote, "There are few ways in which good people do more harm to those who take them seriously than to defend the gospel with arguments that won't hold water. Many of the difficulties encountered by young people going to college would be avoided if parents and teachers were more careful to distinguish between what they know to be true and what they think may be true."[19]

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18. Michael F. Whiting, "Charles Darwin and the Tree of Life: Some Assembly Required," devotional address, Brigham Young University, Provo, Utah, May 24, 2005, https://speeches.byu.edu/talks/michael-f-whiting/charles-darwin-tree-life-assembly-required/.

19. Eyring, *Reflections of a Scientist,* 246.

I have found evidence to support the idea that an increase in knowledge of evolutionary theory leads to a decrease in students' perceived conflict between religion and science.[20] In other words, a better understanding of demonstrated evolutionary science can assist in the reconciliation process. We can receive these ideas with joy no matter where they originated.

I believe that God is a supremely intelligent Creator at the helm of the creative process. Perhaps most of the time the ship requires little intervention, but if he sees a need to interpose, even in miraculous fashion, he may correct the course of the natural world if he desires.[21] God is the ultimate scientist and evolutionary biologist, and I am confident that he desires us to learn of things "both in heaven and in the earth" (D&C 88:78–79). As the world continues to receive new light and knowledge, through research or revelation, we can modify our worldviews as we internalize "knowledge of things as they are, and as they were, and as they are to come" (D&C 93:24). For now, I will accept the fact that we do not know everything in science *or* in religion. My hope is that we all can seek for and embrace truth no matter its source.

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20. Emily A. Holt, T. Heath Ogden, and Susan L. Durham, "The Positive Effect of Role Models in Evolution Instruction," *Evolution: Education and Outreach* 11 (2018), https://doi.org/10.1186/s12052-018-0086-6.

21. Kent C. Condie, "Premortal Spirits: Implications for Cloning, Abortion, Evolution, and Extinction," *Dialogue: A Journal of Mormon Thought* 39, no. 1 (Spring 2006): 35–56.

Wonderful Forms of Life Have Been and Are Being Evolved

A Brief Explanation of What Evolution Is and Is Not

Tyler A Kummer and Jamie L. Jensen

In a famous statement put out by the First Presidency of The Church of Jesus Christ of Latter-day Saints in December 1910, they stated, "Our religion is not hostile to real science. That which is demonstrated, we accept with joy; but vain philosophy, human theory and mere speculations of men, we do not accept nor do we adopt anything contrary to divine revelation or to good common sense. But everything that tends to right conduct, that harmonizes with sound morality and increases faith in Deity, finds favor with us no matter where it may be found."[1] In the dedication of the Life Sciences Building at Brigham Young University in 2015, Elder Russell M. Nelson said, "There is no conflict between science and religion. Conflict only arises from an incomplete knowledge of either science or religion, or both. . . . This university is committed to search for truth and teach the truth. All truth is part of the gospel of Jesus Christ. Whether truth comes from a scientific laboratory or by revelation from the Lord, it is compatible."[2] The purpose of this chapter is to give a basic description of what

1. Joseph F. Smith, Anthon H. Lund, and John Henry Smith, "Words in Season from the First Presidency," *Deseret Evening News,* December 17, 1910, 3.

2. Mariann Holman Prescott, "Church Leaders Gather at BYU's Life Sciences Building for Dedication," Church News, April 17, 2015, The Church of Jesus Christ of Latter-day Saints, https://www.churchofjesuschrist.org/church/news/church-leaders-gather-at-byus-life-sciences-building-for-dedication.

evidence scientists have "demonstrated" concerning evolutionary theory, so that members of the Church can "accept with joy" the beautiful truth that "comes from a scientific laboratory" about God's great works of creation.

One of the reasons that many people reject evolutionary theory stems "from an incomplete knowledge of . . . [the] science."[3] Misconceptions about the mechanisms, concepts, and definitions of evolution can lead to a faulty sense of conflict between science and the restored gospel. Even from a common-sense perspective, many people may reject evolution if they have a misunderstanding of the mechanisms such that it seems implausible or impossible. In an effort to address this particular reason for rejection, our goal is to simplify the process and present evolution in a way that can help readers overcome such barriers and allow them to make an informed, intelligent decision concerning whether or not conflict really exists between these scientific ideas and the truth and light revealed to us by God.

What Is Evolution?

The term *evolution* is commonly misused and misinterpreted. Thus, we find it imperative to begin with a basic definition of what we mean by the word. To quote a premier textbook: "Evolution: Descent with modification; the idea that living species are descendants of ancestral species that were different from the present-day ones; also defined more narrowly as the change in the genetic composition of a population from generation to

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3. Prescott, "Church Leaders Gather." See also Ryan D. P. Dunk and others, "A Multifactorial Analysis of Acceptance of Evolution," *Evolution: Education and Outreach* 10, no. 4 (2017); Amanda L. Glaze, M. Jenice Goldston, and John Dantzler, "Evolution in the Southeastern USA: Factors Influencing Acceptance and Rejection in Pre-service Science Teachers," *International Journal of Science and Mathematics Education* 13 (December 2015): 1189–209; Leslie J. Rissler, Sarah I. Duncan, and Nicholas M. Caruso, "The Relative Importance of Religion and Education on University Students' Views of Evolution in the Deep South and State Science Standards across the United States," *Evolution: Education and Outreach* 7, no. 24 (October 2014); and Deena Skolnick Weisberg and others, "No Missing Link: Knowledge Predicts Acceptance of Evolution in the United States," *BioScience* 68, no. 3 (March 2018): 212–22.

generation."[4] In simplest terms, evolution is descent with modification. We will look at each of these ideas individually and then we will address the genetic definition as we explore the mechanisms through which evolution works.

Evolution Is Descent

The first part of our definition indicates that organisms are descendants of a common ancestor. Let's start with a simple example of animal breeding to illustrate this point. One of the oldest domesticated species is the pigeon. It is estimated that roughly ten thousand years ago humans domesticated a species known as the Rock Dove. The wild type of Rock Dove has many of the traits you would associate with the feral pigeons in your city—a general color pattern with greens and purples around the neck along with black bands across the body. Human-led domestication has resulted in many breeds with dramatic variation in plumage (both color and pattern), body shape, and even behavior. Charles Darwin (1809–1882) cited the variation found in domesticated pigeons when trying to make sense of the natural biological diversity he discovered in his travels. He reasoned that the common ancestors of the pigeon were all very much the same, but through selective breeding, often focusing on specific variation, the breeds became more and more distinct from one another, ranging from the white glamorous plumage of the German Helmet Pigeon to the elongated neck and distinctive waddle of the English Carrier Pigeon.[5] From a fairly homogeneous starting population, humans produced incredibly distinct breeds through artificial selection.[6]

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4. Lisa A. Urry and others, *Campbell Biology*, 11th ed. (New York: Pearson Publishing, 2017), G-12.

5. Charles Darwin, *On the Origin of Species: By Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* (London: John Murray, 1859), 20–29.

6. Artificial selection is the name we give to the process of modifying organisms through artificial (human-caused) means, generally through selective breeding.

Now let's look at an example that illustrates how this commonly occurs in the natural world. Over five hundred miles to the west of Ecuador lie the isolated Galapagos Islands. It was Darwin's 1835 visit to these islands and his observations of the organisms inhabiting them that led to his famous ideas. One of the sets of organisms that most captured his attention were the ground birds inhabiting the island. They had significant variation in traits like beak shape and size, yet they had many unifying features as well. Further analyses of these birds by ornithologists at the time found that, despite their diversity, they were almost all American finches. These observations led to an inescapable question: If these finches had all been created on the island where they now live, why would they share distinct commonalities with American finches? Darwin drew the conclusion (supported by recent genetic analysis) that the diverse species of finches now on the islands must have had a continental ancestor that colonized the islands. Once a population of finches was established, the forces of natural selection unique to each island favored different variations of the population, ultimately resulting in the varied forms now seen. The descendants of a shared common ancestor were modified by natural selection[7] into a diverse number of species, just as humans modified pigeons into their varieties by controlled breeding.

If humans were able to produce so much variety from common ancestors among domesticated species and the environment produced so much from a common ancestor in finches, it suggests that perhaps we can best explain the diversity of life on earth by a pattern of organisms being modified as they descended from a common ancestor. A shared common ancestry for life on earth is supported by a range of evidence.

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7. Natural selection is the name we give to the process of modifying organisms through natural (non-human-caused) means, generally by pressures from the environment. We will discuss this further below.

What Evidence Do We Have for Common Descent?

The study of the anatomy of different species allows us to make comparisons and acquire important insights regarding evolutionary history. For example, superficially, the arm of a human, the wing of a bat, and the flipper of a whale appear to be very different. This superficial dissimilarity is exacerbated by a very real dissimilarity in function. When we look deeper into the anatomy, however, we find underlying commonalities. The limb of each follows a pattern: It starts from the rest of the body with one bone followed by a joint leading to two bones, followed by a second joint with a group of bones and phalanges. While the lengths and thicknesses of the bones vary, the pattern is found in all. We refer to this type of similarity as homology.[8]

Why does this homology exist? Why would organisms with a wing or flipper need to use the same basic underlying structure as a human arm, including finger bones? We, in fact, do find organisms with wings, such as butterflies, and some with fins, such as trout, that do not follow this pattern. How do we explain this? Common ancestry is the best scientific explanation. The forelimbs of Tetrapods (a group that includes humans, whales, and bats) show such similarity because a shared common ancestor evolved a limb with the one bone–two bones–many bones pattern. Over millions of years, evolutionary forces acted upon the descendants of this common ancestor, resulting in tremendous diversity of form and function of this limb while ultimately maintaining the basic pattern.

Evidence of homology is not confined to the field of comparative anatomy. Embryology studies the development of organisms before they are born. Figure 1 shows several different organisms at a similar stage of embryonic development. Notice the homology between them. Each of these creatures has a large, unfolded brain, an eye, four limb buds, and a tail of some kind. While each develops

8. Homology is similarity due to a common ancestry.

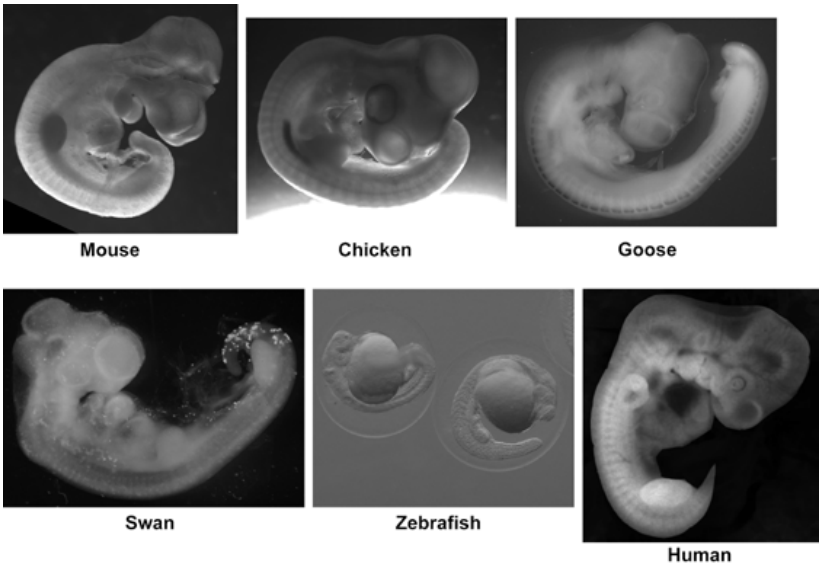

Figure 1. Comparison of six animals at a similar state of embryonic development. "Human Embryo (7th week of pregnancy)" by Ed Uthman, https://commons.wikimedia.org/wiki/File:Human_Embryo_(7th_week_of_pregnancy)_(304334264).jpg, licensed under Creative Commons Attribution 2.0 Generic license, background darkened/removed; the other photographs courtesy of BYU Cell Biology and Physiology Department.

a tail as an embryo, some of the adults have a very short tail or no tail at all. Why would an embryo develop a tail only to have it be reabsorbed and never appear in the adult? The best explanation comes from common ancestry. These species share a common ancestor that passed its developmental process on to its descendants. When we compare the developmental paths of various organisms, we see numerous shared structures and patterns that have no reason to exist unless they were inherited from a common ancestor.

We can test our hypothesis of common ancestry by looking back in the fossil record. If there is common ancestry, we would expect to see intermediate forms of life that show transitions as species evolve. One of the great transitions of life was hypothesized to be the development of the forelimb as life transitioned

Figure 2. An artist's rendition of Tiktaalik. Image courtesy of the National Science Foundation.

from water to land. For decades, scientists searched for the transition fossils that were predicted to exist. Very few organisms that die will actually form a fossil, due to the rare confluence of events needed, but when looking for a particular fossil it is important to know how long ago it would have likely existed and where environmental conditions would have been right. A research team determined a likely location and spent several summers searching the Canadian Arctic until they discovered the fossil they have since named Tiktaalik[9] (see fig. 2). This fossil discovery matched much of what you would predict from common ancestry. It had the head and limb pattern of a tetrapod but the body of a fish.

Tiktaalik is not the only transition fossil to be found. As we gained more insight into the comparative anatomy of reptiles and birds, scientists became convinced that many reptiles like crocodilians shared more in common with birds than with other reptiles. This led scientists to hypothesize that birds had a common ancestry embedded within the reptilian group. Once again,

9. *Tiktaalik* is an Inuktitut word that means "large freshwater fish."

Figure 3. *Archaeopteryx lithographica,* found in the Jurassic Solnhofen limestone of southern Germany. Photograph courtesy of National Geographic Society.

if this were the case, we would predict to find a transition fossil. This time, scientists didn't have to spend years searching for a specimen because many had been found as early as the 1800s shortly after Darwin published *On the Origin of Species*. Archaeopteryx has many of the skeletal features of a dinosaur, such as a mouth full of teeth rather than a beak, a long boney tail, and fingers. Yet, it had large feathers extending out from its forelimb to form wings (fig. 3). These and many other transition fossils provide supporting evidence of common ancestry.

Another evidence for common ancestry comes in the form of vestiges[10] and atavisms.[11] Vestigial structures are structures

10. A vestige is a feature of an organism that no longer has a clear purpose but had a purpose in an ancestor.

11. An atavism is a feature that shows up unexpectedly that was present in an ancestor but is no longer present in the current species (although we have the genes to build it).

found in an extant[12] species that appear to have no particular function. In humans, the arrector pili muscle, coccyx bone, and appendix are considered vestigial. Each of these structures can be tied to functional features in other mammals. The arrector pili, for example, is a muscle that contracts to make the hair of the organism stand up on end. Take a moment and think about when your hair seems to stand up on end. For most, you probably most frequently experience "goose bumps" when you are cold or perhaps in a moment of fear. For a human, this structure and response makes little sense, but imagine how this response would be beneficial for a fur-covered mammal. In the cold, the contraction of the arrector pili results in a thicker layer of fur to decrease heat loss. When in dangerous situations, the animal's expanded fur layer makes it appear larger and may even aid in reducing the impact of bites or scratches. How do we account for humans having the same structure and response? Common ancestry gives us a perfectly reasonable explanation. A shared common ancestor passed these traits on to the descendant species we see today. Humans have vestigial structures because they inherited them, and though there was modification to the structures, they didn't completely disappear.

On occasion, a few people are born with extremely unique traits that are very seldom seen in the human population. One example of this is a tail. It is shocking to see, but it does happen. Humans have thousands of genes that work together to produce the variety we see in the world. Some of these genes control a single trait while others work together. Somewhere in the DNA of these people born with tails is a set of genes that provide the instructions to produce that tail. In fact, it is likely these genes exist in all of us, but they are not expressed in a way that results in a tail forming. Why would humans have silenced genes for producing a tail? Once again, common ancestry provides an

12. Extant means in existence today. It is the opposite of extinct.

explanation. Though these traits, known as atavisms, have been modified and silenced through evolution, the underlying genetic code remains inherited from a common ancestor.

How Convincing Is This Evidence for Common Descent?

Many years ago, we (the authors) were involved in developing a new biology course and in the process created quizzes for the associated labs. When we printed the keys to these quizzes, we accidentally left a misspelled word in one of the answers. The keys were stored in a locked office. A few months into the term, one of the teaching assistants came forward with a concern: one of their students had been using word-for-word answers from the keys on the quizzes, including the exact same misspelling; the teaching assistant felt it was more than coincidence. Upon investigation, it was found that the student worked as a janitor and had access to the office where the keys were kept. While not the case in this circumstance, putting in a deliberate error to find plagiarism has long been a way to catch those not doing their own work in cartography (mapmaking). Many cartographers would purposely embed a mistake in the map, so that anyone copying their map and claiming it as their own would be caught.

We use this illustration to make a point: when we see the exact same "mistake" or change in two very different organisms, it most likely indicates a common source. Let us give an example. Long ago, it was obvious to biologists that while whales had superficial similarity with fish, they clearly should not be grouped with fish (sometimes external similarity does *not* indicate relatedness). In biology, we look for characteristics that a single group of organisms have and organisms outside that group do not have, the idea being that a common ancestor likely evolved this unique characteristic and then passed it on to the descendants that make up the group, rather than both groups independently evolving the same unique feature. The very way that whales swim (with an up-and-down movement) is a giveaway that whales and fish (that

swim side to side) did not inherit their aquatic lifestyle from a common ancestor. In addition, a closer examination shows that whales have hair and mammary glands. These characteristics led scientists centuries ago to classify whales as mammals.

Such unique creatures inspired biologists to search for evidence of how this evolution would have taken place. Scientists believed one of the best places to take their search was modern-day Pakistan, which, during the Eocene Epoch (56–33.9 million years ago), had shallow seas perfect for this ancestor. This search produced a number of different fossils, including one group that was called Pakicetus, which shared much in common with most mammals, including four relatively long legs and an elongated, powerful tail. Originally, due to their similarities with carnivorous ungulates, they were classified as Mesonychids rather than the whale ancestor they were searching for. Then along came more evidence. You are likely familiar with the basic anatomy of a mammalian ear, consisting of three basic sections—external ear, middle ear, and inner ear. One of the structures in the middle ear is called the tympanic or auditory bulla. Among mammals, only whales have a certain form of the tympanic bulla that lacks a medial attachment point and has a thickened part of the bone called the involucrum, that is believed to improve hearing in the water. As more Pakicetus fossils were discovered and analyzed, scientists found these unique signatures of the whale family in the Pakicetus fossils. Just like the student who used the spelling error in her answer or the cartographers placing errors in their maps, it was clear that Pakicetus fossils had been misclassified and were in fact a common ancestor of modern-day whales. In the decades since, numerous fossils showing the transition of whale ancestors from small land-based mammals to the huge aquatic creatures we know today have been discovered, each showing these unique structures. We now have an incredible set of evidence showing the common ancestry that links modern whales with land mammals.

Evolution Is Descent with Modification

Let's look now at the "with modification" part of the definition. What is modification, and how does it occur? We believe it is pertinent first to point out to the reader that evolutionary theory is concerned only with descent and modification, *not* with origination. Evolution does not provide an explanation for the origin of life. That is still an active question in science for which many hypotheses have been proposed (for example, life originating as an RNA molecule in the primordial mud, or life originating from an extraterrestrial source). We will not explore these here in this chapter but would recommend interested readers to seek out additional information.[13] Evolutionary theory is concerned only with how life got from its origins (however that may have occurred) to its current form.

Likely, most readers are familiar with, and generally accept, the idea of natural selection, as discussed above with Galapagos finches. First proposed by both Charles Darwin and Alfred Russel Wallace (1823–1913), independent of each other, natural selection is described as survival and reproduction of those organisms that are most adapted to their environment. Let us illustrate one more well-studied example, coming out of the Valley of Fires in New Mexico, with an organism called the rock pocket mouse. This area of the desert is characterized by white sands interspersed with large black lava flows. The rock pocket

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13. Additional readings on the origin of life: "Chemical Origin of Life Articles from across Nature Portfolio," Nature Portfolio, Springer Nature, https://www.nature.com/subjects/origin-of-life; Helen Fields, "The Origins of Life," *Smithsonian Magazine,* October 2010, https://www.smithsonianmag.com/science-nature/the-origins-of-life-60437133/; Robert F. Service, "Researchers May Have Solved Origin-of-Life Conundrum," *Science,* March 16, 2015, https://www.sciencemag.org/news/2015/03/researchers-may-have-solved-origin-life-conundrum; Jack Szostak, "How Did Life Begin?," *Scientific American* 318, no. 6, (June 2018): 65-67, https://doi.org/10.1038/scientificamerican0618-65; Antonio Lazcano and Stanley L Miller, "The Origin and Early Evolution of Life: Prebiotic Chemistry, the Pre-RNA World, and Time," *Cell* 85, no. 6 (June 14, 1996): 793–98, https://doi.org/10.1016/S0092-8674(00)81263-5; Addy Pross and Robert Pascal, "The Origin of Life: What We Know, What We Can Know, and What We Will Never Know," *Open Biology* 3, no. 3 (March 2013), https://doi.org/10.1098/rsob.120190.

mouse is usually tan in color. However, scientists have discovered several mutations in a pigment-producing gene that causes some mice to be born with dark-colored fur, or hyperpigmentation.[14] If you look at populations of mice living on the light-colored sands, the majority of them are tan in color. If you look at populations of mice living on the black lava flows, they are almost exclusively dark in color (that is, almost all of them have mutations in that pigment gene). This is due to the selective pressure of the visual predators that hunt them (that is, mostly predatory birds). Those that blend in best also survive best and, as a consequence, pass on their genes (mutations and all) to the next generation. This process is a main and influential mechanism in the evolution of organisms. However, it is not the only mechanism by which populations are modified. Other mechanisms include *genetic drift, gene flow, nonrandom mating,* and *mutation.* We do not wish to get into the intricate details of each of these processes because that is beyond the scope of this chapter (we will save that for a biology class); however, we will give a brief definition of each of these mechanisms with an accompanying example for basic understanding. This will help illustrate the genetic definition of evolution stated above: evolution is "the change in the genetic composition of a population from generation to generation."[15]

Genetic drift is the random change in genetic frequencies due to chance. It often occurs when population sizes become small in two processes referred to as a bottleneck[16] and the founder effect.[17] For example, the northern elephant seal was

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14. Michael W. Nachman, Hopi E. Hoekstra, and Susan L. D'Agostino, "The Genetic Basis of Adaptive Melanism in Pocket Mice," *PNAS* 100, no. 9 (April 2003): 5268–73.

15. Lisa A. Urry and others, *Campbell Biology,* 11th ed. (New York: Pearson Publishing, 2017), G-12.

16. The bottleneck effect is a form of genetic drift that occurs when large portions of a population are wiped out, leaving a small, nonrepresentative population behind.

17. The founder effect occurs when a small part of a population that is not representative of the original population branches out and creates its own new population.

hunted nearly to extinction in the 1890s. It has since rebounded to over 225,000 individuals, but the variation in the genetics of these populations is far less than it should be.[18] An example of the founder effect can be seen in the high frequency of fumaric aciduria (an autosomal recessive disease that causes encephalopathy, severe intellectual disabilities, and other brain malformations) in the Fundamentalist Latter-day Saint (FLDS) communities living in Hilldale, Utah, and Colorado City, Arizona.[19] Two of the original founders of this community were John Y. Barlow and Joseph Smith Jessop, who both happened to be carriers of this rare recessive allele. Because the colony has been reproductively isolated for a long time, these genes have perpetuated in a high number. Sometimes, genetic frequencies in large populations can change by chance, drifting from one form of a gene to another, depending on who reproduces and who does not, regardless of any benefit or detriment of the given variation.

Gene flow is the scientific term for migration either into or out of a population. When individuals leave a population, they take their genes with them and thus out of the gene pool. This can drastically change the original population's genetic composition. Equally, if a group of individuals enters a population, they bring new genes with them that can alter the genetic composition of the original population. One of the main outcomes of gene flow is that the two populations involved become more similar in their genetic frequencies. For example, grizzly bears and polar bears are two distinct species. However, due to changes in climate, grizzly bears are moving north in search of cooler territory, and polar bears are moving south due to the loss of their icy habitats, and the two populations are meeting and creating a hybrid

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18. Alicia Abadía-Cardoso and others, "Molecular Population Genetics of the Northern Elephant Seal *Mirounga angustirostris*," *Journal of Heredity* 108, no. 6 (September 2017): 618–27.

19. See, for example, Marieke Peetsold and others, "Fumarase Deficiency: A Case with a New Pathogenic Mutation and a Review of the Literature," *Journal of Child Neurology* 36, no. 4 (2021): 310–23.

species that some call pizzlies and others call grolars.[20] Scientists have documented extensive gene flow between several species of bears that has shaped their evolution, making them more similar than would be expected given their diverse environments.[21]

Nonrandom mating,[22] also referred to as sexual selection, occurs when the perpetuation of an individual's genes into the next generation is due to sexual preference (rather than by being fit for the environment). Darwin once remarked, "The sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick."[23] Why did it make him sick (figuratively, not literally)? Because clearly, the long, cumbersome feathers of a male peacock are not advantageous, making them easier prey because the long feathers impede their ability to get away from predators. So why would this characteristic be perpetuated? It is preferred by the female peahens. Their selection of a mate with the most spectacular feathers has driven the development of this bizarre, and seemingly unfit, characteristic. Ultimately, the tail feathers do not make them more likely to survive; they make them more likely to mate before they die.

Mutation[24] is the basis of variation upon which natural selection works. However, mutation alone is a slow and minor evolutionary driver. Most mutations in coding genes decrease fitness since they introduce variation that is likely less fit than the current variation. However, a lot of mutations that occur have no effect on fitness, either way. But if the environment changes, these mutations may become beneficial. Take, for example, the *MC1R* gene. This gene is involved in the production of the skin pigment eumelanin,

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20. John P. Smol, "Climate Change: A Planet in Flux," *Nature* 483 (March 2012): S12–S15.

21. Vikas Kumar and others, "The Evolutionary History of Bears Is Characterized by Gene Flow across Species," *Scientific Reports* 7, no. 46487 (April 2017): 1–10.

22. Nonrandom mating refers to any mating between individuals that is selective. For example, females are attracted to a certain characteristic in males.

23. Darwin Correspondence Project, "Letter no. 2743," accessed on March 30, 2022, https://www.darwinproject.ac.uk/letter/?docId=letters/DCP-LETT-2743.xml.

24. Mutation is defined as any change in the genetic code of an organism.

a dark-colored pigment. A mutation occurred at some point in the evolution of humans that interrupted its function so that the pathway to eumelanin is incomplete; instead, the pigment made is pheomelanin, a red-colored pigment. Certain forms of this mutation also tend to cause the melanocytes (the cells that make pigment) to clump together. Those with normal eumelanin tend to have darker hair and skin that tans easily. Those with pheomelanin have red or blonde hair, fair skin, and clumped melanocytes in the form of freckles.[25] Likely when this original mutation occurred, it may have been somewhat detrimental, leaving these individuals unprotected from the damage of UV solar radiation. However, as humans migrated into far northern and southern habitats where the sun's rays are indirect, those with normal eumelanin began to have trouble making enough vitamin D, due to the lower sunlight and their darker skin. Suddenly, those white-skinned, red-haired, freckled individuals had a clear advantage in being able to soak up far more sun than their darker friends to produce sufficient vitamin D to avoid rickets (the disease caused by insufficient vitamin D).[26] With the help of natural selection, this mutation was perpetuated in populations of humans living in these extreme habitats, such as the Vikings.

What Are the Major Misconceptions?

Hopefully we have given you a decent understanding of evolution and its mechanisms as defined by science and informed by evidence. As educators, both in the public school system and at the undergraduate level, we have run into many misconceptions about evolutionary theory that tend to impede student acceptance of this idea. We would like to take an opportunity here to discuss those misconceptions in an effort to remove them as roadblocks to evolution acceptance.

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25. "MC1R gene," MedlinePlus, National Library of Medicine, last updated August 18, 2020, https://medlineplus.gov/genetics/gene/mc1r/#references.

26. Ze'ev Hochberg and Irit Hochberg, "Evolutionary Perspective in Rickets and Vitamin D," *Frontiers in Endocrinology* 10, no. 306 (May 2019): 1–10.

Ladder Thinking

Evolutionary trees[27] are the way we graphically depict common ancestry. Figure 4 shows an example of a tree of vertebrate animals. In general, the starting point of a tree (circle A in the figure) is a single population in the past, and the opposite end is where the extant descendants are shown (where you see the names of the species listed in the figure). There are several points at which the ancestral population split into different lineages (see circle B in the figure, for example). The splitting points represent the most recent common ancestor shared by the descendants that evolved from that point (in the case of circle B, the descendants are the sparrow, crocodile, iguana, and cobra). The branches (indicated by C on the figure) represent populations evolving through time. Potential arrangements of extant species are compared as a hypothesis.

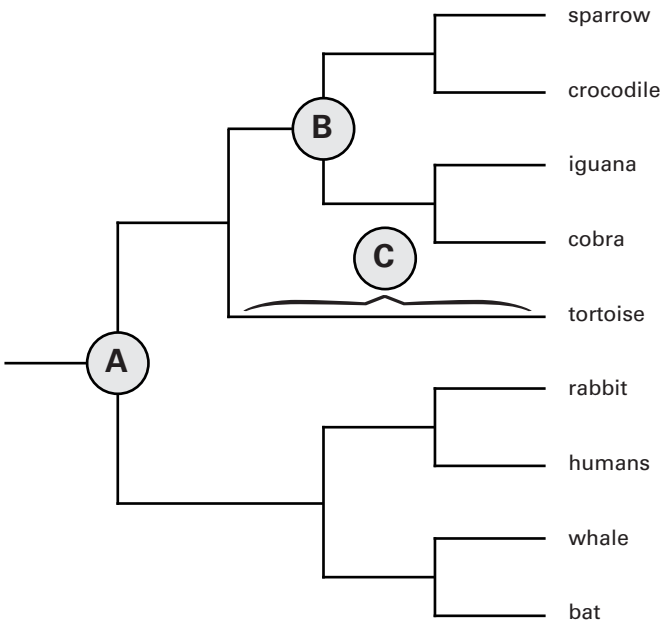

Figure 4. An evolutionary tree of vertebrates.

27. Evolutionary trees, sometimes referred to as phylogenetic trees, are hypothesized depictions of the relationship between organisms.

The existing characteristics or DNA of the extant species in the tree are used as evidence to evaluate which arrangement is most likely to reflect the actual evolutionary history. Through a variety of statistical techniques, scientists look for which arrangement would require the fewest or most likely number of evolutionary changes. We use these evolutionary trees to help us understand the evolutionary process and to evaluate different hypothesized evolutionary events. For example, we can determine approximately when and how many times wings evolved or how a virus spread in a given population.

A common image associated with evolution depicts a chimp on one end and a human on the other with various intermediate forms in between (see fig. 5, left panel). This image reinforces a commonly held misconception that humans evolved from a common ancestor that was a chimp. This is not what evolutionary biologists believe occurred. Rather than a chimp turning into a man, it is more accurate to say that some extinct species existed that is an ancestor of both humans and chimps. At some point in time, the population of this species split into two distinct populations that never joined back together. The division set them on distinct evolutionary paths that led to the species they are today. In other words, chimps are not the ancestor of humans; they are a relative that descended from a common ancestor (see fig. 5, right panel). This distinction may seem inconsequential, but it is actually one of the more commonly held misconceptions about evolution known as ladder thinking.[28] Ladder thinking leads many to believe that evolution had some goal (producing humans for example) and that along the way toward achieving that goal other species jumped off the path to progress and stopped evolving. The problem with this view is that natural selection and other evolutionary forces did and do act on all populations; we run the risk of missing opportunities to learn how these forces work and to discover the unique diversity that has resulted from these processes.

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28. Ladder thinking is the idea that one species turns into another species over time. An extreme version of this thinking would suggest that humans are the pinnacle of evolution and other organisms are just in various stages of becoming human.

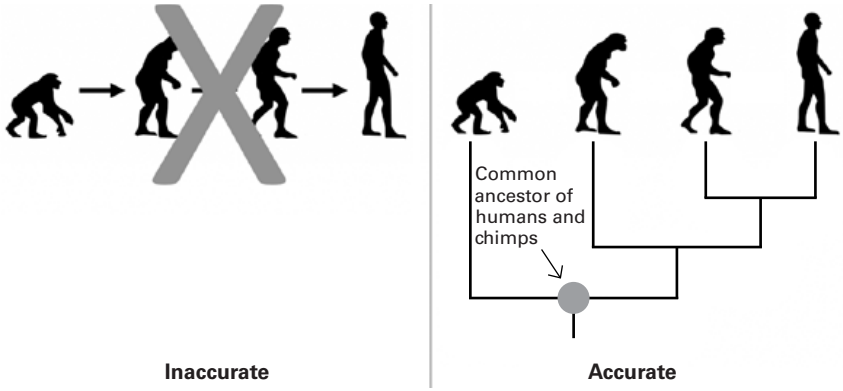

Figure 5. Depictions of human and chimp evolution. The illustration on the left is inaccurate, showing chimpanzees turning into humans. The illustration on the right is accurate, showing that humans and chimpanzees share a common ancestor.

Microevolution vs. Macroevolution

Scientists have used many instruments to try to measure public acceptance of evolution (for example, the MATE and GAENE[29]). However, surprising to scientists who view evolutionary processes at the micro and macro level as the same process, just on different scales, researchers found that respondents did not see these processes as the same. In fact, the newest instruments to measure evolution acceptance (for example, the I-SEA[30]) divides the questions into three distinct sections: Microevolution, Macroevolution, and Human Evolution. Let us explain the perceived difference. Microevolution generally refers to the mechanisms of

29. Measurement of Acceptance of the Theory of Evolution and Generalized Acceptance of Evolution Evaluation. See Michael L. Rutledge and Kim C. Saddler, "Reliability of the Measure of Acceptance of the Theory of Evolution (MATE) Instrument with University Students," *American Biology Teacher* 69, no. 6 (2007): 332–35; and Michael U. Smith, Scott W. Snyder, and Randolph S. Devereaux, "The GAENE—Generalized Acceptance of Evolution Evaluation: Development of a New Measure of Evolution Acceptance," *Journal of Research in Science Teaching* 53, no. 9 (2016): 1289–315.

30. Inventory of Student Evolution Acceptance. See Louis S. Nadelson and Sherry Southerland, "A More Fine-Grained Measure of Students' Acceptance of Evolution: Development of the Inventory of Student Evolution Acceptance—I-SEA," *International Journal of Science Education* 34, no. 11 (2012): 1637–66.

evolution discussed above, natural selection, genetic drift, gene flow, nonrandom mating, and mutation. These are seen as gradual changes to an organism where the organism does not necessarily change into a different species. Many refer to this as adaptation.[31] Not surprisingly, public acceptance of microevolution is highest among the three. Macroevolution generally refers to large-scale speciation events—for example, the evolution of birds from dinosaur ancestors. Macroevolution has a much lower public acceptance rate than microevolution.[32] However, a common misconception is that macroevolution is brought about by different mechanisms than microevolution. In reality, macroevolution is simply the large-scale result of many microevolutionary events. It is just a difference in scale. Admittedly, most examples used in textbooks of microevolution are within the context of a single "type" of organism. A common example is that of two species of squirrel that live on opposite sides of the Grand Canyon. Having been separated for over ten thousand years and having experienced different natural selection and random genetic drift, these two populations of squirrel have become reproductively isolated and are considered two different species. However, you might be saying, "But they are still both squirrels. It's not like one of them turned into a raccoon!" You are correct, they are both still squirrels, and so this may not qualify, in your mind, as a macroevolutionary event. Instead, how did dinosaurs become birds? Now that's a macroevolutionary event. To answer this, we first need to understand how a speciation event occurs. (There are many ways for this to occur and, for the sake of space, we will not go into the details.)

Let's just discuss it simply. Take a look at figure 6. Circle A is highlighting the common ancestor of the two squirrel populations that now live on opposite sides of the Grand Canyon. How

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31. Adaptations are inherited characteristics that increase the survival of an organism.

32. Lia Betti, Peter Shaw, and Volker Behrends, "Acceptance of Biological Evolution by First-Year Life Sciences University Students," *Science and Education* 29 (April 2020): 395–409.

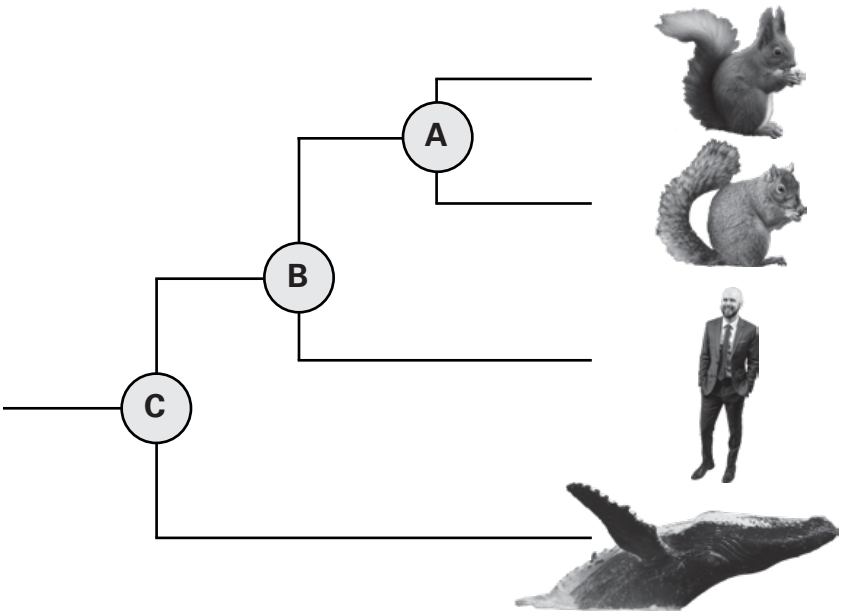

Figure 6. Speciation events at the micro- and macroevolutionary scales. Photographs courtesy of Peter Trimming (top squirrel), Zuzanna J (bottom squirrel), Hermes Rivera (man), and National Oceanic and Atmospheric Administration (humpback whale).

did these squirrels become two species? It happened in the same way all speciation events occur: one population was separated into two populations that were then under different selective pressures (along with genetic drift) that caused them to change over time such that they are no longer the same. Let us point out something important. Circle A does not depict a single individual who gave birth to squirrel 1 and squirrel 2. That is a common misconception, too. Instead, Circle A represents a population that was separated over a long period of time. Circle B is going farther back in time to the ancestor of Rodentia (squirrels are a type of rodent) and Primates (humans are a primate). What happened there? The same thing. One population was separated into two populations that then continued their evolution, one group diversifying into the rodents we see today, and the other diversifying into the primates. And Circle C is no different. In this case,

it is the common ancestral population that was separated, with one group diversifying into rodents and primates, while the other diversified into whales (and bats and tigers and horses and camels). In other words, macroevolution (or large-speciation events) is simply the result of many, many microevolutionary changes.

Let us emphasize one more important concept: speciation events usually take very long periods of time. One common argument against evolution is that if it did occur in the past, why are we not seeing speciation events now? The answer: you just have not lived long enough (nor will you) to see one.[33] We will not touch on human evolution here, but the idea is the same. Many people separate human evolution from micro- and macroevolution for religious reasons.

Populations Evolve, Not Individuals

A French biologist and brilliant scientist named Jean-Baptiste de Lamarck (1744–1829) is unfortunately only remembered for the proposal of an incorrect mechanism for evolutionary change. He suggested that individual organisms can change during their own lifetimes. For example, if you cut off the tails of Dobermans, the puppies will be born tailless. I have heard people use this same logic today saying that the human population has grown more near-sighted because we are constantly staring at computer screens. This is not the case. So why doesn't this happen? Remember that evolution occurs by changes to the genetic frequency of a population over time. That means that changes have to be genetic. They have to be heritable by offspring from parents. So unless there is a genetic change in the organism, specifically in the organism's sex cells, that change will not be passed on to the next generation. Instead, organisms that have a genetic makeup that makes them better able to survive pass that genetic makeup on to the

33. That being said, speciation events have occurred in very short periods of time. They are just rare. See https://www.sciencemeetsreligion.org/evolution/speciation.php for a good review of some examples.

next generation. We have actually seen a surge in this particular misconception recently (data is anecdotal) with the repopularization of Pokémon®. Pokémon creatures are caught by the player and then trained to battle other Pokémon creatures. If they win enough battles, they can undergo changes similar to metamorphosis (for example, grow wings or develop fire-breathing powers). Thus, the individual Pokémon creatures can change over time during their own lifetime. The misconception comes because this process is labeled "evolution" in the game. In actuality, it is not evolution, but metamorphosis.

The Problem with Randomness

One last common misconception that we hear is the claim that there has not been enough time on earth for random mutations to have produced a human being. The idea posits that the probability is just too low. This is an interesting but misguided argument. It is true that mutations are random and that evolution works upon these preexisting mutations. However, many of the processes of evolution are *not* random (for example, natural selection and sexual selection). In other words, the original mutation that occurred in a gene occurred at random. The results of that change on survival and reproductive fitness, however, are not random at all. For example, let's say that we are dealing with a very simple organism that is tan in color. And let us make color a simple, one-gene trait. Let us say these organisms live in the desert sands of an island. With mutations occurring at random, it is possible that a random change could occur that altered the color to cream, brown, black, green, or even blue. In their current environment, any change from tan to a darker color would make this organism stick out like a sore thumb, making it easy prey to its visual predator. However, a change to cream might not affect its fitness at all. Thus, there is a constraint to the number of random changes that are likely to perpetuate into the next generation. This increases the odds, quite a bit, of reaching the adapted forms of animal life that we see today. Although this is

highly oversimplified, ignoring the fact that any change in genes is intimately connected to other genes in gene networks that are part of complex developmental pathways, it illustrates the point that mutations *are* random, but the number of mutations that are viable is *not* random.

Conclusion

We hope that this chapter has provided you with a workable definition of evolution and a decent understanding of the mechanisms through which it operates. Theodosius Dobzhansky (1900-1975), a famous biologist, once stated, "Nothing in biology makes sense except in the light of evolution."[34] His point is that the theory of evolution provides the foundation upon which all of biological science rests. It is a beautiful explanatory theory that ties together an otherwise endless collection of facts into a testable model that helps us build our understanding of ecosystems, of our bodies and our health, of biodiversity, and of the interactions we, as stewards, have with God's creations. We believe that it is vital to our ability to be good citizens and wise stewards to have a working understanding of evolution.[35] We also believe that through understanding we can break down the barriers and the fear that may prevent us from accepting evolution as a valid explanation for God's workmanship here on earth. We would encourage all to "seek learning, even by study *and also by* faith" (D&C 88:118, emphasis added). With it will come great blessings.

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34. Theodosius Dobzhansky, "Nothing in Biology Makes Sense Except in the Light of Evolution," *American Biology Teacher* 35, no. 3 (March 1973): 125–29.

35. For more information, see Jamie L. Jensen, "Accepting Evolution: Why Does It Matter?," herein, 1–22.

evolutionary trees and the assessment of evolution understanding. He and his wife have five children.

Jamie L. Jensen is a professor in the Department of Biology at Brigham Young University. Her research program focuses on educational implementations for teaching biology, and a large part of her work examines the reconciliation of religious faith with topics in science, especially evolution. As a member of the Broader Social Impacts Committee of the Human Origins Project at the Smithsonian's National Museum of Natural History, she works with scientists from a variety of religious denominations to help the public feel more comfortable with human evolution. In addition, with generous funding from the Department of Science Education at the Howard Hughes Medical Institute, she has brought together biologists, theologians, and local pastors and ministers from a variety of religions to help students accept the science of evolution without losing religious faith. She has built a website full of resources for the faithful seekers of reconciliation (https://biology.byu.edu/reconciling-evolution/) Her most fulfilling role, however, is being a wife and a mother of four boys.

The Scientific Evidence for Human Evolution

Seth M. Bybee

> Everywhere in nature we are taught the lessons of patience and waiting. We want things a long time before we get them, and the fact that we wanted them a long time makes them all the more precious when they come.
>
> —Joseph F. Smith[1]

Introduction

Science explores the natural aspects of our world. Religion explores our relationship to the Creator and the spiritual world. It is a false choice to suppose that knowledge must come from either science alone or faith alone. Both contribute to our understanding of creation. President David O. McKay said, "Science, dominated by the spirit of religion, is the key to progress and the hope of the future."[2]

The process of reconciling scientific evidence and religious doctrines is not simple. The scientific study of evolution is key to understanding how life emerged on Earth. Many people can be

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1. Joseph F. Smith, *Gospel Doctrine: Selections from the Sermons and Writing of Joseph F. Smith* (Salt Lake City: Deseret News, 1919), 372.

2. David O. McKay, devotional address, Brigham Young University, Provo, Utah, October 10, 1952, https://speeches.byu.edu/talks/david-o-mckay/message-lds-college-youth.

comfortable with the theory of evolution and its principles but do not accept human evolution as part of that theory because it seems like a challenge to their faith. As a professor at Brigham Young University, I see this challenge firsthand. On the first day of Biology 100 (Introduction to Biology for nonmajors), around 75–80 percent of BYU students are accepting of the principles that support the theory of evolution, but when asked specifically about human origins being a result of the process of evolution, student acceptance falls by half to 35–40 percent.[3] However, after a semester of studying the data in support of the theory of evolution (including human evolution) in light of an accurate understanding of Church teachings on evolution, student acceptance of the theory of evolution grows considerably, and the difference in acceptance of evolution and human evolution decreases.[4] Of particular note, our students do not report any loss of testimony; in fact, their testimonies slightly increase.[5]

If one cannot personally accept the theory of evolution overall, or reconcile human evolution as part of that theory, it is still useful to understand why scientists accept human evolution as a proven scientific theory. To scientists, the data and science that support the theory of evolution generally and the origins of humans specifically are both robust and resilient. They have withstood the same scientific process, rigors, and examination as any other theory in science (for example, heliocentrism, gravity, and quantum theory).

In what follows, I will present evidence for human evolution that is similar to what is taught in Biology 100 at BYU. This is

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3. Katie F. Manwaring and others, "Influencing Highly Religious Undergraduate Perceptions of Evolution: Mormons as a Case Study," *Evolution: Education and Outreach* 8 (2015), https://doi.org/10.1186/s12052-015-0051-6.

4. Daniel G. Ferguson and Jamie L. Jensen, "Role Models, Compatibility, and Knowledge Lead to Increased Evolution Acceptance," *Evolution: Education and Outreach* 14, no. 1 (2021): 1–11.

5. Ferguson and Jensen, "Role Models, Compatibility, and Knowledge Lead to Increased Evolution Acceptance"; Manwaring and others, "Influencing Highly Religious Undergraduate Perceptions of Evolution."

simply an introduction to the evidence for human evolution; there is much more scientific evidence that could be presented, but it cannot fit in this chapter. From a scientific perspective, the information is demonstrated,[6] but each reader can take the time to think more deeply about how it may or may not fit into his or her own understanding.

From the First Life on Earth

The first life on Earth arose more than 3.5 billion years ago[7] and likely resembled a small RNA molecule (a single-stranded nucleic acid, the ancestor of DNA, and still present in all living cells today) that was fully dependent on an aquatic environment.[8] According to the theory of evolution, from these humble aquatic beginnings, and due to natural processes enforced as a selective filter over billions of years, a whole host of other organisms, including *Homo sapiens,* evolved to their present forms.[9] There is strong evidence that these same organisms, including humans, continue to evolve today.

What Is a Species?

In order to fully explore human evolution, particularly the evidence for hybridization between humans and other human-like species, it is important to understand what scientists mean by

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6. The First Presidency, "Words in Season from the First Presidency," *Deseret Evening News*, December 17, 1910, 3.

7. J. William Schopf and others, "Evidence of Archean Life: Stromatolites and Microfossils," *Precambrian Research* 158, nos. 3–4 (October 5, 2007): 141–55; J. William Schopf, "Fossil Evidence of Archaean Life," *Philosophical Transactions of the Royal Society* 361, no. 1470 (June 29, 2006): 869–85; Peter H. Raven and George B. Johnson, *Biology,* 6th ed. (Boston, Mass.: McGraw-Hill, 2001), 68.

8. Sidney Becker and others, "Unified Prebiotically Plausible Synthesis of Pyrimidine and Purine RNA Ribonucleotides," *Science* 366, no. 6461 (2019): 76–82; Nicholas V. Hud and David M. Fialho, "RNA Nucleosides Built in One Prebiotic Pot," *Science* 366, no. 6461 (2019): 32–33.

9. See Charles Darwin, *On the Origin of Species* (1859; New York: HarperCollins, 2011); Charles Darwin, *The Descent of Man and Selection in Relation to Sex* (London: John Murray, 1871).

species. High school students are commonly taught that a species is a group of organisms that can breed and produce fertile offspring (that is, hybridization between species is not supported).[10] However, this definition is too simple to capture what is happening in the biological world around us. For example, many plants, animals, and microbes can hybridize and have viable seedlings, offspring, or strains. Take lions and tigers as an example. Few would argue that tigers and lions are the same species. In nature, they inhabit different environments and geographical regions and have different social structures—tigers being solitary and lions living in prides. However, when they are bred together, the resulting offspring, ligers and tigons, are fully fertile and can be bred to each other or back to a lion or tiger making ti-ligers and li-tigons. This example demonstrates that defining species based solely on their ability to successfully interbreed breaks down. Therefore, there are additional ideas, called "species concepts," that are used to define species.[11] Species concepts are based on morphology (that is, anatomy), genetics, and ecology as well as genealogical relatedness. It is important to understand species concepts when considering human evolution because many of the species that are related to modern humans are diagnosed from fossil and genetic data.

Did We "Come from" Apes?

There is a common misconception that evolution posits that humans "came from" or "evolved directly from" modern apes. This is not an accurate reflection of scientific thought. For example, from an evolutionary perspective, humans did not evolve directly from chimpanzees but rather share a common ancestor

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10. Ernst Mayr, "The Biological Species Concept," *Species Concepts and Phylogenetic Theory: A Debate,* ed. Quentin D. Wheeler and Rudolf Meier (New York: Columbia University Press, 2000), 17–29.

11. Wheeler and Meier, *Species Concepts and Phylogenetic Theory*; Kevin de Queiroz, "Species Concepts and Species Delimitation," *Systematic Biology* 56, no. 6 (December 2007): 879–86.

with them. It is a subtle but large difference. For example, you did not come from or originate from your cousins, but you do share a common ancestor with your cousins (your grandparents). Likewise, humans did not come from modern apes, but we do share a common ancestor with apes. Further, humans, apes, and hominoid fossils (such as Neanderthals, Lucy, Turkana boy, and so on) share a common ancestor. Although the story of human evolution is complex, when we consider evidence like hybridization (which I discuss later), we can see that we did not evolve directly from modern apes, but we are related through common ancestry.

Could Humans Have Been Created through an Evolutionary Process?

The overwhelming scientific evidence provides an emphatic "Yes!" to the question of whether humans evolved on this earth. Does that then mean there is still room for God in the creative process? A correspondingly overwhelming amount of evidence from the religious perspective would provide an equally emphatic "Yes!" Jamie Jensen and Tyler Kummer outline a definition of evolution, the major lines of evidence for the theory of evolution, and common misconceptions using examples across biology.[12] These examples include anatomical, molecular, phylogenetic (genealogical), biogeographical, fossil, and even microevolutionary evidence. I will concentrate on these same lines of evidence here, but I will explore each with a focus on the evidence for human evolution.

Evidence for Human Evolution

Anatomy. A discussion of anatomy, especially in an evolutionary context, is often best begun with a definition of the word *homology.* Homology is the similarity between structures, such as bones,

12. Tyler A Kummer and Jamie L. Jensen, "Wonderful Forms of Life Have Been and Are Being Evolved: A Brief Explanation of What Evolution Is and Is Not," herein, 161–85.

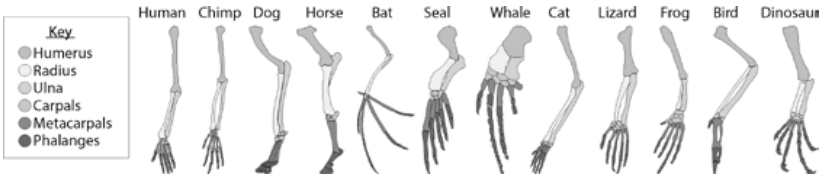

Figure 1. Tetrapod arm bone anatomy. Homologous bones are shaded according to bone type and can be seen to be conserved across tetrapods.

that are shared by different organisms due to common ancestry. If humans do share a common ancestor with other organisms, then it would follow that human anatomy would be similar. For example, if we compare the bones in the human arm with other living relatives—even distant relatives such as bats, whales, birds, and so forth—we should share the same set of arm bones, and we do (see fig. 1). This homology among arm bones and overall bone structure in our bodies is, according to science, because we share a common ancestor with all other vertebrate animals.[13]

A hypothesis of relatedness would predict that the anatomical similarity of humans and our closest living relatives, the greater apes, should have more in common than those of distant relatives. To test this hypothesis even further, the anatomy of hominid fossils, those that arose after the split between chimps and humans, should share even more anatomical features with modern humans than chimps and the rest of the greater apes. When comparing hominid fossils with humans, there is a clear pattern of shared anatomical similarity between humans and the greater apes, and this pattern sharpens and becomes stronger as we begin to consider the humanoid fossil record. When comparing the anatomy of humans to the humanoid fossil record, anatomical

13. See Kenneth P. Dial, Neil Shubin, and Elizabeth L. Brainerd, eds., *Great Transformations in Vertebrate Evolution* (Chicago: University of Chicago Press, 2015); Axel Meyer and Rafael Zardova, "Recent Advances in the (Molecular) Phylogeny of Vertebrates," *Annual Review of Ecology, Evolution, and Systematics* 34, no. 1 (2003): 311–38; Sen Song and others, "Resolving Conflict in Eutherian Mammal Phylogeny Using Phylogenomics and the Multispecies Coalescent Model," *Proceedings of the National Academy of Sciences* 109, no. 37 (2012): 14942–47.

transitions that have led to modern traits are clearly observable.[14] Shared bone structures between humans and other animals are just one of many shared sets of anatomical features. We also share extensive similarities in our tissues (brain complexity and size, organs, and so forth[15]) and genetics (see below).[16] If each system of the human body is compared with our closest primate relatives and other animals, the most plausible scientific explanation is that each system came about through evolution.

Ontogeny. Using the tools of homology, an exploration of ontogeny follows. Ontogeny is the developmental process that organisms go through, beginning immediately following fertilization and culminating in the adult form. If we compare the development of the human embryo to other animal embryos, we can see the same developmental pathways resulting in the same homologous anatomical structures across distantly related species (see fig. 2). Due to homology, human embryos have a striking similarity to other animals during early development, including a prominent set of gills and a well-formed tail. In fact, the genes that control the formation of the gills in human embryos are the same (homologous) genes that govern the formation of gills in animals. Overall ontogeny of the body plan is fascinating. Ontogeny, or development as we have seen it here, can be extended to

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14. For example, loss of arboreal features, upright posture, and all the associated anatomical shifts that are required in the foot, leg, pelvis, back, shoulders, skull, and so on, as well as brain complexity and development, jaw formation, and so on. See Rui Diogo and Bernard Wood, *Comparative Anatomy and Phylogeny of Primate Muscles and Human Evolution* (New York: CRC Press, 2012); and Robin H. Crompton, Evie E. Vereecke, and Susannah K. S. Thorpe, "Locomotion and Posture from the Common Hominoid Ancestor to Fully Modern Hominins, with Special Reference to the Last Common Panin/Hominin Ancestor," *Journal of Anatomy* 212, no. 4 (2008): 501–43.

15. See Dial, Shubin, and Brainerd, *Great Transformations in Vertebrate Evolution*; Leslie Aiello and Christopher Dean, *An Introduction to Human Evolutionary Anatomy* (Cambridge, Mass.: Academic Press, 2002).

16. See, for example, Jennifer F. Hughes and Steve Rozen, "Genomics and Genetics of Human and Primate Y Chromosomes," *Annual Review of Genomics and Human Genetics* 13 (September 2012): 83–108.

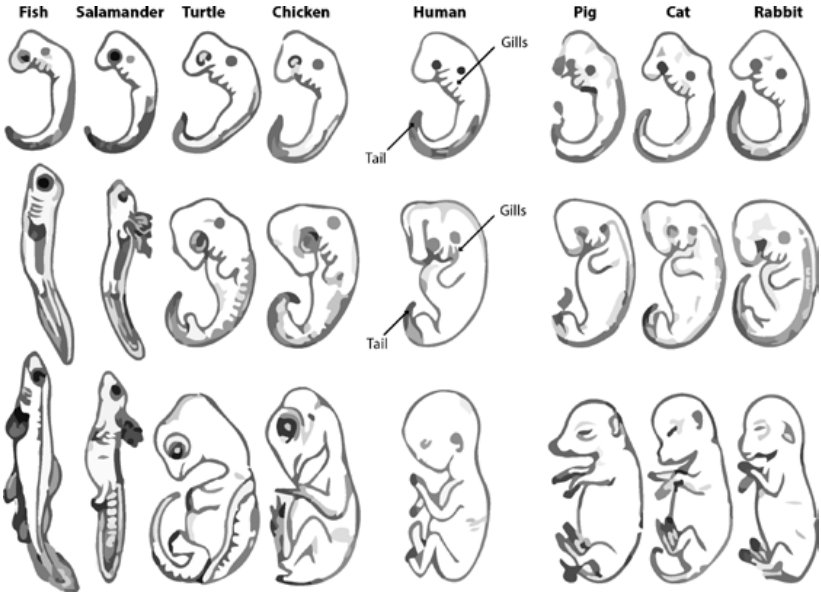

Figure 2. Ontogeny of a fish and other tetrapods. The similar shape and anatomical features of many animal groups are demonstrated. Among many other features, human gills and a tail are pointed out. These features eventually become the human ear (gills) or are reduced and combined into a single structure (tail) at birth.

specific regions of the body, such as the brain.[17] Looking at the similarities in the development of animals and other organisms, the most scientific explanation for the similarities is evolution.

Vestigial Traits. Humans also display vestigial traits. These are traits that had a clear function in an ancestor but are of little to no use now, having been reduced to a rudimentary structure, such as leg and pelvic bones in whales and snakes. There are

17. Philipp Mitteroecker and others, "Comparison of Cranial Ontogenetic Trajectories among Great Apes and Humans," *Journal of Human Evolution* 46, no. 6 (2004): 679–97; Christoph Peter Eduard Zollikofer and Marcia Silvia Ponce De León, "Pandora's Growing Box: Inferring the Evolution and Development of Hominin Brains from Endocasts," *Evolutionary Anthropology: Issues, News, and Reviews* 22, no. 1 (2013): 20–33; Chet C. Sherwood, Francys Subiaul, and Tadeusz W. Zawidzki, "A Natural History of the Human Mind: Tracing Evolutionary Changes in Brain and Cognition," *Journal of Anatomy* 212, no. 4 (2008): 426–54.

many traits in humans that are vestigial. For example, muscles in the human wrist for grasping and in the foot for manipulating objects are extremely reduced and essentially nonfunctional. These muscles are actually lacking in nearly 10 percent of the human population, while present in all the greater apes. Some vestigial traits may still have some function. For instance, the appendix is a rather large organ used in other herbivorous animals to help digest plant matter. The human appendix is by comparison extremely reduced and may be a safe haven for the gut microbiome in case the intestine needs to be repopulated after sickness or due to a change in diet. But this does not negate the fact that the use of the human appendix is still uncertain and certainly rudimentary when compared to the appendixes of other animals.

Consider the human tailbone. During human embryological development, the tail begins as several vertebrae that then fuse into a single bone to form the coccyx. Instead of supporting a tail like in other animals, the coccyx is reduced to a structure where muscles and ligaments attach. That muscles and ligaments attach at the coccyx does not mean that it is not vestigial. The fact remains that the coccyx is not a tail; thus by definition, it is vestigial. Further, although uncommon, humans are sometimes born with tails, demonstrating that the genetics for this once fully functional structure are still present in our DNA. There are other vestigial structures that humans display from the tops of our heads to the bottoms of our feet, even among our genes.[18] The viable scientific explanation that can explain all the vestigial traits that humans display is the theory of evolution.

Molecular Biology. More evidence for human evolution can be found in the genetic material that drives our development and maintains our bodies. All living organisms on earth share the same genetic material: DNA. This DNA is composed of the same

18. Phil Senter and others, "Vestigial Biological Structures: A Classroom-Applicable Test of Creationist Hypotheses," *The American Biology Teacher* 77, no. 2 (February 2015): 99–106.

four bases: A, C, T, and G. The way that human DNA is read and encoded is identical to how it is done in our closest living genetic relatives, the chimps and bonobos. Further, the complete complement of DNA (that is, all genes and chromosomes) found in each of our cells and those of apes are nearly identical in sequence, distribution, and function. The genes in our bodies are not only highly similar and even identical to those in apes and other animals, but the process of expressing those genes (transcription and translation) is as well. The fact that our genes can be nearly identical and have the same function as in other distantly related animals, such as the lowly fruit fly—and even plants!—means that we can conduct clinical trials on animals that are informative to our own biology in a medical context. It is also the reason that diseases derived from other animals can infect our bodies, as demonstrated by COVID-19, which likely had its origins in a relatively distantly related mammalian host.[19]

Extensive international research from multiple independent laboratories has revealed that not only do our genomes share a nearly identical set of the same genes with our closest living relatives, but there is also strong evidence that modern humans once interbred with now-extinct relatives such as *Homo neanderthalensis* and a group called Denisovans.[20] It appears that the success

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19. Yasmeen Junejo and others, "Novel SARS-CoV-2/COVID-19: Origin, Pathogenesis, Genes and Genetic Variations, Immune Responses and Phylogenetic Analysis," *Gene Reports* 20 (2020): 100752; Erwan Sallard and others, "Tracing the Origins of SARS-COV-2 in Coronavirus Phylogenies: A Review," *Environmental Chemistry Letters* 19, no. 2 (2021): 769–85.

20. Matthew Warren, "Mum's a Neanderthal, Dad's a Denisovan: First Discovery of an Ancient-Human Hybrid," *Nature* 560 (2018): 417–18; Sriram Sankararaman and others, "The Genomic Landscape of Neanderthal Ancestry in Present-Day Humans," *Nature* 507 (2014): 354–57; Sriram Sankararaman and others, "The Combined Landscape of Denisovan and Neanderthal Ancestry in Present-Day Humans," *Current Biology* 26, no. 9 (2016): 1241–47; Matthias Meyer and others, "A High-Coverage Genome Sequence from an Archaic Denisovan Individual," *Science* 338, no. 6104 (2012): 222–26; Qiaomei Fu and others, "An Early Modern Human from Romania with a Recent Neanderthal Ancestor," *Nature* 524, no. 7564 (2015): 216–19; Erik Trinkaus and others, "An Early Modern Human

and exceptional adaptability of modern humans is because they interbred with other *Homo* species. For example, most modern-day humans share between 1.5 and 2.5 percent of their DNA with Neanderthals.[21] These genes likely led to lighter-pigmented skin, allowing for better synthesis of vitamin D at higher and lower latitudes where sunlight is less intense (see below), while also providing us with the immune system to cope with the new environments we encountered after our first progenitors left Africa.[22]

In order for species of *Homo* to interbreed (for example, humans with Neanderthals and Denisovans), the chromosome numbers would need to be the same, 46 total or 23 pairs. Our closest living relatives, the great apes, have 24 pairs. But if we are so closely related, how could we differ in chromosome number? A closer look at all 23 copies of our chromosomes reveals some compelling answers to this question. We see there are many inversions, or flipping, of portions of our chromosomes compared to those of apes (for example, chromosomes 4, 5, and 18) and even a fusion of chromosomes (that is, chromosome 2 in humans appears to be a fusion of two ape chromosomes; see figs. 3, 4a, and 4b). Inversions are easily spotted and understood. Essentially, a portion of the chromosome was inverted at some point in the evolutionary history of the organism, in this case, in apes. The inversion did not disrupt the overall genetics of the chromosome, but simply reordered it.

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from the Peştera cu Oase, Romania," *Proceedings of the National Academy of Sciences* 100, no. 20 (2003): 11231–36; Rebecca Rogers Ackermann, Alex Mackay, and Michael L. Arnold, "The Hybrid Origin of 'Modern' Humans," *Evolutionary Biology* 43, no. 1 (March 2016): 1–11.

21. Richard E. Green and others, "A Draft Sequence of the Neandertal Genome," *Science* 328, no. 5979 (2010): 710–22; Kay Prüfer and others, "The Complete Genome Sequence of a Neanderthal from the Altai Mountains," *Nature* 505, no. 7481 (2014): 43–49; Jeffrey D. Wall and others, "Higher Levels of Neanderthal Ancestry in East Asians than in Europeans," *Genetics* 194, no. 1 (May 2013): 199–209.

22. Tim Compton and others, "The Morphology of the Late Pleistocene Hominin Remains from the Site of La Cotte de St Brelade, Jersey (Channel Islands)," *Journal of Human Evolution* 152 (March 2021): 102939.

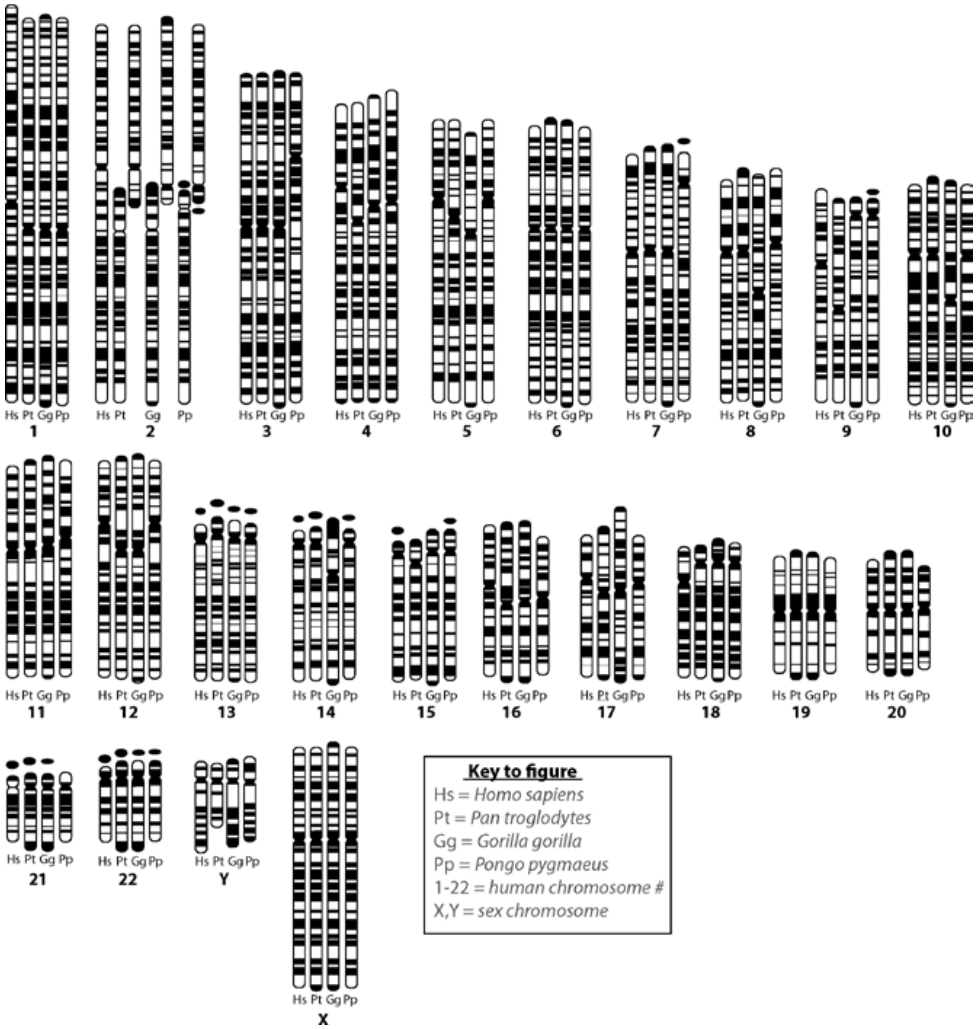

Figure 3. Chromosomal arrangement of the greater apes. Each chromosome is listed, from left to right, as Hs (*Homo sapiens* or Humans), Pt (*Pan troglodytes* or Chimpanzees), Gg (*Gorilla gorilla* or Gorillas), or Pp (*Pongo pygmaeus* or Orangutan). Chromosome number (or letter in the case of the sex chromosomes) is listed under each chromosome and numbered after the human system. This figure is close to the actual human chromosome arrangement and is redrawn after the work of Yunis and Prakash. Jorge J. Yunis, "The Origin of Man: A Chromosomal Pictorial Legacy," *Science* 215, no. 4539 (March 1982): 1525–30.

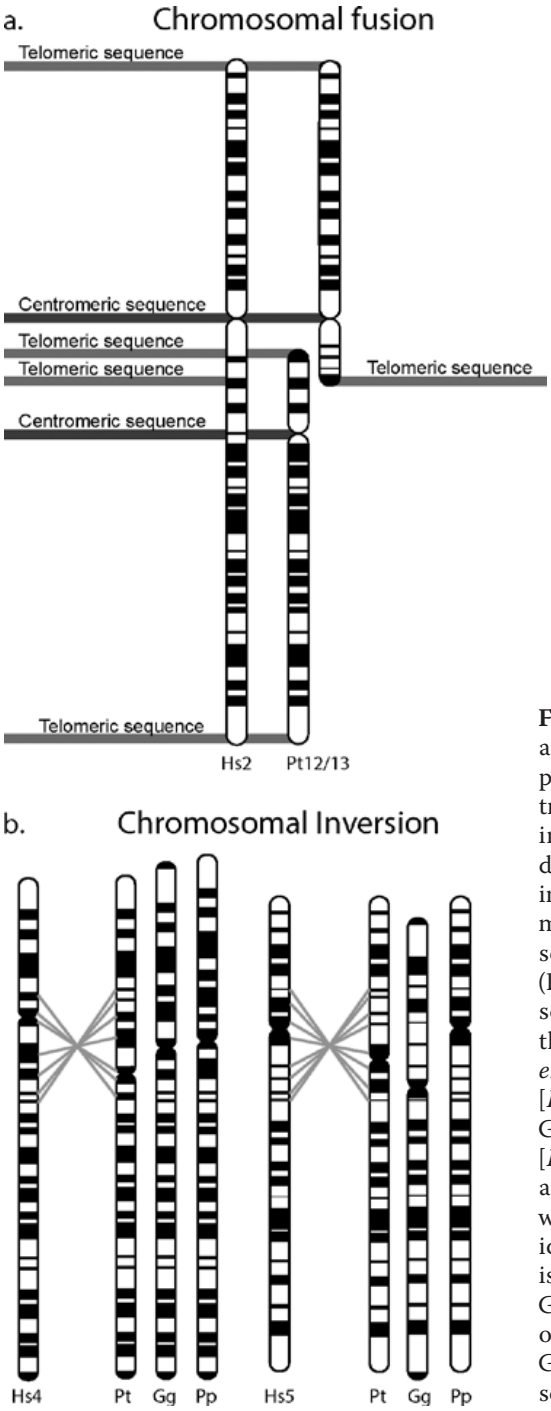

Figure 4. Chromosomal inversions and fusions. Part a demonstrates the presence of both telomeric and centromeric DNA at multiple locations in human Chromosome 2 (Hs2), demonstrating that at some point in hominin evolution human Chromosome 2 arose due to chromosome fusion between Chimpanzee (Pt2/13). Part b shows what chromosomal inversions look like between the greater apes (Hs4 [*Homo sapiens* or human] chromosome 4, Pt [*Pan troglodytes* or Chimpanzee], Gg [*Gorilla gorilla* or Gorilla], or Pp [*Pongo pygmaeus* or Orangutan]), and how genetics can be rearranged without changing the overall genetics of a chromosome. This figure is redrawn from figure 1, in Open Genetics Lectures: Fall 2015, http://opengenetics.net/Files/MRUOpenGeneticsLectures//Ch17-Chromosome_rearrangements.pdf.

The fusion of chromosomes is more fascinating. How can we be sure that human chromosome 2 is actually a fusion of two ape chromosomes? The ends of chromosomes, called telomeres, are composed of short repeat sequences; in humans, the sequence is TTAGG. These telomeric regions are not small, reaching 15,000 total base pairs. So if human chromosome 2 is actually a fusion of two ape chromosomes, then there should be telomeric sequences in the middle of this chromosome. And indeed there are (see fig. 4a). Further, centromeres, the central portion of chromosomes, also have their own unique DNA signatures, and there are also multiple regions of centromeric DNA in the merged human chromosome 2. Thus, it seems that at some point in the evolution of the greater apes, there was a chromosome fusion that is unique to species of the genus *Homo* studied so far.

Molecular data in support of human evolution are abundant and scientifically robust, and scientifically conclusive molecular data are currently being generated on a level never before seen in science. We can expect molecular data to flood not only into scientific databases but also into our lives and to provide vast new areas of research within human evolution at a level of detail never imagined even a decade ago. There are many examples of molecular evolution that we could tackle here to provide additional evidence for human evolution (for example, jumping genes, GULO gene, divergence time estimation from molecular data for the split between chimps and humans, and so on). I invite readers to explore this evidence for themselves, because there simply is not the space here for these topics and many more we could have covered.

Phylogeny. Phylogenetics is the scientific process of reconstructing genealogical trees to understand the evolutionary history between species.[23] These trees, called phylogenies in science, are not the same as the more familiar genealogical trees we are

23. Willi Hennig, "Phylogenetic Systematics," *Annual Review of Entomology* 10, no. 1 (1965): 97–116.

used to seeing in places like FamilySearch. Phylogenies are used to reconstruct the evolutionary relatedness between species and not between individual family members. Additionally, by using phylogenies, organisms are grouped into kingdoms, phyla, classes, orders, families, and genera based on a shared evolutionary history. Phylogenies can be reconstructed using many different types of data, including ecological, behavioral, morphological (anatomical), and genetic data (DNA, RNA, and proteins). Today, the most common data used in phylogenetic reconstruction is genetic data, while in the past, most phylogenies were reconstructed using anatomical data. No matter the data source, the more closely related organisms are, the more similar their genetics or anatomy. This increasing similarity can be seen between fossil hominid species, a group that includes humans (fig. 5), in both anatomy and genetics.

When using either morphological or genetic data, including entire genomes, chimpanzees (along with the lesser-known bonobos) are *always* shown to be our closest living relative.[24] Humans and chimpanzees form a subfamilial group called "Homininae," and humans, along with the rest of the greater apes, form the larger family group "Hominidae." What is also remarkable is that phylogenies derived from both morphological and genetic data that include extinct hominids, such as *Homo neanderthalensis,* also recover humans as closely related to these fossil hominids (see fig. 5).[25]

Another fascinating example of the power of phylogeny is that of parasites and their hosts. Often, the phylogenies of a parasite will follow the same branching patterns as the phylogeny of the host. Phylogenies of human parasites such as lice and pinworms

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24. See, for example, Luca Pozzi and others, "Primate Phylogenetic Relationships and Divergence Dates Inferred from Complete Mitochondrial Genomes," *Molecular Phylogenetics and Evolution* 75 (June 2014): 165–83; Mark Grabowski and William L. Jungers, "Evidence of a Chimpanzee-Sized Ancestor of Humans but a Gibbon-Sized Ancestor of Apes," *Nature Communications* 8, no. 1 (2017): 1–10.

25. See, for example, Grabowski and Jungers, "Evidence of a Chimpanzee-Sized Ancestor of Humans."

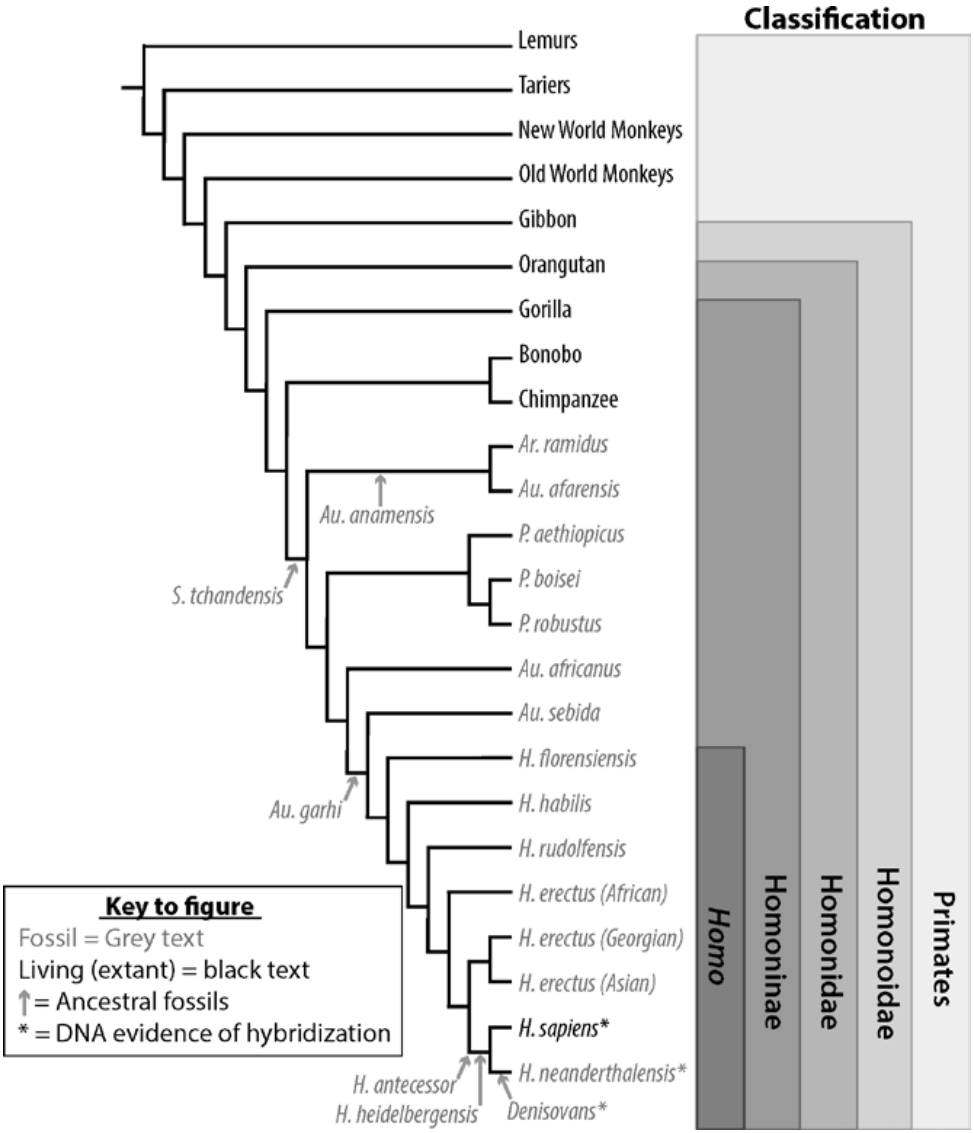

Figure 5. Current hypothesis of primate phylogeny. Some fossil species are missing from this phylogeny (such as *Kenyanthropus platyops*, *Homo naledi,* and *H. sapiens javal*). The phylogeny represents the current phylogeny for all of the major primate groups, including both fossils and living (extant) hominin species. Grey text represents fossils. Black text represents extant species. Arrows show where fossils species that are likely ancestral to the main branch existed. *H.* is *Homo*, *Au.* is *Australopithecus*, *Ar.* is *Ardipithecus* and *P.* is *Paranthropus*. The * represents species where DNA evidence demonstrates hybridization has taken place. On the right of the figure, a classification scheme is presented as a series of bars and can be interpreted as all groups or species being a member of the bar that they overlap.

closely follow the branching patterns of hominids.[26] For example, the branching patterns of lice not only follow similar branching patterns of humans but can also provide compelling insight into when humans first put on clothes and how lice may have speciated on humans as a result.[27] For a scientist, evolutionary biology provides the framework by which all of the above phylogenetic information (and much more not discussed) can be compiled into testable hypotheses and evaluated.

Biogeography. The modern-day distribution of organisms has been determined by the ever-changing geology of our earth and the ability of organisms to disperse. When biological distributions are examined in an evolutionary framework, we call this *biogeography.* There are exceptional examples among both plants and animals that demonstrate how modern-day distributions have been shaped by geological events, such as the breakup of Pangea—a giant continent that existed two hundred million years ago. The biogeography of hominids is not as ancient as the breakup of Pangea, but human biogeography can be studied using tools such as genetics, anthropological evidence, and migration routes.[28] From these studies, it is clear that *Homo sapiens* originated in Africa and migrated out of Africa,[29] where they then interbred with several other hominid species, ultimately becoming the most successful of the hominid species.

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26. Adauto Araujo and others, "Parasites as Probes for Prehistoric Human Migrations?," *Trends in Parasitology* 24, no. 3 (March 2008): 112–15; David L. Reed and others, "Genetic Analysis of Lice Supports Direct Contact between Modern and Archaic Humans," *PLoS Biology* 2, no. 11 (October 2004), https://doi.org/10.1371/journal.pbio.0020340; Elizabeth Pennisi, "Louse DNA Suggests Close Contact between Early Humans," *Science* 306, no. 5694 (October 2004): 210.

27. Ralf Kittler, Manfred Kayser, and Mark Stoneking, "Molecular Evolution of *Pediculus humanus* and the Origin of Clothing," *Current Biology* 13, no. 16 (August 2003): 1414–17.

28. Jennifer C. Stearns and others, "Bacterial Biogeography of the Human Digestive Tract," *Scientific Reports* 1, no. 1 (2011): 1–9; John Edward Terrell, "Human Biogeography: Evidence of Our Place in Nature," *Journal of Biogeography* 33, no. 12 (December 2006): 2088–98; Sarah A. Tishkoff and Kenneth K. Kidd, "Implications of Biogeography of Human Populations for 'Race' and Medicine," *Nature Genetics* 36, no. 11 (November 2004): S21–S27.

29. See, for example, Tishkoff and Kidd, "Implications of Biogeography of Human Populations."

Further, there are biogeographic phenomena, such as island dwarfism, that we see among hominid species, even including humans, and many other animal groups. Island dwarfism holds that large species inhabiting islands with few predators and limited resources will, essentially, shrink. The island of Flores in Indonesia is home to two separate examples of hominid dwarfism, *Homo floresiensis* and *Homo sapiens.* The fossil hominid *Homo floresiensis* (named after the island it inhabited) inhabited Flores until approximately fifty-four thousand years ago, when modern humans arrived. They stood about 3.6 feet tall (1.1 meters) and had all the attributes of ancient *Homo* species.[30] The second example is from pygmies currently living on Flores today. These modern human pygmies have accumulated genes that result in small stature at a much higher rate than those of the most closely related human populations (in New Guinea and East Asia).[31]

Fossils. Fossils provide insight into the evolution of modern species by documenting now-extinct species that are related to modern living ones. Most people are aware of dinosaur fossils and petrified forests that represent long-extinct biodiversity. There are some groups with extensive fossil records so complete that it is easy to imagine and even see the transition to the modern living species (for example, dragonflies). The human fossil record, although not as complete as some, is still exceptional. As of 2024, there have been roughly thirty fossil hominid species found that have existed since the split between chimpanzees and humans. In recent years, there has been a significant uptick in the discovery of hominid fossils.[32] These thirty hominid species have

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30. Peter Brown and others, "A New Small-Bodied Hominin from the Late Pleistocene of Flores, Indonesia," *Nature* 431 (2004): 1055–61, https://doi.org/10.1038/nature02999.

31. Serena Tucci and others, "Evolutionary History and Adaptation of a Human Pygmy Population of Flores Island, Indonesia," *Science* 361, no. 6401 (August 2018): 511–16.

32. See Tim D. White and others, "*Ardipithecus ramidus* and the Paleobiology of Early Hominids," *Science* 326, no. 5949 (October 2009): 75–86; Florent Détroit and others, "A New Species of *Homo* from the Late Pleistocene of the Philippines," *Nature* 568, no. 7751 (2019): 181–86; Lee R. Berger and others, "*Homo naledi,* a New

been established from thousands of individual fossil remains spread across the earth. These fossil species have provided an even deeper insight into our evolutionary origins and the hominid family tree (see fig. 5). Taken together, from them we can see a transition toward current human anatomy and gain insight into our origins. For example, the human chin found among most ancient and all modern *Homo sapiens* is unique among hominids, as is the globular brain sitting above the brow (elongate in other hominoid species). These features are not developed in the same way, even among closely related Neanderthals as they are in humans. However, looking at the hominid fossil record, there are clear transitions in the size, shape, and positioning of both the brain and chin. Additionally, due to well-preserved tissues, we can also explore hominid genetics more deeply by sequencing DNA from closely related ancient species (see above). Fossils have proven key for scientists to better understand the origins of our physical bodies.

Direct Observation (Microevolution). The distinction between micro- and macroevolution was first made in 1909.[33] Generally, microevolution is evolution that happens over a short amount of time and can be "observed" in the loose sense of the word, while macroevolution requires millions of years to generate large evolutionary changes, which are clearly not observable in a human lifetime. Microevolution can result in traits that are undesirable for humans, such as pesticide resistance in insects[34] and antibiotic resistance of pathogenic bacteria in modern medicine.[35] There are also examples of microevolution

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Species of the Genus *Homo* from the Dinaledi Chamber, South Africa," *eLife* 4 (September 10, 2015), https://doi.org/10.7554/eLife.09560.

33. Robert Greenleaf Leavitt, "A Vegetative Mutant, and the Principle of Homoeosis in Plants," *Botanical Gazette* 47, no. 1 (1909): 30–68.

34. Nichola J. Hawkins and others, "The Evolutionary Origins of Pesticide Resistance," *Biological Reviews* 94, no. 1 (February 2019): 135–55; Richard T. Roush and Bruce E. Tabashnik, eds., *Pesticide Resistance in Arthropods* (New York: Chapman and Hall, 1990).

35. Marianne Frieri, Krishan Kumar, and Anthony Boutin, "Antibiotic Resistance," *Journal of Infection and Public Health* 10, no. 4 (July–August 2017): 369–78; Jose M.

occurring through artificial selection, selection that is conducted by humans to bring about desirable traits. Looking at both plants and animals that are associated with the human lifestyle, many of which are associated with agriculture, it is easy to see evolutionary principles at work when humans select for desirable traits.[36] The results of artificial selection, which is really microevolution at work, are seen clearly in dogs, where one species has resulted in hundreds of varieties, all due to human breeding preference for different traits.[37] Evolution by natural selection works exactly the same way, where different traits that are more adaptive are selected for across different environments. Taken over long time scales of billions of years, the result of natural selection is the dazzling diversity we see on Earth today.

Is there evidence that humans are evolving today? In other words, where are the microevolutionary evidences for human evolution? There are some examples of microevolution from human anatomy.[38] However, in recent years, due to advances in genetic sequencing, it has become possible to examine evolution among humans at a microevolutionary scale—that is, within the lifetime of a human. There is current research that has shown how, in populations, the human genome is evolving regarding eye color, complexion, adult milk (lactose) consumption, and nicotine

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Munita and Cesar A. Arias, "Mechanisms of Antibiotic Resistance," *Microbiology Spectrum* 4, no. 2 (2016), https://doi.org/10.1128/microbiolspec.VMBF-0016-2015.

36. Tanya Lewis, "Here's What Fruits and Vegetables Looked Like before We Domesticated Them," Science Alert, September 20, 2018, https://www.sciencealert.com/fruits-vegetables-before-domestication-photos-genetically-modified-food-natural; Stephen I. Wright and others, "The Effects of Artificial Selection on the Maize Genome," *Science* 308, no. 5726 (2005): 1310–14; William G. Hill and Alan Robertson, "The Effect of Linkage on Limits to Artificial Selection," *Genetics Research* 8, no. 3 (1966): 269–94.

37. Vincent Careau, "The Pace of Life under Artificial Selection: Personality, Energy Expenditure, and Longevity Are Correlated in Domestic Dogs," *The American Naturalist* 175, no. 6 (April 2010): 753–58; Guo-dong Wang and others, "The Genomics of Selection in Dogs and the Parallel Evolution between Dogs and Humans," *Nature Communications*, 4, no. 1 (2013): 1–9.

38. Teghan Lucas, Jaliya Kumaratilake, and Maciej Henneberg, "Recently Increased Prevalence of the Human Median Artery of the Forearm: A Microevolutionary Change," *Journal of Anatomy* 237, no. 4 (2020): 623–31.

addiction.[39] Further, if differing genetics of human populations can be considered microevolution, then there is even more evidence for the evolution of humans. For instance, an additional example of human evolution beyond the pygmies of Flores is the light skin color shared between Asians and Europeans. Vitamin D is manufactured by the human body. As our ancestors left Africa, it would have been less advantageous to have darker skin due to the need to make vitamin D in areas of the world with less intense sunlight.[40] The lighter skin tones of Asians and Europeans are coded for by different genetic changes that produce the same result.[41] This is an example not only of evolution among *Homo sapiens* but also of convergent evolution (when similar environmental pressures drive or select for independent evolution of a similar adaptation), another evidence for evolution among human populations.

Anthropological Evidence for Human Evolution

My treatment of anthropology will be even more modest than the previous sections and will be in the form of an exercise. The implications of the exercise are significant to human evolution. To begin, I'll ask the question "What makes humans human?" In other words, what is something unique only to modern humans? Answers to this question might include art, large brains, clothing, diet, fire, language, religion, societal structure, tools, and upright walking.[42]

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39. See, for example, Frank Jakobus Rühli and Maciej Henneberg, "New Perspectives on Evolutionary Medicine: The Relevance of Microevolution for Human Health and Disease," *BMC Medicine* 11, no. 1 (2013): 1–7; Jay T. Stock, "Are Humans Still Evolving? Technological Advances and Unique Biological Characteristics Allow Us to Adapt to Environmental Stress: Has This Stopped Genetic Evolution?," *EMBO Reports* 9, no. S1 (2008): S51–S54.

40. Alan W. C. Yuen and Nina G. Jablonski, "Vitamin D: In the Evolution of Human Skin Colour," *Medical Hypotheses* 74, no. 1 (September 2009): 39–44.

41. Melissa Edwards and others, "Association of the *OCA2* Polymorphism His615Arg with Melanin Content in East Asian Populations: Further Evidence of Convergent Evolution of Skin Pigmentation." *PLoS Genetics* 6, no. 3 (March 2010), https://doi.org/10.1371/journal.pgen.1000867.

42. See Sally Mcbrearty and Alison S. Brooks, "The Revolution That Wasn't: A New Interpretation of the Origin of Modern Human Behavior," *Journal of Human Evolution* 39 no. 5 (2000): 453–563; D. L. Hoffmann and others, "U-Th Dating of

When looking at rigorously established anthropological data, there is evidence that all of these traits—every single one—may have originated before the evolution of modern humans. Perhaps we could think of attributes that are uniquely human, such as empathy, cooperation, and the ability to reason.[43] However, these all appear to have been common traits among our close relatives as well.[44] So then are we animals in every sense?[45]

How could a spirit with godlike potential exist in harmony with a body forged by an evolutionary process? In other words, what are the necessary attributes needed to house a spirit of one of God's children? I believe that all the attributes listed above (and others), particularly those attributes that foster spirituality and enable us to become godlike, were a necessary part of God's

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Carbonate Crusts Reveals Neandertal Origin of Iberian Cave Art," *Science* 359, no. 6378 (2018): 912–15; Bruce Hardy and others, "Direct Evidence of Neanderthal Fibre Technology and Its Cognitive and Behavioral Implications," *Scientific Reports* 10, no. 1 (April 2020): 1–9; Cara Ocobock, Sarah Lacy, and Alexandra Niclou, "Between a Rock and a Cold Place: Neanderthal Biocultural Cold Adaptations," *Evolutionary Anthropology: Issues, News, and Reviews* 30, no. 4 (July–August 2021): 262–79; Sarah Hlubik and others, "Hominin Fire Use in the Okote Member at Koobi Fora, Kenya: New Evidence for the Old Debate," *Journal of Human Evolution* 133 (2019): 214–29; Jordi Rosell and Ruth Blasco, "The Early Use of Fire among Neanderthals from a Zooarchaeological Perspective," *Quaternary Science Reviews* 217 (August 2019): 268–83; S. Semaw and others, "2.5-Million-Year-Old Stone Tools from Gona, Ethiopia," *Nature* 385, no. 6614 (1997): 333–36; Sonia Harmand and others, "3.3-Million-Year-Old Stone Tools from Lomekwi 3, West Turkana, Kenya," *Nature* 521, no. 7552 (2015): 310–15; Hansjörg Hemminger, *Evolutionary Processes in the Natural History of Religion: Body, Brain, Belief* (Switzerland: Springer Nature, 2021); Emiliano Bruner and others, "Functional Craniology and Brain Evolution: From Paleontology to Biomedicine," *Frontiers in Neuroanatomy* 8 (2014): 19.

43. Cathal O'Madagain and Michael Tomasello, "Shared Intentionality, Reason-Giving and the Evolution of Human Culture," *Philosophical Transactions of the Royal Society B* 377, no. 1843 (2022): 20200320; Michael Tomasello, *Becoming Human: A Theory of Ontogeny* (Cambridge, Mass.: Harvard University Press, 2019); C. Owen Lovejoy and Melanie A. McCollum, "Spinopelvic Pathways to Bipedality: Why No Hominids Ever Relied on a Bent-Hip–Bent-Knee Gait," *Philosophical Transactions of the Royal Society B* 365, no. 1556 (2010): 3289–99.

44. See "Human Characteristics: What Does It Mean to Be Human?," Smithsonian National Museum of Natural History, accessed September 30, 2021, https://humanorigins.si.edu/human-characteristics/.

45. See Cecelia Heyes, *Cognitive Gadgets: The Cultural Evolution of Thinking* (Cambridge, Mass.: Belknap Press, 2018).

creative process. With these attributes as part of our physical bodies, he facilitates our ability to become like him (see Moses 2:27). Therefore, the evolution of these attributes would predate Adam and be seen among other creations. My personal opinion is that the one unique feature that makes us human is our divine spirit. That spirit was created in the premortal creation and placed in a body derived from the physical creation. The combination of those two creations—divine events carried out by God himself (see Gen. 2:7 and Moses 2:27)—resulted in an opportunity for us all to master the natural man (see Mosiah 3:19) and overcome our deeply rooted evolutionary origins. Thus, the ultimate test of this life is to overcome undesirable biological attributes (that is, the natural man)—that have been actually encoded in our physical bodies by natural selection over billions of years of evolution—*in a single human lifetime*. Each one of us carries within us the desire to live and reproduce; these are among the strongest of human desires.[46] Without a spiritual connection to our Heavenly Father, these attributes would rule our lives. Spiritual direction from the restored gospel provides us with the necessary steps, built on covenants and sacrifice, to overcome our evolutionary past. Mercifully, God has encoded desirable biological attributes during our evolution as well. Additionally, he has provided modern medicine that has extended our lifetimes and provided most of us a few more years to take on the test of mortal life and hopefully succeed.

Conclusion

The very simple evidence I have provided above shows why there is strong consensus among biological scientists that humans, our species, evolved. I hope this summary of evidence for human evolution helps readers who want to reconcile the process of human origins and faith in a purposeful, divine creation. Of

46. See Gordon B. Hinckley, "Reverence and Morality," *Ensign* 17, no. 5 (May 1987): 45–48.

note, the evidence provided above, and science in general, does not and cannot comment directly on the existence of God, the actual existence of Adam and Eve, our place before God, or how we personally view the Creation. It can only provide evidence from the agnostic vantage point of the scientific method. President David O. McKay understood the complexity of reconciling human evolution and faith when he said, "Evolution's beautiful theory of the creation of the world offers many perplexing problems to the inquiring mind."[47] Regardless of how we approach the theory of evolution, and human evolution as a part of that theory, it does not need to be in a spirit of fear or anxiety. Fear does not come from the Lord. Anxiety causes good people to think irrational thoughts. If we use another source of knowledge, personal revelation, then there is no need to fear. We can draw on personal revelation throughout our life to calm our anxieties until the full light and knowledge of the gospel, including the exact origins of mankind, are shown to us in great detail. We can also wait for revelation (see D&C 101:32–34) to either rule out or enhance the theory of evolution or to demonstrate how to reconcile it completely with revealed truth. Until that time when all truth is shown as one whole, we are left to push forward with the scientific knowledge we can gain, never fearing, never wavering in our love and trust in God.

Seth M. Bybee is a professor at Brigham Young University in the Department of Biology. He is an evolutionary biologist and specializes in the evolution of insects, particularly dragonflies and beetles. He is intrigued by the evolution of color visual systems and color signals and how the these may have driven both molecular and species diversity. He teaches introductory biology (for nonmajors), entomology, and evolutionary biology. He is married to a wonderful woman and is the most biologically fit biologist you will ever meet . . . he has seven kids.

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47. McKay, "Message for LDS College Youth."

Thoughts on Reconciliation

Should Evolution Be Taught at BYU?

A Certain "Yes" from an Uncertain Defender

James P. Porter

As past dean of the College of Life Sciences, I had the responsibility to answer letters or emails that came to me asking why we teach evolution at Brigham Young University. Some of the inquiries came to me directly. Others were forwarded to me by then university president Kevin J Worthen. Some of those were forwarded to President Worthen from leaders of The Church of Jesus Christ of Latter-day Saints in Salt Lake City. These inquiries came from concerned members of the Church, parents of BYU students, and at least one seminary teacher. Interestingly, I never received any letters from current or former students.

Regardless of what specific objections about evolution were raised in these letters, I decided not to respond with an item-by-item argument or detailed reply. Rather, I chose to provide a justification for why our students need to learn about evolution (which I fully support), accompanied with assurances that our professors believe that God is the Creator of life and teach this subject in the light of the Spirit. My reply typically included the following justification: "We believe it is important for our students to understand the scientific argument for natural selection as the mechanism for the diversity of life on earth throughout its history. Students should be exposed to the original experiments that led to this thinking and to ongoing work that continues to

test this idea. If their career choice is in a biology-related field, they will continue to be exposed to evolutionary thought and will need to have the understanding and skills to critically analyze and weigh new data as it arises."

As a scientist, I can see the plausibility of evolution; however, I am not completely comfortable with the idea that all life on earth evolved from a common ancestor. My faith tells me that God is the Creator, and this is more deeply embedded in me than my intellectual sense that natural selection is the mechanism for that creation. However, I recognize that some are more comfortable than I am with the role of evolution in God's creation. I do not believe that it is the teaching of evolution that causes students to lose their faith. I believe it is the requiring them to choose between faith and science that can lead to a crisis. We need to give them space and encouragement to grapple with these questions "by study and also by faith" and teach them to accept God's timetable in finding their answers (D&C 109:7).

I began my personal journey to recognize the possible role of evolution in life's origins when, following my mission, I switched my major at BYU from electrical engineering to zoology, with the idea of pursuing medicine as a career. I am sure I learned about evolution in high school biology, but I do not remember it being a big deal for me at the time. My first college-level course in biology was Zoology 201, Introduction to Biology. We used *Biological Science* by William Keeton as our textbook.[1] I think this is where my curiosity and interest in, and questions about, evolution began. My zoology program also required me to take courses in vertebrate and invertebrate zoology and genetics, where I am sure evolutionary principles were also taught. Because of my interest in preparing for medical school, I chose electives such as histology and developmental biology over courses like

1. William T. Keeton, *Biological Science,* 2nd ed. (New York City: W. W. Norton, 1972).

comparative evolutionary theory, so I never had an in-depth course on evolution. By the time I was in my PhD program at the University of California, San Francisco, exploring possible conflicts between evolution and religion had become a personal hobby. This was fueled by the controversy in Arkansas over the lawsuit brought by the American Civil Liberties Union against the Arkansas Board of Education because of their "Balanced Treatment for Creation-Science and Evolution-Science Act." *Science* magazine was following this story closely and published multiple articles about it in late 1981 and early 1982. Ultimately, Judge William R. Overton enjoined the Arkansas Board of Education from implementing the act.[2]

My personal exploration involved a more in-depth study of both the science of evolution (including the idea of uniformity, the fossil record, the age of the earth, radioactive dating, gradual versus punctuated evolution, and so on) and the writings of Church members and leaders.[3] Reading *Man: His Origin and Destiny* and *Doctrines of Salvation*[4] was especially difficult for me because Joseph Fielding Smith, who authored these two books, was the prophet who called me to serve as a missionary, and I had great love and respect for him. He wrote, "I say most emphatically, you cannot believe in this theory of the origin of man, and at the same time accept the plan of salvation as set forth by the Lord our God. You must choose the one and reject the other, for they are

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2. "Creationism Goes on Trial in Arkansas," *Science* 214, no. 4525 (December 4, 1981): 1101–04; "Creationism on the Defensive in Arkansas," *Science* 215, no. 4528 (January 1, 1982): 33–34; "Creationism in Schools: The Decision in McLean versus the Arkansas Board of Education," *Science* 215, no. 4535 (February 19, 1982): 934–43.

3. See, for example, Frank B. Salisbury, *The Creation* (Salt Lake City: Deseret Book, 1976); James E. Talmage, "The Earth and Man," public address, the Tabernacle, Salt Lake City, August 9, 1931; and Ernest Eberhard Jr., *The Origin: A Mormon's View on Evolution* (self-pub., 1981).

4. Joseph Fielding Smith, *Man: His Origin and Destiny* (Salt Lake City: Deseret Book, 1954); Joseph Fielding Smith, *Doctrines of Salvation: Sermons and Writings of Joseph Fielding Smith,* 3 vols., ed. Bruce R. McConkie (Salt Lake City: Bookcraft, 1954).

in direct conflict and there is a gulf separating them which is so great that it cannot be bridged, no matter how much one may try to do so."[5] That statement pains me today because it forced the choosing between faith and science that I believe is not necessary. Nevertheless, at the time I was originally exposed to these writings, my acceptance of evolution was definitely diminished. All of this exploration culminated in a personal spiritual experience through which I felt prompted to set aside my concerns and patiently wait for further light and knowledge.

Since those early days, I remained in academia rather than going to medical school, choosing to teach and research in the area of physiology (which addresses the relationships between body form and function). Did my uncertainty about evolution lead me to choose a field where I could focus on how things work and avoid questions about how those things came to be? Have I minimized discussion about the evolution of form and function in my classes because of my personal uncertainty with this? I think the answer to both of these questions is *yes.*

My personal decision to avoid the topic of evolution was thrown into disarray when I was assigned to teach PDBio 120, The Science of Biology, in 2008. This introductory biology course has six main units, the sixth being "Life Evolves." I taught this course for seven years. How could I teach the principles of evolution if I still was uncertain about some of them? I always began the evolution topic by exploring what the Church has to say about evolution, using the BYU packet *Evolution and the Origin of Man,* which was approved for use by the BYU Board of Trustees in 1992.[6] I also made the point that scientific inquiry is based solely on physical evidence and does not test things of the Spirit and also that all hypotheses and theories are incomplete but

5. Smith, *Doctrines of Salvation,* 1:141–42.

6. "Evolution and the Origin of Man," Brigham Young University, 1992, https://biology.byu.edu/00000172-29e6-d079-ab7e-69efe5890000/byu-evolution-packet.

should not be rejected on this basis; rather, they should be used to the fullest extent possible. I shared with my students an adage I learned when in graduate school: "The absence of evidence is not evidence of absence." I would make the point that active, temple-recommend-holding members of the Church have different levels of acceptance of evolution (from zero to total). Then I would teach the fundamental principles of evolutionary science.

I stopped teaching PDBio 120 when I became dean in 2015. As dean, my role transitioned to the defender of teaching evolution. I never held the view that my response to letters critical of teaching evolution at BYU would change anyone's mind. At the minimum, I hoped the response helped the writer understand that there is no better place than BYU for the teaching of evolution because our professors can, and do, bathe this subject "in the light and color of the restored gospel" and keep it "perfumed lightly with the spirit of the gospel."[7]

One additional role I took on as dean was to help our students deal with uncertainty. My convocation talks at graduation time focused on this topic. I wanted to help our students understand that there is uncertainty in both faith and science. It is okay not to know everything about either. The root word for faith is *fides*, which means "to trust." When we have faith, we learn to trust in our spiritual promptings. Alma taught that faith was "not to have a perfect knowledge" and gave a formula (experimenting on the word) for gradually growing our spiritual knowledge (Alma 32:21, 27). There is also plenty of uncertainty in science. I usually cite our use of statistical tests and our willingness to live with the fact that the standard practice is to allow for a five percent chance that we are wrong when we reject a null hypothesis.

I hope our students understand that even if we do not know everything about faith and science, we can still know many things.

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7. Spencer W. Kimball, "Education for Eternity," devotional address, Brigham Young University, September 12, 1967, https://speeches.byu.edu/talks/spencer-w-kimball/education-eternity/.

I am trying to convince them to be patient (like me) and wait for their questions to resolve. It would be premature to abandon faith or science based on incomplete understanding. The Doctrine and Covenants promises us that when Christ returns, he will tell us all things about how the earth was created (D&C 101:32–33). My personal uncertainties about evolution have diminished over the years, but some may remain until that day.

James P. Porter graduated from BYU with BS and MS degrees in zoology, in 1974 and 1976, respectively. He received his PhD in endocrinology from the University of California, San Francisco, in 1982. He did a three-year postdoctoral fellowship at the University of Iowa before his first faculty position in the Department of Physiology and Biophysics at the University of Louisville School of Medicine in Kentucky. He joined the faculty of the Department of Zoology at BYU in 1998. He was the dean of the College of Life Sciences from 2015 to 2022. He retired from BYU July 1, 2023.

Evolutionary Biology as a Discipline at Brigham Young University

An Academic Success Story

Michael F. Whiting

I was born to be an evolutionary biologist. My mother reports that when she was in labor with me in a small provincial hospital in Brazil, she was aghast at the large beetles scuttling up and down the walls. Hence my first interaction with insects was apparently *in utero* and somewhat traumatic, but my fondness for bugs has never faded. One of my earliest memories involves me as a kindergartener sneaking into the school library to borrow a picture book of insects cryptically camouflaged on the trunks of trees. I was not allowed to check that book out because it was a big picture book, and I was just a little boy. But I swiped it anyway, and the delight I got from fingering through every page more than compensated for the tongue-lashing I received from the librarian when I finally returned the book. When I was fourteen, I jumped at the opportunity to volunteer at the Bean Life Science Museum on Brigham Young University campus to help assemble an insect zoo. The zoo was a failure (most insects are hard to keep alive), but it got me involved with their extensive insect collection. Later, I enrolled at BYU as a zoology major and continued to work in the insect collection. As I took my coursework in the mid-1980s, I recall how difficult it was as a student to navigate the discord that existed among some religion faculty and biology faculty over the subject of evolution. I remember going to a religion course

and receiving a long list of quotes that presented evolution as a threat to faith and testimony. But I would go to my evolution class and be thrilled at what I was learning about biology and how it all just made sense, especially with what I was learning about insect diversity. I will never forget the tension that existed over a subject that many had found no way to reconcile.

After graduation in 1990, I left for a doctoral program in entomology at Cornell University and then completed a postdoctoral fellowship at the American Museum of Natural History in New York City. In 1997, I returned to BYU and joined the Department of Zoology as an assistant professor. The first course I was assigned to teach was our senior-level course in evolutionary biology, which I team-taught with the venerated professor of evolutionary biology, Dr. Duane E. Jeffrey. For the past twenty-five years, I have taught undergraduate and graduate courses in evolutionary biology and have had the privilege to be part of the remarkable growth of the evolutionary biology program at BYU.

When new neighbors or ward members find out that I teach evolution at BYU, they often remark, "I didn't know BYU taught evolution." Others have ascribed our teaching of evolution to it being simply a requirement for accreditation so that our students will perform well on standardized exams. To many, this is seen as just another way in which BYU is "in the world but not of the world." Some think that biology faculty are only teaching evolution tongue-in-cheek or that we secretly do not really believe the subject matter, or if we do, it must be because we have some fundamental problem with faith. But Duane Jeffrey recounts that in the early 1970s, when the Board of Trustees first granted permission to begin teaching a formal course in evolutionary biology, the permission came with a charge: we are to teach the very best, most rigorous course in evolutionary biology but to do so in the light of the gospel.[1] We have done our best to follow this instruction.[2]

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1. Personal communication.

2. See Michael F. Whiting, "Evolution and the Gospel: Seeking Grandeur in This View of Life," in *Converging Paths to Truth: The Summerhays Lectures on*

BYU now has a nationally recognized program in evolutionary biology that has all the hallmarks of scholarly excellence. We train and mentor undergraduate students in our labs and in the field. We recruit graduate students from across the country, both within the LDS faith and without, who are anxious to join our program. Postdoctoral researchers from across the globe participate in what we have established. We have been extremely successful at obtaining competitive funding from the National Science Foundation (NSF) and other funding agencies. We have been very prolific at publishing our work in the top journals in the field. All of these accomplishments are well-known within the evolutionary biology community where BYU has an established presence, but they are less well-known at our own university. In fact, you would be hard-pressed to find another research group at BYU that has had the same level of consistent, scholarly productivity over the past twenty-five years as BYU evolutionary biologists. The purpose of this paper is to argue that not only do we teach evolution at BYU, but that we do an excellent job of teaching evolution, that our students perform very well, that we have developed a research program that is on par with the best programs in evolutionary biology across the country, and that we do this in a way that helps our students reconcile evolution with their faith in the gospel of Jesus Christ.

A Brief History of Evolutionary Instruction at BYU

For well over a century, evolution in some form has been taught at BYU. In 1907, BYU President George H. Brimhall hired BYU's first PhD (Joseph Peterson) to oversee the psychology department and Peterson's younger brother (Henry) to supervise the College of Education. The following year, Brimhall hired Ralph Chamberlin, who was serving as the University of Utah's Biology Department chair, and two years later he hired Chamberlin's

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Science and Religion, ed. Michael D. Rhodes and J. Ward Moody (Salt Lake City: Deseret Book, 2011).

brother William, who taught classes in psychology, philosophy, and languages. These four men had formal training in the sciences and a heartfelt desire to help BYU students understand the basics of evolution and how one might reconcile these ideas with faith. To coincide with the centennial celebration of the birth of Charles Darwin and the fiftieth anniversary of the publication of *On the Origin of Species* in 1909, the Church released its first formal statement on evolution. *The Origin of Man* statement is long and has clear anti-evolutionary (and anti-science) statements in it, which reflect the general sentiment of the leadership of BYU and the Board of Trustees at the time. In a 1910 Christmas message, the First Presidency released a short statement in which they stated: "Our religion is not hostile to real science."[3] After a series of conversations and ultimatums, in 1911 the Chamberlin and Peterson brothers were dismissed by the university for refusing to back down from teaching basic evolutionary principles to BYU students.[4]

In the 1920s, the subject of evolution was thrust into the public eye because of the Scopes Trial. In many ways, this was the culmination of the fight between those arguing that it was time to embrace science as a way of knowing and those desiring to get back to old-fashioned religion by rejecting these modern ideas. In 1925, the Church released a third statement on evolution, which quoted entirely from the 1909 statement but included only paragraphs 3, 7, 8, 14, 18, and 19. The paragraphs that were omitted include those with the most anti-evolution or anti-science sentiments. It was also during this decade that a dispute broke out over evolution at the General Authority level of the Church,

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3. Originally, Joseph F. Smith, Anthon H. Lund, and John Henry Smith, "Words in Season from the First Presidency," *Deseret Evening News,* December 17, 1910, 3. This is excerpted in the official BYU evolution packet, "Evolution and the Origin of Man," Brigham Young University, published June 1992, https://biology.byu.edu/00000172-29e6-d079-ab7e-69efe5890000/byu-evolution-packet.

4. Gary J. Bergera, "The 1911 Evolution Controversy at Brigham Young University," in *The Search for Harmony* (Salt Lake City: Signature Books, 1993), 23–41.

with Joseph Fielding Smith, B. H. Roberts, and James E. Talmage playing major roles. This was a fascinating period in Church history, but the dispute was never really resolved and only led to more discomfort and confusion over the idea of evolution within LDS theology.

In the 1920s, there was no formal class in evolution taught at BYU, but there were BYU biologists who pursued research that was underpinned by evolutionary theory. Vasco M. Tanner, a beetle specialist who received a PhD from Stanford in 1925, was the chair of the Department of Zoology and Entomology at BYU for thirty-three years, from 1925 to 1958.[5] He taught many zoology courses, mentored more than forty graduate students, and sent students off to highly rated PhD programs. Given his formal training in taxonomy and his extensive publication list, it is clear that Tanner understood the basics of evolution and likely provided students with a basic understanding of evolution in his courses.[6] Later in his career, Tanner authored a *BYU Studies* paper explaining the contributions of Charles Darwin to mark the centennial celebration of *On the Origin of Species.*[7] Other faculty also taught evolution, including George Hanson in geology and Howard Stutz in botany in the 1950s.

In 1969, Duane Jeffrey, a recently trained geneticist, was recruited by BYU to join the Department of Zoology and provide some much-needed help with the genetics courses. Jeffrey recognized that BYU biology students had developed a bad reputation at other universities because they lacked knowledge of evolution, and he came to BYU with the understanding that he would be allowed to help fill this gap. Jeffrey compiled the curricula and

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5. Hugh B. Leech, "Vasco M. Tanner—a Lifetime with Beetles," *Great Basin Naturalist* 30, no. 4 (1970): 213–15.

6. See C. Lynn Hayward, "Vasco M. Tanner," *Great Basin Naturalist* 30, no. 4 (1970): 181–89.

7. Vasco M. Tanner, "Charles Darwin after One Hundred Years," *BYU Studies* 1, no. 5 (1959): 43–53, https://byustudies.byu.edu/article/charles-darwin-after-one-hundred-years.

assembled a proposal that went through various committees and was eventually approved by the Board of Trustees. When the board approved the course, it came with the previously mentioned charge to teach as scientifically rigorous and accurate a course in evolution as could be had at the best universities in the country but to teach it in the light of the gospel. Together with Clayton White, an ornithologist in the Department of Zoology, Jeffrey began teaching a formal course in evolution that specifically targeted senior undergraduate students.

From that day until now, BYU has always offered at least one formal course in evolutionary biology at the undergraduate level and multiple courses for graduate students. Recently, the Department of Biology expanded its undergraduate offerings to include a 200-level course (evolutionary medicine) in addition to a 400-level evolution course in order to meet students' demands for more courses in evolution.

One of the most oft-repeated statements on the influence of evolution was made by Theodosius Dobzhansky, one of the founders of modern evolutionary biology: "Nothing in Biology makes sense except for in the light of evolution."[8] Since evolution is the foundational principle in biology, any faculty member working with living organisms is in some degree involved with evolution. From this perspective, there are at least one hundred faculty at BYU spanning many departments (both within and without the College of Life Sciences) who are pursuing their specialties using evolutionary biology as a foundation for their research. As an example, the tools that evolution provided us for dealing with the devastating SARS-CoV-2 (COVID-19) pandemic demonstrated the importance and effectiveness of evolutionary biology in dealing with real-world problems.

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8. Theodosius Dobzhansky, "Nothing in Biology Makes Sense Except in the Light of Evolution," *American Biology Teacher* 35, no. 3 (March 1973): 125–29.

In 1997, when I joined BYU as a faculty member, the majority of faculty who were pursuing questions in evolution were housed in the Department of Zoology. There were a few other faculty scattered among other departments (botany, microbiology, geology) who studied evolution, but the concentration was found in zoology. Further, zoology faculty were largely responsible for teaching the upper-division courses in evolution. In the early 2000s, our college went through a reorganization that brought together in the same department faculty focused on similar evolutionary questions, without regard to the underlying organisms they specialized in, and we became the Department of Integrative Biology. A few years later, "Integrative" was dropped from the title, and we became the Department of Biology. The number of faculty in this ever-evolving department has fluctuated over time (around twenty-five faculty), with roughly one-third of the faculty who have developed a strong research program focused on evolution.

Evidence for Scholarly Excellence in Evolution over Twenty-four Years (1997–2020)

The following is a tally of scholarly accomplishments BYU made in the past quarter century (from the time I started in 1997 to the year 2020) as we developed a first-class program in evolutionary biology. Over the course of those years, the Department of Biology had roughly eight full-time equivalent slots for faculty who specialized in some subdiscipline of evolutionary biology. The data below are based on the productivity of these eight faculty members, but these numbers are *underestimates* of productivity, since additional faculty who have programs in evolutionary biology, both within and without the Department of Biology, were not counted in these totals.

1. Number of undergraduates who were taught evolution.

Every student who takes a 100-level biology class at BYU is taught basic evolutionary concepts, though the emphasis and the

curricula tend to differ from professor to professor. This is similar to what happens at most universities, and students get some exposure to evolution but not in-depth study. From 1997-2020, we increased the evolution content in this introductory course so that students walked away with a more solid introduction to evolutionary biology.

We also created a capstone, 400-level course in evolutionary biology that many of our senior undergraduates were required to take before they graduated. The purpose of this more advanced course was to take our students who have had prior courses in organismal diversity, ecology, morphology, and genetics and tie all these concepts together through the perspective of evolution. In addition, between 2010 and 2020 we developed a series of labs that allowed students to get hands-on experience in evolution. Students were required to learn how to best respond to both theologically based and scientifically based criticisms of evolution. They learned how to design an exhibit teaching evolutionary principles at a natural history museum. We engaged in activities to learn about the properties of natural and sexual selection. Students received a primer in phylogenetic reconstruction (the theory and methodology of recovering historical evolutionary relationships) by creating phylogenetic trees based on morphological features and DNA sequences from a variety of species. They learned principles of population genetics and debated species concepts. All of this culminated in a series of lab activities where they were engaged in studies of primate and hominin (early human) evolution. Students learned primate morphology in great detail, and they got to study casts of skeletons and skulls from more than a dozen hominin species. Between 1997 and 2020, we had 7,553 undergraduate students complete this intense training in evolutionary biology (table 1). Student feedback consistently indicated that this was one of the most popular and meaningful classes that many students take while at BYU. We plan to continue these efforts in decades to come and we expect outcomes to be similarly positive.

Table 1. Some Measures of Scholarly Productivity between 1997 and 2020

Area	Number
Students enrolled in 400-level evolution class	7,553
Undergraduates mentored in lab/field	1,040
Master of science degrees awarded	43
Doctoral degrees awarded	54
Postdoctoral researchers mentored	53
Faculty and student publications	934

2. Undergraduate comprehension of evolutionary concepts.

When our seniors graduate, they take a standardized Educational Testing Services (ETS) Major Field Test in Biology. This exam is designed to gauge proficiency in different subareas of biology. One section of the exam (subscore 4) measures competency in evolution, ecology, and population biology, which are all closely interrelated disciplines. I have compiled data from 2000 to 2020, and there are some trends that emerge: (1) The BYU student average is always higher than the average calculated across all universities by about one standard deviation (for years when the standard deviations were reported). (2) About 92 percent of BYU students score higher than the national average in any given year. (3) These numbers are consistent from year to year. These data suggest that our BYU students have a better grasp of evolution than most students from other universities. So not only do we teach evolution at BYU, but we do a better job of teaching it than programs at most universities in the country.

3. Outstanding undergraduate mentored research opportunities in evolution

Over a span of more than two decades, eight faculty members specifically mentored 1,040 undergraduates in evolution-based projects in our labs, in the field, or at the Life Science Museum at BYU. Students collected and identified specimens, did

observational work in the field, sequenced DNA, performed modern evolutionary analyses, presented research papers at national meetings, and published as coauthors in peer-reviewed publications. BYU has in fact gained the reputation of being one of the top schools to produce students for graduate programs in evolution, and every year we are queried by our colleagues who wish to recruit from the fresh crop of BYU graduates. There are now many BYU graduates who are at various stages of graduate programs in evolutionary biology across the country.

4. Scholarship to support undergraduate research in evolutionary biology

In 2016, BYU received a generous endowment to establish the Robert M. Squires Scholarship in Evolutionary Biology to honor the memory of Robert M. Squires, a donor who had a keen interest in all aspects of nature and evolution. The intent of this scholarship is to encourage and support undergraduate education and research in evolution and to help excellent students pursue a path toward a career in evolutionary biology. This scholarship provides $2,000 to two students every year, and as of 2020, we had a dozen undergraduates who received this scholarship, most of whom had gone on to graduate school in some field of evolutionary biology.

5. Solid graduate program in evolutionary biology

Between 1997 and 2020, we awarded forty-three MS degrees and fifty-four PhD degrees to our students, each of whom had some aspect of evolution as the focus of their thesis or dissertation. Our graduate students publish, present at meetings, and win competitive awards for their work, and as a group are very successful. Our graduates go on to receive postdoctoral fellowships, and faculty positions at other universities or museums throughout the country.

6. Postdoctoral researchers

Given our success at obtaining external grant money (see below), we were able to sponsor fifty-three postdoctoral research fellows between 1997 and 2020. We also sponsored sabbatical visitors, Fulbright scholars, and so forth. The ability to sponsor postdocs is directly related to the external funding success of a program, since BYU provides no funding specifically for postdocs.

7. Publications

Between 1997 and 2020, faculty in the eight slots that focused on research in evolution published 934 papers in peer-reviewed scientific journals. This number does not include book chapters, technical reports, or other such products. As a group, we published on average 4.7 publications per faculty member per year, and some of our faculty were extremely prolific publishers. We published in a large number of journals, from the top journals in the field (*Nature, Science*, *Proceedings of the National Academy of Sciences*) to smaller, more specialized journals, and roughly one half of these publications included a BYU undergraduate or graduate student as coauthor.

8. Externally funded competitive grants

Our consistent and prodigious success in this time period in receiving grants from the National Science Foundation (NSF) and other funding agencies had no parallel anywhere else on BYU campus. Among evolutionary biologists, BYU gained the reputation of landing many large grants, particularly in the field of systematic biology. There was a period during the first decade of the twenty-first century when NSF program officers told me that whenever they received a grant proposal from BYU, it was always accompanied by a giant "whooshing sound," because they knew a major portion of their budget was heading to Provo. Later on, when I served as a program officer for NSF, it became apparent that what we accomplished at BYU during that first decade in terms

of grantsmanship in systematic biology had no rival at any other institution. Our success with receiving NSF grants was the envy of many evolutionary biology programs in the country, and was a strong indicator of the quality of work done at BYU in evolutionary biology.

From 1997 to 2020, BYU received a total of 112 NSF grants for a total of $24 million dollars of funding that came directly to BYU, or just under $1 million per year. This total includes 54 major NSF grants (three to five years each), with an additional 17 grants for doctoral candidates (Doctoral Dissertation Improvement Grants), and 41 supplements to support undergraduates, K–12 teachers, and faculty from predominantly undergraduate institutions (table 2). On each of these grants, the BYU faculty member was the principal investigator (PI) or co-principal investigator, which means he or she developed the ideas and was responsible to conduct the research. Hence, BYU faculty are not just hanging onto the coattails of researchers at other institutions; we have developed an internationally recognized program in evolution, which was consistently funded over the twenty-four year period, and we expect to this to continue going forward.

National Science Foundation grants are very competitive, and receiving a funded NSF grant in the Life Sciences is a signal from the research community that the PI is doing cutting-edge work in their field. Additionally, the funding brings opportunities to hire postdocs, recruit graduate students, and provide undergraduates with significant research experiences that would never be possible with only university funding sources. Moreover, it forces the PIs to keep sharp, to keep asking good questions, and to keep pushing the boundaries of their own discipline. Evolutionary biology at BYU is not a one-hit wonder: we have been consistent in funding our research. I am not aware of any other program at BYU that can compare in terms of consistency and degree of funding.

Why has BYU been so successful with funding from NSF? During the first decade of the twenty-first century, BYU established itself as one of the leading institutions in the world for molecular

Table 2. Summary of National Science Foundation Grants Received by BYU Evolutionary Biologists 1997–2020

This includes 54 major grants, 17 grants to support doctoral dissertation research, and 41 supplements to support undergraduate students and teachers. Many of these grants included coinvestigators from many different universities and other institutions. However, dollar amounts are given only for funding coming directly to BYU.

Program	Program Description	Grants Received	Grant Amount	Examples of Funded Projects
Systematics and biodiversity sciences	Research addressing fundamental questions in biodiversity, taxonomy, and phylogenetics, such as the following: What kinds of organisms exist (or existed)? How are they related? Typical grant is 3–5 years long.	26	$8,363,000	Phylogeny of dragonflies, fireflies, katydids, stick insects, grasshoppers, webspinners, lice, ground beetles, jewel beetles, scorpionflies, fleas, cucujoid beetles, tardigrades, crayfish, catfish, Calyceraceae plants, phlox, *Helicosporidia* (algae), and night lizards. Development of analytical and genomic tools.
Assembling the Tree of Life	These are prestigious, large-scale, 5-year grants to decipher major portions of the Tree of Life.	4	$4,137,000	Hexapods (insects), beetles, decapods (crustaceans), squamates (lizards and snakes)
Collections-based grants	These 3–5-year grants support the digitization of biological collections and the infrastructure to store, catalog, and maintain collections.	5	$670,000	Databasing and digitization for fleas, beetles, grasshoppers, plants and storage for mammal and plant collections.
Major research instrumentation grants (MRI)	These support the purchase of scientific equipment.	3	$1,401,000	Robotics and DNA-sequencing equipment for evolutionary studies.
Antarctic Research Program (ANT)	These 3–5-year grants support long-term ecological research in the Antarctic.	8	$1,443,000	Glacial structure and ecology, springtails, nematodes, tardigrades, microbial genomics.
Various programs	Partnership for International Research and Education (PIRE), Emerging Frontiers (EF), Integrative Organismal Systems (IOS), Population Biology (Pop Bio), symposia.	8	$3,324,000	Speciation in Patagonia, climate impacts on lizard extinction, giant Amazon River turtle.
Doctoral dissertation improvement grants (DDIG)	These grants supplement doctoral candidates' research and help develop grant-writing skills (discontinued by NSF in 2016).	17	$212,000	Phylogeny of mayflies, polyneopterous insects, mantids, katydids, crayfish, coral snakes, skink lizards, spiny lizards, tropidurid lizards, spiny rats, Mesoamerican rodents, Central American freshwater fish.
Research experience for undergraduates (REU) and teachers (RET and ROA), and REU sites grant	This is supplemental funding which allows undergraduates, K–12 teachers, and faculty at predominantly undergraduate institutions to participate in research.	41	$1,016,000	Students and teachers take intellectual ownership of a side project associated with any of the funded projects described above.
Total		**112**	**$20,566,000**	

systematics, and the grants received reflect this. At the turn of the century, DNA technology was just beginning to ramp up, and BYU was one of the first institutions in the country to establish a centralized facility to sequence DNA (BYU DNA Sequencing Center). The combination of this center with a series of strategic hires put BYU in the position to be one of the first institutions to use DNA-sequence information to decipher the evolutionary history among various organisms. In addition, we fostered collaborations between biologists and computer scientists to develop the analytical tools to handle this deluge of data. We received twenty-six grants (each of which was three to five years long) to study the systematics of various organismal groups. Most telling was the fact that we received four grants from the NSF program Assembling the Tree of Life. These were very competitive, large, and prestigious grants that focused on reconstructing a major evolutionary branch on the tree of life. BYU received funding to use DNA to reconstruct the evolutionary relationship among all insect orders, among all beetle families, among decapods (crustaceans and relatives), and among squamates (snakes and lizards). I am not aware of any other university in the country that received this many Tree of Life grants. In addition to the NSF funding, we received forty grants totaling $3.5 million from other funding sources, including local, state, and national funding agencies (see table 3).

9. The genesis of bioinformatics

Around 2001, two BYU evolutionary biologists teamed up with two faculty members from the Department of Computer Sciences and a faculty member from the Department of Statistics and began developing some of the first computational tools for effectively analyzing DNA-sequence data for phylogenetic analysis. This initial collaboration gained momentum and internal and external funding, and it eventually resulted in the establishment of the bioinformatics major housed in the Department of Biology. Conceptually, bioinformatics relies on evolution to make sense of overwhelming volumes of genetic and other data, and the BYU

Table 3. Other Sources of External Support for Evolutionary Biology Research at BYU between 1997 and 2020

Source of Funding	Grants Received	Grant Amount	Examples of Funded Projects
Bureau of Land Management (BLM)	9	$416,000	Mammals of Grand Staircase, leatherside chub, *Cycladenia* (waxy-dogbane), *Penstemon* (beardtongues), lichens, *Astragulus*
Central Utah Water Conservancy District	2	$81,000	June sucker
Howard Hughes Medical Institute	4	$343,000	Understanding the intersection of evolution and religion and searching for reconciliation
National Geographic Society	3	$42,000	Freshwater crayfish, koala, *Liolaemus* lizards
National Institutes of Health	2	$626,000	Genetic recombination and the estimation of phylogeny
Utah Division of Wildlife Services	5	$298,000	Bluegills, rainbow trout, quagga mussels, leatherside chub, black bears
US Department of Agriculture	10	$1,245,000	Nematodes, jewel beetles, wildland forbs, bark beetles, lichens
Other sources	5	$470,000	Nematodes, freshwater crabs, infrastructure
Total	**40**	**$3,521,000**	

bioinformatics group expanded to grapple with problems far beyond phylogenetic analysis. While in the early days, there were only about three faculty members who were entirely focused on the bioinformatics program, their productivity was remarkable. Between 2004 and 2020, these faculty generated 270 publications (not included in the totals above), received $14 million in grants (primarily from the National Institute of Health), and graduated 270 undergraduate majors. As of 2020, Bioinformatics was one of the "hot" programs at BYU, nationally recognized as one of the top programs in the country, and our graduates have been highly recruited in academia and industry.

10. The BYU Bean Life Science Museum

The BYU Bean Life Science Museum has played a pivotal role in the growth of evolutionary biology at BYU. The museum has two major functions: it serves as a repository for specimens used in evolutionary studies, and it has an outreach function to educate the public about the natural world. The museum's research collections expanded significantly over this time period, and this growth went hand in hand with our NSF-supported projects (table 4). BYU has a long history of maintaining a variety of natural history collections, with some specimens dating back more than a century. The growth since 2000 has been primarily focused on obtaining specimens for DNA research, which requires different techniques for preserving and storing specimens. For instance, as of 2020 BYU was widely recognized as having one of the oldest, largest, and taxonomically most diverse collections of insect tissues in the world, comprised of approximately 1.5 million DNA-grade specimens. We also have outstanding tissue holdings in other taxonomic groups. In terms of educational outreach, from its inception the museum was reluctant to incorporate evolution in any exhibit. However, in about 2016, museum leadership placed an emphasis on exhibits that explain evolutionary principles, and this culminated with BYU's first exhibit on hominin (human) evolution in 2019. Another, more extensive exhibit on hominin evolution is on display in the BYU Life Sciences Building and is targeted toward students with a more sophisticated understanding of human anatomy and principles of evolution. The generous resources provided to the museum by BYU as well as many donors is evidence of the institution's long-term commitment to supporting research and collections associated with evolution.

Final Thoughts

My hope is that this article will help the reader recognize the tremendous growth of evolution as a discipline at BYU and put to rest the notion that BYU is not serious in teaching or conducting

Table 4. Specimen Holdings at the BYU Bean Life Science Museum as of 2020

Collection	Specimen Numbers
Lichens	105,000 specimens
Plants	180,000 herbarium sheets
Microfauna (nematodes)	250,000 specimens
Insects	4,000,000 specimens
Fish	170,000 specimens
Reptiles and amphibians	41,000 specimens
Birds	11,000 specimens
Mammals	43,000 specimens

research on evolution. Not only do we teach it across multiple courses, but we do a better job of teaching than most other universities, and our students have a better comprehension of evolution than students at most universities. In my quarter century of teaching the senior-level course in evolutionary biology, I have recognized increased acceptance of evolutionary ideas by our students and much less antagonism toward the science. Moreover, when students leave the class, many have expressed a profound appreciation for how the study of evolution has increased their testimonies and made them appreciate the wonders of biological diversity. They have learned to reconcile their science with their faith, and as a result, both have been strengthened.

BYU has a well-known and nationally respected program in evolutionary biology, and the scholarly productivity of our faculty in this discipline has been one of the remarkable, unsung achievements at BYU. We are well-known within the field, and BYU has become the institution to beat when it comes to winning awards or publishing papers in high-impact journals. Further, because BYU evolutionary biologists' background in science has allowed them to challenge the critics, these faculty have played a central role in helping the Church address criticisms of the faith (for example, questions regarding DNA and the Book of Mormon).[9]

9. See Michael F. Whiting, "DNA and the Book of Mormon: A Phylogenetic Perspective," *Journal of Book of Mormon Studies* 12, no. 1 (2003): 24–35.

How is it that in a quarter century BYU went from an institution that once widely distrusted evolution to one that has largely accepted it? I suppose there are many reasons, but I think the primary one hinges on the decision to provide opportunities for students to ask difficult questions and providing an atmosphere where these could be answered honestly, with scientific rigor, and within the context of faith. During the 1980s, as an undergraduate student at BYU, I never felt safe exploring these topics with my fellow students or with faculty. My religion professor never provided an atmosphere in which I felt I could discuss these important issues. It wasn't until I was in graduate school away from BYU that I really could dive in deep and begin to understand the marvels of evolution. I had to work out the reconciliation largely on my own. As BYU's program in evolutionary biology has developed over a quarter century, we have tried to provide a safe space where our students can reconcile their faith with evolution before they leave BYU. I think this has made all the difference, both in the success of our students and in their general change in attitude toward evolution.

There is a lesson to be learned in all of this. There are currently other heart-wrenching and divisive topics that center on perceived contradictions between science and faith. As with evolution, many people seek answers that are black and white, without realizing that the science is more nuanced, and that reconciliation often does not mean entirely discarding one side to embrace the other. Like the early days of evolution at BYU, students end up leaving the Church when they cannot find harmony between faith and science and are forced to choose one over the other. Our students struggle with these issues now. These may be the current stumbling blocks. But here is the crux: just as we provided a safe space to learn and discuss evolution at BYU, we need to provide opportunities for students to feel safe in grappling with their faith and with science, even though it may make some feel uncomfortable. Our students are yearning for difficult discussions in an atmosphere of faith. We must work together on a road to faithful

reconciliation. We must teach the best science. We must provide safe spaces.

The future of evolution at BYU is very bright, and as our discipline evolves, BYU will continue to be one of the main players in the field. We have embraced the charge to establish the best evolution program that we can and to do so in the light of the gospel, and this approach has blessed the university and the lives of our students and faculty. Moreover, we have provided a pathway forward for dealing with thorny issues at the interface of science and faith. Evolution is a fundamental truth, and BYU is an institution that seeks all truth.

Michael F. Whiting is a professor in the Department of Biology and Director of the BYU Bean Life Science Museum. He has served as director of the BYU DNA Sequencing Center, as head curator of insects, as a program director for the National Science Foundation in Systematic Biology, and holds the Robertson Endowed Professorship in genetics. His research focuses on reconstructing the evolutionary relationships among insects using DNA and morphological features. He is the recipient of more than twenty National Science Foundation grants based upon this work including an Early Career Award, has authored over 150 publications, and has traveled the globe with BYU students in search of rare and exotic insects. He is the husband of Alison Whiting, curator and adjunct professor of herpetology at BYU. When they are not in the field together, they exert their influence on each of their six rambunctious children to pursue a career in either entomology or herpetology.

From Seminary Teacher to Scientist to Institute Director

Learning by Study and Also by Faith

Ugo A. Perego

Back in 2007, while working late one evening as a doctoral student at the University of Pavia in Italy, I was in the middle of preparing several plates containing DNA samples from individuals carrying maternally inherited genetic profiles specific to Native American ancestry. During that time, I was well aware that no one had at their disposal as much data and DNA samples as I had to address questions pertaining to the origins, dispersal, and expansion routes of indigenous groups of America's double continent. These samples resulted from several collaborative efforts with institutions and universities in diverse parts of Central and South America and from volunteer submissions from the general population of the United States and Canada. As often happened in those days, I was the only one in the lab at that late hour, alone with my thoughts. Although my research objectives as part of Professor Antonio Torroni's scientific team had nothing to do with religious matters, I could not help but reflect on the genetic origins of these people and the controversy surrounding the narrative found in the Book of Mormon. Because of the nature of my doctoral work, my employment with the Sorenson Molecular Genealogy Foundation, and my membership in The Church of Jesus Christ of Latter-day Saints, I had been approached several times with questions and high expectations that such research

could shed some light on whether "Lamanite DNA" could be detected, settling once and for all the question of an Israelite origin of the people of the Book of Mormon. For some reason, although I was interested in providing some science-based answers to such queries, I was not troubled by them. My understanding of the principles governing population studies based on genetic evidence had deepened and expanded, and it was clear in my mind that the answers to Book of Mormon peoples' origin questions were not to be found in the DNA samples in my hands.

That experience was one of many that helped me sort through a number of issues pertaining to the apparent conflict between faith and science-based matters. Things that I have learned, studied, and researched, and things that I do not have an answer for—including occasional personal struggles, doubts, or confusion—have gradually and steadily faded into the background in the face of my relationship with the Divine. Yes, I, like many others, have experienced faith challenges and times of loneliness and loss. During those moments, I learned to stop what I was doing, sit back, and ponder whether my heart and mind were set on what really mattered and whether my faith was rooted where it was supposed to be. Years later, I found great similarity between how I occasionally felt and the words of Elder Lawrence E. Corbridge given at a 2019 BYU devotional, when he taught the importance of focusing on a set of "fundamental questions" rather than running in circles over the "marginal questions."[1] From personal experience, I can attest that this pattern has worked for me. Elder Corbridge summarizes the primary questions as follows:

1. Is there a God, and is he our Father in Heaven?
2. Is Jesus Christ the Son of God and the Savior of the world?
3. Was Joseph Smith a prophet?

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1. Lawrence E. Corbridge, "Stand Forever," devotional address, Brigham Young University, Provo, Utah, January 22, 2019, https://speeches.byu.edu/talks/lawrence-e-corbridge/stand-for-ever/.

4. Is The Church of Jesus Christ of Latter-day Saints the kingdom of God on the earth?[2]

Working on the most important questions first requires diligence, humility, faith, and patience. In a recent conversation with a friend from another faith, I felt impressed to share my feelings that sometimes the lack of knowledge on a specific matter, including the nature of the Godhead, is an act of mercy from a loving Father in Heaven so that we can be accountable for our actions based on our knowledge. "To want more from God means to do more for him, and in doing more for him, we become more like him," were my words to my good friend. I am therefore persuaded that an open and willing heart and mind will eventually be filled with God's light. I also believe that what we currently acquire as knowledge in this mortal journey is very, very little when compared to the wealth of divine knowledge he is waiting to share with us. Coming to an understanding that everything in life has a purpose and that our heavenly parents really care about us and want the very best for us is the most important element to a peaceful and meaningful experience on this earth.

Faith before Science, and Then Science

In my adult life, as I have continually worked on becoming a better scientist and a more committed disciple of the gospel of Jesus Christ, I have had a number of experiences that required a recentering on the fundamental questions, as outlined by Elder Corbridge. One of them happened in 2002, when I was a young and inexperienced researcher at the Sorenson Molecular Genealogy Foundation in Salt Lake City, Utah. Under the mentorship of molecular biologist Scott R. Woodward, I began working on

2. These questions are quite similar to those posed by Leonard Arrington in his essay, "Why I Am a Believer," in the original edition of *A Thoughtful Faith: Essays on Belief by Mormon Scholars,* ed. Philip L. Barlow (Centerville, Utah: Canon Press, 1986), 225–33.

the reconstruction of Joseph Smith Jr.'s genetic profile. That project was an early experiment, or template, for what was quickly becoming a worldwide interest in combining family history with DNA information. During that process, I was contacted by a descendant of early Apostle Parley P. Pratt, who asked if I could use the knowledge of the Smith family's DNA to address questions related to Joseph Smith's polygamy and alleged children born to women other than Joseph's first wife, Emma. I was somewhat familiar with the practice of plural marriage in early Church history, but I had never spent much time learning about it. The man who reached out to me explained that there were records in his family history supporting the possibility that one of Parley's sons, Moroni Pratt, was actually the biological son of Joseph Smith.[3]

In order to build a proper case study, I began investigating more about Joseph Smith's gradual introduction and practice of plural marriage during the Kirtland and Nauvoo eras of Church history. I learned that most writings on the subject were laced with sensationalism and authors' biases. It became difficult to know what was historically correct and what was speculation. In a few instances, I was quite disturbed by the way certain authors decided to frame the alleged actions of the Prophet; it felt like I was drinking mud from an old boot. I remember pushing my chair away from the desk as if I could distance myself from my feelings by distancing myself from the text. I took a deep breath. Amid this distaste for what I was encountering, I had the clear impression that I needed to do something else before continuing to work on that project: I had to reassess my primary questions. I had to reevaluate where I stood with my personal testimony of the Restoration. I spent

3. The DNA evidence shows that Moroni Pratt was not Joseph Smith's biological son. See Ugo A. Perego, Natalie M. Myres, and Scott R. Woodward, "Reconstructing the Y-Chromosome of Joseph Smith: Genealogical Applications," *Journal of Mormon History* 31, no. 2 (2005): 42–60.

the next few days reading scriptures, pondering, and pouring out my soul to the Lord, specifically asking about the reality of the First Vision. The answer came, and it was clear and personal. I felt at peace. I could continue to work on a project that became a significant area of my research and put me in contact with wonderful people from the Smith family over the course of the following two decades. Additionally, I began studying Church history more diligently from that time onward, including the rich material surrounding the multiple accounts of the First Vision.

Two Paths

Five years previous to this experience, I had the life-changing opportunity to attend the BYU summer study abroad program in Jerusalem. I returned from the Holy Land with a clear desire to become a full-time seminary teacher and enrolled in the seminary teaching preservice course. I also had a new bishop in my student ward: the same Scott Woodward who later invited me to join him in the molecular genealogy journey I described above.

Interviewing me in his office in the old Widtsoe Building on BYU campus, Bishop Woodward went over the usual questions regarding personal worthiness and commitment to the restored gospel. When the interview was over, we continued to chat for a while. At one point, he asked a question that had a tremendous academic impact on my mind. He was curious to know how I was going to answer when a seminary student inquired about the theory of organic evolution. Although I cannot remember what I said (because I am not sure I had ever thought about it before then), this question was the initial spark that ignited my curiosity about the relationship between science and religion. From that time onward, I took as many opportunities as I could to learn more about the Church teachings regarding specific scientific topics. Thanks to that intriguing question from Bishop/Professor Woodward, I made the decision that day to embark on a fascinating journey.

Brigham Young University is one of the best places in the world to ponder the mysteries of the universe and at the same time learn how to look for the hand of God in all things. During my undergraduate and graduate years there, I probably spent an equal amount of time in buildings named for the scientists John Widtsoe and Henry Eyring as in the building named for the Prophet Joseph Smith. Religious education was just as fascinating to me as attending a lecture on evolution. My bachelor's and master's degrees in scientific fields were accompanied by twice as many religion courses as were required for graduation, and in addition I acquired a graduate minor in ancient scripture. My trajectory did not change substantially after graduating, since I worked for more than a decade as a researcher for Dr. Woodward at the Sorenson Molecular Genealogy Foundation, collecting and analyzing genealogical and genetic data to study the recent and ancient history of individuals and populations, while at the same time volunteering as an instructor at the Salt Lake Community College's institute of religion. I found equal joy and satisfaction, spiritually and intellectually, in studying and sharing both scientific and religious ideas. I learned that if I left my mind and heart open to be taught and if I surrounded myself with people who knew a lot more than I did, both my mind and my spirit were continually expanded. How true is the saying that the more you know, the more you know how little you know!

Becoming an LDS Scientist

Those were also the years when I was given the opportunity to work on my doctoral degree. My colleagues and I at the Sorenson Molecular Genealogy Foundation collaborated with several world-renowned scientists. One of them was Professor Antonio Torroni from the University of Pavia, who suggested that I come to Italy to do graduate work using the data produced by Sorenson as part of my dissertation. It was a dream opportunity for me to be involved in a prestigious collaboration and to study

in the field of population genetics with one of the top international experts in my discipline. Curiously, when I submitted my graduate research proposal on autosomal DNA as a tool to trace family histories,[4] Professor Torroni suggested that I instead take up a project he had worked on as a postdoctoral researcher at Emory University. This work would expand the current knowledge of Native American origins and migrations through the analysis of complete mitochondrial DNA genomes. For more than a decade, very little on that subject had been researched, and he felt that the time was right to employ new advances in technology and the large dataset from Sorenson to reassess ancient migration routes to and within the Americas.

First under his mentorship, and later with Professor Alessandro Achilli from the same department, I was given the opportunity to experiment with different genetic markers and populations, which resulted in several peer-reviewed scientific publications in journals of influence.[5] My doctoral research and continued employment with the Sorenson group resulted in numerous trips around the globe, attending conferences, collecting DNA samples, and learning about diverse cultures and histories. My training included work in population migrations, anthropological genetics, and evolutionary biology. We studied everything from Neanderthals and Denisovans and their likely admixture with anatomically modern humans, to the different expansion routes followed by our ancient ancestors thousands of years ago as they left the African continent to "colonize" the entire planet, and the biological relationships shared by individuals living in the recent past and today.

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4. Lynn B. Jorde and Michael J. Bamshad, "Genetic Ancestry Testing: What Is It and Why Is It Important?," *JAMA* 323, no. 11 (2020): 1089–90.

5. A full list of scientific, peer-reviewed publications that I co-authored is available on the National Library of Medicine website (https://pubmed.ncbi.nlm.nih.gov/?term=ugo+perego, accessed March 2022).

Amid all this work, I regularly received questions from curious, and often puzzled, members of the Church. For example, how did I reconcile ancient human events that science showed happened tens or hundreds of thousands of years ago with the biblical account of the Creation that seemed to imply that humans have been walking on the earth for no more than six millennia? Additionally, my scholarly work in the field of DNA and the origin of Native Americans placed me in the middle of the debate about whether there was any genetic evidence to support the historical identity of the people whose stories are narrated in the Book of Mormon.

Science and Religion: Can They Be Reconciled?

Organic Evolution and the Creation Accounts

There is an overwhelming body of scientific evidence brought forth by many different disciplines that supports the existence of hominids dating from a time much earlier than the biblical Adam and Eve. The theory of evolution is not a mere guess about human origins. Rather, it is a well-supported explanation about the biological origins of our species. The genetic hierarchy that results in the nicely organized world tree of all living organisms is just the last of a mountain of scientific evidence showing a likely evolutionary path for our physical body.[6] So how do we reconcile assumptions regarding what scriptural accounts seem to be saying about the Creation, together with the views of past prophets, with the theory of evolution? My personal understanding, having studied the matter from the viewpoints of science and the Restoration, is that The Church of Jesus Christ of Latter-day Saints teaches a historical couple, Adam and Eve, as the first two

6. A recent comprehensive and well-written treatise on this subject and a great resource to learn more about the genetic evolution of hominids, including modern humans, is David Reich, *Who We Are and How We Got Here: Ancient DNA and the New Science of the Human Past* (New York: Oxford University Press, 2018).

modern humans to enter in a covenant relationship with the Divine, and that their spirits, along with all the spirits of every person that ever lived on this earth since their time, are spirit children of heavenly parents. However, regarding the creation of their physical bodies and whether others lived before them, the Church has not taken an official position,[7] leaving the matter to science and to some future time when the Lord may explain how biological life was organized on this planet (D&C 101:32–34). In other words, modern revelation has not officially spoken on the matter of organic evolution. What we learn about the creation of man and woman from the scriptures does not provide the complete story. With such an information gap that still needs to be filled and with what science has brought to the table at this point, there is no real need for conflict between science and religion, particularly since each field has its unique emphasis in addressing similar questions: science is concerned with how we came to be, while faith provides answers about why we are here. Science and religion may be viewed as complementary sides of the same coin.

Book of Mormon and DNA Studies

On the matter of Book of Mormon "genetics," a few years ago I wrote a comprehensive essay explaining that using DNA testing to attempt to identify biological descendants of Lehi, Ishmael, Mulek, and other personages mentioned in the Nephites' record is unlikely to succeed.[8] Eventually, that article was reviewed, edited, and shortened by both scientists and a special Church committee to be included as one of the Gospel Topics Essays available

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7. "What Does the Church Believe about Dinosaurs?," *New Era* 46, no. 2 (February 2016): 41, reprinted herein, 349; and "What Does the Church Believe about Evolution?," *New Era* 46, no. 2 (October 2016): 41, reprinted herein, 347.

8. Ugo A. Perego and Jayne E. Ekins, "Is Decrypting the Genetic Legacy of America's Indigenous Populations Key to the Historicity of the Book of Mormon?," *Interpreter: A Journal of Latter-day Saint Faith and Scholarship* 38 (2020): 355–90.

on the Church website.[9] Based on nearly two decades of working directly with ancient and modern DNA samples from several international populations, including those from the Americas, I continue to affirm what I wrote then. The answer to the question of the genetic origin of Book of Mormon people is not in the data that have been gathered by research groups I have been associated with or in data gathered by others. To understand why the data will not yield the sought-after answer, we need to examine the assumptions underlying the use of genetic evidence to answer the question of the historicity of Book of Mormon people. Simply stated, the DNA of a single family of about thirty individuals coming 2,600 years ago to an already populated region of the American continent would be swallowed in the indigenous gene pool, leaving no genetic legacy detectable in the generations to follow. In contrast to various claims and assumptions made by certain authors, DNA is not a viable tool to prove or disprove an ancient origin of the Book of Mormon. My own experience confirms that of others before me, that certain tools work well for certain questions, and matching the tool to the proper question is both wise and productive, while applying a tool to a question it is not designed to address brings confusion and dissatisfaction.

Moving Forward

Following my time at the Sorenson group, I worked full time for nearly a decade (2012–2021) for The Church of Jesus Christ of Latter-day Saints Seminaries and Institutes of Religion program. I did so while living in Italy with my family, providing support and training to local units and volunteer teachers in Central Italy and Malta. I was also the director of the Rome Institute of Religion, where I personally taught several religious courses each year. Living closer to my alma mater, I was able to regularly

9. "Book of Mormon and DNA Studies," Gospel Topics Essays, The Church of Jesus Christ of Latter-day Saints, accessed January 31, 2021, https://www.churchofjesuschrist.org/study/manual/gospel-topics-essays/book-of-mormon-and-dna-studies.

visit and continue a scholarly collaboration with colleagues and friends at the University of Pavia and other prominent institutions. Both my scientific and religious endeavors provide me with new opportunities to engage in the probing and debate of science and religion, especially in guiding the younger generation. As I did when I was a young and inexperienced college student at BYU, they too are navigating questions dealing with the interplay between secular and spiritual matters.

In the summer of 2021, our family moved to Nauvoo, Illinois, where we already had a home we purchased years ago as our base camp in the United States. We are now living and are being fully immersed in one of the hotspots in Church history. I also volunteer as an institute teacher for North America's Pathway and BYU–Idaho Online students. I am now a full-time science instructor for a local college, teaching courses in biology, microbiology, biotechnology, genetics, forensic sciences, and . . . evolution. It is clear to me that in one form or another, sciences and religious education will probably continue to be integral parts of my earthly existence.

Conclusion

I'll summarize my final thoughts using the words of colleagues from BYU–Idaho I have never met, whose words beautifully reflect my own convictions regarding the relationship between science and the Divine: "Revealed truth provides instructions for salvation, moral standards, and knowledge of God's will, but rarely provides knowledge about how things work, including how the physical world works. While God could choose to reveal anything, He rarely reveals what we can discover on our own."[10] As I have worked to maintain intellectual humility, accepting my own personal limitations when it comes to understanding all that surrounds me, together with a sense of gratitude for all the people

10. Dan Moore, Brian Tonks, and Alan Holyoak, "Seeking Truth through Science and Religion: Being Disciple Scholars," *Perspective* 12, no. 2 (Spring 2012): 13.

and experiences that have enriched my life, I am convinced that I have been rewarded with knowing more than what the natural world has to offer. I long for a time when our intellect will have fewer boundaries, our bodies will not be limited in this dimension, and our divine potential may finally be reached. Until then, I will continue to search and embrace truths, wherever they might be, as scripture invites us to do (D&C 88:118).

Ugo A. Perego, a native of Milan, Italy, received a BS and an MS in health sciences at Brigham Young University and a PhD in human genetics and biomolecular sciences at the University of Pavia. His dissertation focused on the origin of Native Americans through the analysis of complete mitochondrial DNA genomes. After working for twelve years as senior researcher for the nonprofit Sorenson Molecular Genealogy Foundation in Salt Lake City, Utah, Ugo joined the Church Educational System in his native Italy as the director of the Rome Institute campus and a coordinator for Seminaries and Institutes of Religion from 2012 to 2021. With his family, he now lives in Nauvoo, Illinois, where he is a full-time faculty member in the biology department of Southeastern Community College in West Burlington and Keokuk, Iowa. He is also serving as a volunteer institute instructor for BYU Pathway. Ugo's research interests revolve around the use of DNA to address historical, forensic, religious, and genealogical questions.

A version of this chapter will appear in the forthcoming book *A Thoughtful Faith for the 21st Century: Essays on Belief by Latter-day Saint Scholars,* ed. Philip L. Barlow (Provo, Utah: Maxwell Institute, 2025).

Living with Uncertainty Helps Us Reconcile Evolution and Faith

Jared Lee

I teach evolution at Southern Virginia University, where most of the students and faculty are members of The Church of Jesus Christ of Latter-day Saints. Each semester, students ask me about evolution and faith, seeking genuine answers as to how evolution fits into their beliefs. While their backgrounds vary, someone they trust—or just common American cultural misunderstanding—has led them to the misconception that science and religion are in conflict.[1] Thus, I regularly have conversations with undergraduate students regarding the intersection of evolution and faith in the hopes of replacing this idea of conflict with one of reconciliation. Since I am an evolutionary biologist and a member of the Church, they assume that I have struggled with the same questions they have (and they are correct) and will be able to answer their questions (and they are wrong).

Over the last few decades, the public's perception of evolution has expanded into a continuum between two extremes.[2] At

1. See, for example, chapter 1 of James R. Moore, *The Post-Darwinian Controversies: A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America 1870-1900* (Cambridge: Cambridge University Press, 1981); and Jeff Hardin, Ronald L. Numbers, and Ronald L. Binzley, eds., *The Warfare between Science and Religion: The Idea That Wouldn't Die* (Baltimore: Johns Hopkins University Press, 2018).

2. "The Creation/Evolution Continuum," National Center for Science Education, last modified January 22, 2016, https://ncse.ngo/creationevolution-continuum.

one extreme, we have creationists who either deny the scientific evidence or reinterpret it to fit their belief system.[3] At the other extreme, some intellectuals wield their supposed higher reasoning to argue for the nonexistence of God.[4] Indeed, it is portrayed as if evolution and faith are constantly in mortal combat with each other.

However, amid all this rhetoric, many evolutionary biologists teach science (including evolutionary concepts), engage in cutting-edge research (using evolutionary principles), and are devout members of a wide variety of faith traditions. They reject the conflict thesis too, allowing both faith and reason to coexist in their minds and hearts.[5]

How can so many people, regardless of their scientific training, allow for the study of both evolution and faith? In this chapter, I will argue that understanding and living with uncertainty can help us reconcile evolution and faith. I will begin by describing uncertainty and its role in both faith and evolutionary science. I will then discuss what it takes to live with uncertainty in this area and conclude with some thoughts on how reconciliation is the accurate model for evolution and faith. I hope to demonstrate that by learning to live with uncertainty, we can move forward in faith and scholarship without compromising either one.

Uncertainty for Everyone

We all experience uncertainty and must manage it in our lives.[6] We have incomplete information and must make decisions to live faithfully to any faith tradition or belief system we may adopt. While my

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3. Answers in Genesis (https://answersingenesis.org) is one example of a Christian apologetics organization dedicated to reinterpreting scientific evidence to fit with a young-earth creationist interpretation of Genesis.

4. John Henry, "Atheism," in *Science and Religion: A Historical Introduction*, ed. Gary B. Ferngren (Baltimore: Johns Hopkins University Press, 2017), 333–47.

5. In the lab where I performed my graduate research, the faith traditions of my colleagues were Southern Baptist, nondenominational Christian, Jewish, Muslim, Hindu, and Catholic.

6. See Proverbs 27:1 and James 4:14.

focus in this chapter pertains to members of The Church of Jesus Christ of Latter-day Saints, individuals of all faiths will encounter uncertainty. Other words such as *unclear, unknown,* and *ambiguous* are similar and express the uncertainty I will discuss. The word *doubt* should not be considered similar to uncertainty since it indicates a potential loss of faith, while the other terms express the unknown that is inherent to faith.

People like certainty; it provides comfort and assurance. We can plan for the future and minimize stress. We try to avoid uncertainty; it makes planning for the future difficult and increases stress.[7] As such, we strive to resolve uncertainty in our lives.[8] One of the ways we resolve uncertainty is by obtaining evidence that supports a course of action. Scientists and people of faith resolve uncertainty in different ways and utilize different evidence. However, as I will explain below, both science and faith strive to resolve uncertainty in life and discover truth.

Uncertainty in Faith

I wish to address two different aspects of uncertainty in faith. *First, faith strives to address and resolve uncertainty in life.* Major questions in life, such as what our purpose on earth is and what happens after death, contain a high amount of uncertainty. Faith seeks to address that uncertainty by providing answers in the form of scriptural declarations and revelation from living prophets. Paul the Apostle describes faith as a lack of evidence (Heb. 11:1), but earlier I claimed that resolving uncertainty requires evidence. Let's consider the evidence faith provides that seeks to address uncertainty in life.

Evidence for faith manifests itself in a personal way through spiritual experiences. These experiences can provide a course

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7. Kostas Kampourakis and Kevin McCain, "The Psychology of (Un)certainty," in *Uncertainty: How It Makes Science Advance* (New York: Oxford University Press, 2020), 19–32.

8. Bruce C. Hafen addressed this topic directly in 1979. See Bruce C. Hafen, "On Dealing with Uncertainty," *Ensign* 9, no. 8 (August 1979): 63–67.

of action, confirm a decision, or offer reassurance. These experiences form the basis of our testimonies, and repeated experiences only strengthen our resolve for the beliefs we have to the point that, as Alma teaches, faith yields to complete knowledge (Alma 32:33–34).

Second, uncertainty exists in faith.[9] We may have some certainty about principles of the gospel, but there are limits. For example, the doctrine of the Resurrection is plainly taught in the scriptures. This fundamental doctrine of the plan of salvation is easily taught to members and nonmembers alike. We have certainty that all will be resurrected and receive a perfect, immortal body as promised in the scriptures.[10] However, exactly when and how this Resurrection will take place is uncertain.

One source of uncertainty in faith is how scripture is interpreted. For example, some prominent creationists interpret the Creation account in Genesis 1 as a God's-eye account of the natural history of the earth's creation over the course of seven twenty-four-hour days.[11] Others agree that Genesis recounts the scientific or natural history of the earth but argue the days are each one thousand years long. Some Latter-day Saints have argued this perspective, particularly on the basis of Doctrine and Covenants 77.[12] LDS or not, creationists often use these understandings as their evidence to refute the scientifically established

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9. Bruce C. Hafen and Marie K. Hafen, *Faith Is Not Blind* (Salt Lake City: Deseret Book, 2018), further explores the uncertainty in faith.

10. The Resurrection is discussed throughout the Bible and the Book of Mormon. Some notable references include Ezekiel 37:1–13; Matthew 27:52; John 5:21; 1 Corinthians 15:20–23; 2 Nephi 9:10–12; and Alma 11:41–45; 41:4.

11. For example, Ken Ham writes, "The only eyewitness account of human origins is the one provided by God our Creator in the Bible's book of Genesis." Ken Ham, "Supposed Human Ancestor Found in African Cave?," Answers in Genesis, September 10, 2015, https://answersingenesis.org/blogs/ken-ham/2015/09/10/supposed-human-ancestor-found/.

12. See Nicholas J. Frederick, "The Seven Seals, the Age of the Earth, and Progressive Revelation," *BYU Studies* 64, no. 1 (2025): 95–96, https://byustudies.byu.edu/article/the-seven-seals-the-age-of-the-earth-and-ongoing-revelation, reprinted herein, 77–79.

age of the earth and the concept of evolution; obviously if the earth is young, there is insufficient time for evolution to have happened. However, there are many reasons to reevaluate the interpretations of Genesis mentioned above, reasons which concern things like translation, intended audience, and genre.[13] Modern-day revelation (either personal revelation or revelation from a living prophet) may contain uncertainty in that the way in which it should be applied or the purposes for which it was given are not always immediately clear.

Uncertainty in faith should not cause a loss of faith; rather, it means that we currently do not have a scriptural explanation or modern-day revelation on a subject.[14] This uncertainty can be helpful in obtaining revelation, much like the revelation on extending priesthood ordination to all worthy males in 1978.[15] Moreover, just because the scriptures and modern-day prophets are silent on a certain subject does not make that topic bad or evil.[16] For example, in a question posed to the *New Era*, "What does the Church believe about dinosaurs?" the answer clearly stated there have been no revelations on this topic, but the

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13. See Joshua M. Sears, "From Biology Major to Religion Professor: Personal Reflections on Evolution," *BYU Studies* 63, no. 1 (2024): 71–90, https://byustudies.byu.edu/article/from-biology-major-to-religion-professor, reprinted herein, 23–46; and Avram R. Shannon, "The Genesis Creation Account in Its Ancient Context," herein, 61–75.

14. See Elder Paul V. Johnson's remarks as quoted in Marianne Holman Prescott, "Elder Paul V. Johnson: Helping Students Dispel Doubt through Spiritual Knowledge," *Church News,* published by *Deseret News,* updated August 11, 2012, https://www.thechurchnews.com/archives/2012-08-11/elder-paul-v-johnson-helping-students-dispel-doubt-through-spiritual-knowledge-50371.

15. For a historical perspective, see Official Declaration 2; "Race and the Priesthood," Gospel Topics Essays, The Church of Jesus Christ of Latter-day Saints, accessed March 2022, https://www.churchofjesuschrist.org/study/manual/gospel-topics-essays/race-and-the-priesthood; and Edward L. Kimball, "Spencer W. Kimball and the Revelation on Priesthood," *BYU Studies* 47, no. 2 (2008): 4–78, https://byustudies.byu.edu/article/spencer-w-kimball-and-the-revelation-on-priesthood.

16. Church leaders may have personal views on topics that may or may not be public; however, those views should not be considered doctrine. See J. Reuben Clark Jr., "When Are Church Leader's Words Entitled to Claim of Scripture?," *Church News,* published by *Deseret News,* July 31, 1954, 2, 9–11.

scientific evidence says they existed and lived on the earth for millions of years. The article further stated that events before Adam and Eve "aren't a huge doctrinal concern of ours."[17] Likewise, President Dallin H. Oaks addressed questions about the spirit world—reviewing the scriptural teachings and encouraging members to trust in the Lord with respect to that which has not been revealed.[18] Thus, uncertainty can be resolved through faith in God or spiritual experiences that increase our faith to the point that we can accept the uncertainty.

Uncertainty in Evolutionary Science

As with faith, there are two aspects of uncertainty in evolutionary science that need to be addressed. *First, science seeks to resolve uncertainty through empirical investigations.* When scientists observe phenomena that they do not understand, those observations form the initial questions that can lead to studies and experiments. Scientists strive to obtain data and results that help address the question and resolve the uncertainty. Science is driven by first looking at the uncertainty, then seeking evidence through data collection, experimentation, and analysis.

Scientific evidence often involves a wide range of data and analyses. Scientists will measure and describe variables in nature and their experiments. They will create mathematical models and simulations to address questions about the past or the future. Most often, the evidence is quantifiable in some way, and the same results can be obtained by anyone following the same methods. This makes the communication and transfer of scientific results very important; often the most detailed and lengthy portions of a scientific article are the methods sections.

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17. "What Does the Church Believe about Dinosaurs?," *New Era* 46, no. 2 (February 2016): 43, reprinted herein, 349.

18. Dallin H. Oaks, "Trust in the Lord," *Ensign* 49, no. 11 (November 2019): 26. He also discusses what is considered official doctrine for the Church and how members can recognize it.

Second, there is uncertainty in the results of evolutionary science. One evolutionary biologist described science more like the Three Stooges trying to move a piano than some heroic march to the truth.[19] Indeed, science is not as neat and tidy as portrayed in textbooks. Data may be incomplete or imperfect, analyses may be inconclusive, or the scope of any individual study may be limited. However, uncertainty is built into the scientific method.[20]

The evidence that resolves the uncertainty in scientific results is buried in the methodology. We assess sample size, appropriateness of the statistical analyses, and the assumptions made. This also means that science never proves something one hundred percent correct. Instead, it sets up more questions that need to be addressed. Rarely does one experiment settle a scientific question. Rather, a series of experiments and observations published by many people over a long period of time tend to resolve scientific uncertainty.

To illustrate this, consider the age of the earth. Over the last several centuries, scientists have extended the estimates for the age of the earth as new technology and techniques have provided better data, which justifies an older planet than previously thought. Similarly, the scientific understanding of and evidence for evolution has progressed by addressing questions not yet resolved by observation or experimentation—including questions regarding speciation[21] and human evolution.[22] New technology and techniques have advanced evolutionary

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19. David Sloan Wilson, "Cooperation and Altruism," in *Evolutionary Ecology: Concepts and Case Studies*, ed. Charles W. Fox, Derek A. Roff, and Daphne J. Fairbairn (New York: Oxford University Press, 2001), 222–31.

20. See Steven L. Peck, "Why the Latter-day Saint Community Can Trust Science (in the Same Way Scientists Do)," herein, 119–41.

21. See Tyler A. Kummer and Jamie L. Jensen, "Wonderful Forms of Life Have Been and Are Being Evolved: A Brief Explanation of What Evolution Is and Is Not," herein, 161–85.

22. Seth M. Bybee, "The Scientific Evidence for Human Evolution," herein, 187–210.

science's ability to address questions that previously could not be explored.[23] Thus, science uses uncertainty in the natural world to formulate questions, design experiments, collect data, and attempt to resolve the uncertainty.

Living with Uncertainty

All this uncertainty in faith and in evolutionary science may cause us to throw up our hands, losing hope in gaining certainty in anything. Here, I suggest three things we can do to live with uncertainty and still be faithful followers of Christ: (1) be open to new information, (2) distinguish between primary and secondary questions, and (3) recognize and be comfortable with unanswered gospel questions.

First, we should have the humility to consider new information critically. World-renowned Latter-day Saint geologist and chemist Henry Eyring, father of President Henry B. Eyring, understood religious and scientific truth to operate in similar ways. He stated, "In the long run, the truth is its own most powerful advocate when it is honestly evaluated. The Lord uses imperfect people. He often allows their errors to stand uncorrected. He may have a purpose in doing so, such as to teach us that religious truth comes forth 'line upon line, precept upon precept' in a process of sifting and winnowing similar to the one [known] so well in science."[24] We should be willing to take the time to learn, read, and listen to new information and what others have to say about it.[25] This follows the counsel given to

23. An example would be the advent of molecular biology in the twentieth century. Indeed, some of the most powerful evidence for evolution is found in our own genome.

24. Henry Eyring, *Reflections of a Scientist* (Salt Lake City: Deseret Book, 1983), 48.

25. President Gordon B. Hinckley taught, "It is imperative that we as teachers in the seminary and institute of religion program of the Church read constantly the scriptures and other books related directly to the history, the doctrine, and the practices of the Church. But we ought also to be reading secular history, the great literature that has survived the ages, and the writings of contemporary

Oliver Cowdery to "study it out in your mind" (D&C 9:8). Asking questions and exploring new information, in either faith or evolution, demonstrates humility.

Second, we need to remember that not all questions in the gospel are of equal importance. While he was a member of the Seventy, Elder Lawrence E. Corbridge distinguished between primary and secondary questions. Primary questions deal with our basic testimonies, and there are relatively few of them. Secondary questions are endless and rarely relate to saving ordinances and covenants.[26] For example, the first few temple recommend interview questions could all be considered primary questions.[27] We will find uncertainty in secondary questions more than primary questions.

Evolution is a secondary question. In 1931, amid a heated debate regarding evolution between Elder B. H. Roberts of the Seventy and Elder Joseph Fielding Smith of the Twelve, the First Presidency stated, "Upon the fundamental doctrines of the Church we are all agreed. Our mission is to bear the message of the restored gospel to the world. Leave geology, biology, archaeology, and anthropology, *no one of which has to do with the salvation of the soul of mankind,* to scientific research, while we magnify our calling in the realm of the Church."[28] This statement demonstrates

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thinkers and doers. In so doing we will find inspiration to pass on to our students who will need all the balanced strength they can get as they face the world into which they move." Gordon B. Hinckley, "Four Imperatives for Religious Education," in *The Voice of My Servants: Apostolic Messages on Teaching, Learning, and Scripture,* ed. Scott C. Esplin and Richard Neitzel Holzapfel (Provo, Utah: Religious Studies Center, Brigham Young University, 2010), 63. See also the recent section added to the Church's General Handbook, "Seeking Information from Reliable Sources," *General Handbook: Serving in The Church of Jesus Christ of Latter-day Saints,* 38.8.40, https://www.churchofjesuschrist.org/study/manual/general-handbook/38-church-policies-and-guidelines?lang=eng#title_number226.

26. Lawrence E. Corbridge, "Stand Forever," devotional address, Brigham Young University, Provo, Utah, January 22, 2019, https://speeches.byu.edu/talks/lawrence-e-corbridge/stand-for-ever/.

27. See Russell M. Nelson, "Closing Remarks," *Ensign* 49, no. 11 (November 2019): 120.

28. *First Presidency Minutes*, April 7, 1931, quoted in William E. Evenson, "Evolution," in *Encyclopedia of Mormonism,* ed. Daniel H. Ludlow, 4 vols. (New York:

that evolution is not a fundamental doctrine (primary question) of the restored Church, and thus we should expect uncertainty regarding what the scriptures and modern-day revelation say (or do not say) about it.

Finally, we need to recognize and be comfortable with leaving gospel questions unanswered.[29] The Lord has purposely not revealed everything to us.[30] For this purpose, we must live by faith, because if we knew everything, there would be no need for faith.[31] How did God create the earth? How do dinosaurs fit into the plan of salvation? Did other hominids develop religion and believe in God? All of these are secondary gospel questions that may remain unanswered as far as revealed scripture and modern-day revelation are concerned, yet the scientific evidence surrounding them is real and cannot be discarded just because the Church of Jesus Christ's theology is silent on the issue. Science will progress on its own and address these questions, but as for our faith, we cannot let secondary questions distract us from primary questions. As such, we may need to accept the uncertainty in some secondary gospel questions. Furthermore, we should carefully study what has and has not been revealed so that we do not assert or overinterpret doctrine as settling a question. For example, accepting the English translation of Genesis 1 and 2 as a refutation of the evidence for human evolution is poor gospel scholarship. We cannot expect to understand ancient scripture accurately without taking into account its ancient contexts and audience, but this information is not available to the reader through translation alone, whether in the King James Version or in some modern translation.

In short, to live with this uncertainty, we need an open heart and an open mind. Our hearts need to be open to the promptings

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Macmillan, 1992), 2:478, emphasis added.

29. See Hugh B. Brown, quoted in James E. Faust, "The Abundant Life," *Ensign* 15, no. 11 (November 1985): 7.

30. See Articles of Faith 1:9.

31. See Alma 32:33–34.

of the Spirit, which will confirm the truthfulness of primary questions and guide us as we live righteously. Our minds need to be open to the knowledge we can obtain through our God-given and evolutionarily derived faculties.

Reconciling Together

Students ask me questions regarding evolution and faith because they seek certainty and resolution. Often when I discuss evolution and faith with students, they are relieved that it is okay to be uncertain and it is okay to explore that uncertainty, though they may not get resolution. However, uncertainty can bring reconciliation, which is a marvelous opportunity. Reconciliation means there is an open dialogue between groups of people. Reconciling something forces us to determine what is essential and what is tangential. These points give students hope and understanding as they approach evolution and faith. Students may leave my office with more questions than they came with, but hopefully, they have a framework to build upon as they move through life's uncertain waters.

Many want to have resolution with respect to evolution. Did it happen? Did it only occur in nonhuman life? Was it directed by God? Was it driven by natural law? How many species did God create? The answers to these questions would bring resolution and certainty. But The Church of Jesus Christ of Latter-day Saints has a very neutral stance on evolution. The revealed word and modern-day prophets are silent on the issue except to assert that Adam was the first man.[32] I would argue that this issue will not be resolved until the Millennium, when all things are revealed.[33]

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32. The BYU course packet on evolution ("Evolution and the Origin of Man," Brigham Young University, published June 1992, https://biology.byu.edu/00000172-29e6-d079-ab7e-69efe5890000/byu-evolution-packet), contains the Church's official stance and is reiterated by a question published in the October 2016 issue of the *New Era*. See "What Does the Church Believe about Evolution?," *New Era* 45, no. 10 (October 2016): 41.

33. See Russell M. Nelson, "The Creation," *Ensign* 30, no. 5 (May 2000): 84.

If resolution is unattainable for evolution, then we must live with uncertainty and seek for reconciliation. Reconciliation does not need to answer the question; instead, we need to engage the question with open dialogue and an exchange of ideas. The Church of Jesus Christ is not an antagonist of science; rather, it embraces science as it is demonstrated.[34] This reconciliation can occur among members, scholars, scientists, and especially families.

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34. Joseph F. Smith, Anthon H. Lund, and John Henry Smith, "Words in Season from the First Presidency," *Deseret Evening News,* December 17, 1910, 3. This is excerpted in "Evolution and the Origin of Man," which describes the Church's official stance on evolution.

Using a Reconciliation Approach to Teach Evolution May Help Religious Students Remain Faithful

Danny Ferguson, Ethan Tolman, Spencer Shumway, and Cassidy Shively

Many religious people struggle to accept the theory of evolution, and about 40 percent of Americans reject the theory outright, preferring a literalist, creationist account that confirms a young earth.[1] As Latter-day Saints ourselves, we understand the trepidation surrounding the idea that perhaps evolution contradicts our belief of an earth created by a loving Father and Savior. People may feel that the scientific theory of evolution implies that there is no need for a God or that our existence is simply an accident. As college-age youth, we are familiar with the struggles that students face as they confront evolution in their science classes. We are saddened by, but sympathize with, the growing trend in our generation to leave organized religion, preferring instead to embrace the alternative path of secularism.[2] It is no wonder that we feel such deep conflict, having been bombarded by misinformation and conflicting messages from the world around us.

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1. Megan Brenan, "40% of Americans Believe in Creationism," Gallup, July 26, 2019, https://news.gallup.com/poll/261680/americans-believe-creationism.aspx.

2. Michael Lipka, "Religious 'Nones' Are Not Only Growing, They're Becoming More Secular," Pew Research Center, November 11, 2015, https://www.pewresearch.org/fact-tank/2015/11/11/religious-nones-are-not-only-growing-theyre-becoming-more-secular; Alan Cooperman and Gregory A. Smith, "The Factors Driving the Growth of Religious 'Nones' in the U.S.," Pew Research Center, September 14, 2016, https://www.pewresearch.org/fact-tank/2016/09/14/the-factors-driving-the-growth-of-religious-nones-in-the-u-s.

Take, for instance, typical kids growing up in the United States. They may have encountered a high school science teacher who took an atheistic approach to science, telling the students that their religious beliefs have no place in the classroom and that evolution provides a complete explanation of how life (and humans) emerged on this planet and therefore an argument against the need for any supernatural power.[3] On the flip side, they may have encountered high school science teachers who take the opposite viewpoint and teach evolution flippantly, as "just a theory," or not at all, preferring to avoid the conflict they themselves might feel.[4] These students may have interacted with friends or family members who hold staunch opinions in one direction or another and who forcibly share those opinions, hoping to influence young minds. They may have church leaders who actively preach against evolution, suggesting that it is a tactic designed to deceive them and lead them away from their faith. Even in the media they consume, they are bombarded with misinformation about evolution (such as the Pokémon portrayal of evolution as more of a metamorphic event, the *Simpsons* episodes that pit religious fanatics against ardent atheists, the memes that portray monkeys morphing into man, and so on).

And as these students enter a college campus, the battle continues. Statistics show that the majority of those teaching biology courses at the undergraduate level do not believe in God, and even less so if they specialize in evolutionary science.[5] While many (and

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3. M. Elizabeth Barnes and Sara E. Brownell, "A Call to Use Cultural Competence When Teaching Evolution to Religious College Students: Introducing Religious Cultural Competence in Evolution Education (ReCCEE)," *CBE—Life Sciences Education* 16, no. 4 (Winter 2017): 2–3.

4. Randy Moore and Sehoya Cotner, "The Creationist Down the Hall: Does It Matter When Teachers Teach Creationism?," *BioScience* 59, no. 5 (May 2009): 431–32.

5. Elaine Howard Ecklund and Christopher P. Scheitle, "Religion among Academic Scientists: Distinctions, Disciplines, and Demographics," *Social Problems* 54, no. 2 (May 2007): 296, 299; Gregory W. Graffin and William B. Provine, "Macroscope: Evolution, Religion, and Free Will," *American Scientist* 95, no. 4 (July–August 2007): 294–97; see also Brenan, "40% of Americans Believe in Creationism."

probably most) do not set out to actively discredit religious faith, there are many who preach an atheistic version of evolution.[6] It is no wonder that students feel that they are faced with a presumed dichotomy, an inescapable choice between science and their faith. Sadly, some students decide to leave their religion when they feel forced to choose. Other students choose their religious identity over the science, feeling like they need to reject the theory of evolution to be faithful to their religious beliefs. We, as past students at Brigham Young University, want to make it known that the teaching of evolution at BYU is different from most other institutions and that this difference helped us embrace the science while also increasing our testimonies of Jesus Christ and our Heavenly Father, the loving Creators of this planet. The purpose of this essay is to share with the reader this unique approach.

A Reconciliation Approach

Let's start with the approaches to teaching evolution that we have seen. Given that the theory of evolution is the central theme in biology,[7] increasing student understanding and acceptance has been a popular and productive research pursuit for decades that has led to a wide variety of proposed methods, some better than others. A particularly harmful approach is to teach that the rejection of evolution is a product of some kind of deficit (we call this a "deficit model"); that is, those who do not accept evolution lack knowledge, intelligence, or reasoning abilities.[8] Methods stemming from this approach are highly ineffective, often causing students to dig in their heels even further. Another approach is to assume a direct relationship between understanding and

6. M. Elizabeth Barnes and others, "'Accepting Evolution Means You Can't Believe in God': Atheistic Perceptions of Evolution among College Biology Students," *CBE—Life Sciences Education* 19, no. 2 (Summer 2020): 3.

7. See Theodosius Dobzhansky, "Nothing in Biology Makes Sense Except in the Light of Evolution," *The American Biology Teacher* 35, no. 3 (1973): 125–29.

8. See, for instance, Anton E. Lawson and John Weser, "The Rejection of Nonscientific Beliefs about Life: Effects of Instruction and Reasoning Skills," *Journal of Research in Science Teaching* 27, no. 6 (1990): 589–606.

acceptance. In other words, you can teach the facts of evolution as a way of increasing acceptance. This method has been shown to be marginally successful among religious individuals,[9] given that worldviews are not easily changed by increased knowledge that is seemingly contradictory to those worldviews. In fact, these methods seem to ignore these conflicts in worldview and the presumed cultural conflict that religious students may be feeling. This type of education can drive away from biology many religious students who feel like they don't belong. However, focusing on how science is done, commonly called "the nature of science,"[10] has shown promise in helping to increase evolution acceptance among college students.[11] Along with teaching the nature of science in biology classes or other science classes, professors at BYU use an additional approach dedicated to helping students directly overcome feelings of conflict they may have between science and religion: the reconciliation approach.

The basic idea behind a reconciliation approach is to help individuals realize that their religious beliefs and evolutionary theory are not mutually exclusive. Dr. M. Elizabeth Barnes and Dr. Sara E. Brownell provided a useful outline for this approach, which they labeled "religious cultural competence in evolution education" (ReCCEE for short), that includes six practices biology instructors can follow: (1) acknowledge that students may perceive conflict between evolution and their religious beliefs; (2) discuss students' views on evolution and religion and

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9. Amanda L. Glaze, M. Jenice Goldston, and John Dantzler, "Evolution in the Southeastern USA: Factors Influencing Acceptance and Rejection in Pre-service Science Teachers," *International Journal of Science and Mathematics Education* 13 (2015): 1191, 1203.

10. This refers to the process of hypothesis testing: experimentation, data gathering, data analysis, and interpretation.

11. Ryan D. P. Dunk and others, "A Multifactorial Analysis of Acceptance of Evolution," *Evolution: Education and Outreach* 10, no. 1 (2017): 4–5; Hernán L. Cofré and others, "The Effect of Teaching the Nature of Science on Students' Acceptance and Understanding of Evolution: Myth or Reality?," *Journal of Biological Education* 52, no. 3 (2018): 255.

encourage them to explore this relationship further; (3) teach students about the nature of science and different ways of finding truth; (4) explain that there are multiple ways of viewing evolution and religion outside of atheism and a literal belief in the biblical creation story, including that evolution was guided by a creator; (5) provide examples of religious leaders and biologists who embrace both evolution and religion; and (6) explicitly discuss the compatibility between evolution and religion and share their own experience reconciling their religious beliefs with evolutionary theory.[12] Our reconciliation approach is patterned after these recommendations (but has been practiced in one form or another at BYU for decades[13]). This approach typically manifests in introductory biology classes where the professor devotes a whole class period to discussing the reconciliation of the science of evolution with our religious beliefs as Latter-day Saints. In this class period, the professor follows the six steps of ReCCEE, provides additional context about the history of evolution in the Church, highlights the fact that the Church has no official position concerning evolution,[14] and shares his or her personal reconciliation story and testimony.

Having been student researchers in Dr. Jamie Jensen's lab at BYU, and having had professors who used this approach, we found that this was an effective way to increase acceptance in traditional undergraduate classroom settings at BYU, at other private religious institutions of various faiths,[15] and even

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12. Barnes and Brownell, "Call to Use Cultural Competence," 5–6.

13. William S. Bradshaw and others, "A Longitudinal Study of Attitudes toward Evolution among Undergraduates Who Are Members of The Church of Jesus Christ of Latter-day Saints," *PLOS One* 13, no. 11 (2018): 1–29, https://doi.org/10.1371/journal.pone.0205798.

14. See "What Does the Church Believe about Evolution?," *New Era* 46, no. 10 (October 2016): 41, reprinted herein, 347; and other chapters in this volume.

15. Katie F. Manwaring and others, "Influencing Highly Religious Undergraduate Perceptions of Evolution: Mormons as a Case Study," *Evolution: Education and Outreach* 8, no. 23 (2015): 1–12; John Lindsay and others, "Using a Reconciliation

when taught in a religion class instead of a science class.[16] This approach is also productive in less traditional settings. In our lab, we found that a fifteen-minute live-animal presentation, which incorporated a reconciliatory model, increased acceptance of evolution among patrons at a small aquarium,[17] and Jasmine M. Truong, M. Elizabeth Barnes, and Sara E. Brownell demonstrated that a six-minute ReCCEE-based lesson at a public institution increased undergraduate acceptance of evolution.[18] In all these instances, we saw no reduction in religiosity by improving evolution acceptance. We even interviewed past students who had been through this approach to determine its effect on their testimonies. All interviewees indicated a positive effect.

As students who have been through BYU and taken a biology class in which the reconciliation approach was used, we would like to share our own personal experiences. These experiences can be found below, following our names (Danny, Ethan, Spencer, and Cassidy). Additionally, we will share some quotes from other students who have also experienced this same approach and documented their experiences through anonymous essays.

Danny

I am currently a postdoctoral researcher in the Department of Biology at North Dakota Statue University, having completed my PhD at BYU, where I studied pedagogical approaches to teaching

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Module Leads to Large Gains in Evolution Acceptance," *CBE—Life Sciences Education* 18, no. 4 (2019): 1–11.

16. Ethan R. Tolman and others, "Reconciling Evolution: Evidence from a Biology and Theology Course," *Evolution: Education and Outreach* 13 (2020): article 19, https://doi.org/10.1186/s12052-020-00133-9.

17. Ethan R. Tolman and others, "Testing the Effect of Aquarium-Based Learning on Patron Acceptance of Evolutionary Theory," *Journal of Zoo and Aquarium Research* 9, no. 2 (2021): 102–9.

18. Jasmine M. Truong, M. Elizabeth Barnes, and Sara E. Brownell, "Can Six Minutes of Culturally Competent Evolution Education Reduce Students' Level of Perceived Conflict between Evolution and Religion?," *American Biology Teacher* 80, no. 2 (2018): 106–15.

evolution to religious audiences with the goal of preserving these students' religious identity. I also investigated the influence of popular culture like Pokémon on student understanding and acceptance of evolution.

I grew up in Mapleton, Utah, in an active Latter-day Saint family and served a mission in the Philippines. I believe that the way I was raised and my love for living organisms shaped my desire for a deeper understanding of the creation and evolution of life on earth.

Growing up, I was one of those kids who was always bringing things home that my parents didn't want (for example, snakes, frogs, and insects). Because of this, I had a multitude of pets. My curiosity was piqued during one particular summer when I was fourteen and I got fifteen chickens for my birthday. I didn't have a lot of friends, so I spent most of my summer outside in my chicken coop watching the chickens run around chasing bugs and mice. I became increasingly curious about my chickens' behaviors; for example, why did they hide when hawks would fly over the coop? I didn't teach them that. Why would they chase each other when one of them had a grasshopper? Why were our roosters so mean? The time I spent outside pondering such things really influenced my desire to better understand the world we live in.

During my mission, as I focused on teaching the gospel, my desire to learn about and understand our wonderful world waned. This was not a problem; I loved my mission, and I loved learning the gospel more fully. However, after I came home from my mission, I found it difficult to find my path forward when I realized that what I had loved most growing up had been pushed aside and forgotten. Like most parents, mine recommended taking some classes to help me find a path for myself. It wasn't until my fourth semester at Utah Valley University that my love for and curiosity about living things was rekindled in a biology class; biology spoke to me. However, the topic that made the greatest impression on me in this biology class was the theory of evolution. Up to this point, my understanding of evolution had

been extremely limited. Learning the full mechanisms behind it brought my love for living organisms into a new and wonderful light. Unfortunately, all the joy and excitement this class brought me was also coupled with agony and disappointment. Where did evolution fit into my religion? I wondered, Is religion compatible with evolution? Do I have to choose between my religious beliefs and evolution? I was lost. Thankfully, my professor held a seminar outside of class for those who wanted to know his personal views on evolution and religion. It turns out that my professor was an active member of The Church of Jesus Christ of Latter-day Saints, a believer in God who accepted evolution and who had successfully reconciled it with his religious faith. When my professor shared his beliefs, my conflicted feelings about evolution abated.

That opportunity to talk to someone who understood my pain in the very moment of my struggle really pushed me onto my current path of helping others who are going through something similar. I now accept the theory of evolution as a scientifically valid theory, and I am still a believer in a loving Heavenly Father and Creator. The research I do is extremely impactful for me as a person of faith. I was given the gift of learning evolution from a faithful professor who understood the importance of teaching evolution in a way that makes everyone, including religious people, feel welcomed. Evolution is not always taught this way, and many students feel that they have to choose between religion and science. As a researcher, I want to help all religious students not only keep their identities in a science classroom but also become more accepting of science as another way of gaining truth. In one of my favorite books, *Faith of a Scientist*, Henry Eyring, a world-renowned chemist and member of the Church, said, "Since the Gospel embraces all truth, there can never be any genuine contradictions between true science and true religion."[19]

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19. Henry Eyring, *The Faith of a Scientist* (Salt Lake City: Bookcraft, 1967), 41.

Ethan

I am currently a postdoctoral research associate in the Department of Biological Sciences at Virginia Tech University. I earned a PhD in evolution, ecology, and behavioral ecology at the City University of New York and Richard Gilder Graduate School at the American Museum of Natural History's Partner Program. At BYU, I earned a bachelor's degree in genetics, genomics, and biotechnology. Most of my research has focused on the evolution and genomics of dragonflies and damselflies.

I have always found biology to be a fascinating subject, and when I was younger, I would spend a lot of time learning about it. At some point, I came across the theory of evolution. It always made logical sense to me. I didn't feel that my belief in evolution and in the doctrine of The Church of Jesus Christ of Latter-day Saints were at odds with one another until I began to notice anti-evolution sentiments expressed by those who held my same religious beliefs. I began noticing more anti-evolution rhetoric in church classes, in seminary, and from extended family members. Sometimes it was even suggested to me, supported with quotes from General Authorities, that it was heretical for a member of The Church of Jesus Christ of Latter-day Saints to accept evolution. It didn't feel right to reject either my acceptance of evolution or my testimony of the restored gospel, but there was a time in my life when thinking about evolution or the creation stories in scripture brought a lot of discomfort and conflict.

I was fortunate enough to have parents who accepted both evolution and the restored gospel and a grandfather who was a biology professor and strongly advocated for evolution education while remaining a faithful member of the Church. Through conversations with my parents and grandfather, I came to understand that evolution and the gospel do not have to be two separate entities in my life. They are two lenses that work together to provide a clearer picture of the world. It was also helpful for me to understand that past Church leaders who rejected evolution

were not speaking for the Church but offering their own opinion, since Church doctrine is established by the First Presidency and Quorum of the Twelve. I also discovered that Church leaders have expressed support for evolutionary theory in the past. These realizations helped me leave behind the conflict I once felt. When I learn about evolution now, it increases my reverence for, and builds my testimony of, God's role as the Creator.

Spencer

I am currently a medical student at the University of Oklahoma College of Medicine. I graduated with a bachelor's degree in Biochemistry from BYU. I grew up in Utah among faithful members of The Church of Jesus Christ of Latter-day Saints. Although my parents have taken classes at BYU, neither of them know much about biology. I remember, as a child, having a conversation with some family members about evolution. Based on erroneous ideas of evolution, we decided that those who accepted evolution were either mistaken or misguided. Like many people, I held a negative and distrustful view of evolution. However, I also had a natural and intense love for science and good parents who fueled that fire with things like kids' chemistry books and trips to zoos and aquariums.

Eventually, I decided I wanted a career in medicine, and my desire to get more involved in science grew. I took biology classes in high school and came to love the subject. Despite my earlier rejection of evolution, I actually came to accept it pretty quickly in high school. I didn't dwell too much on potential conflicts between evolution and the Church, and based on the enormous amount of scientific evidence available, I figured evolution had to be an accurate depiction of the world.

After high school, I served a mission in the Four Corners region of the Southwestern United States. On my mission, I became much more aware of (and worried about) the potential conflict between the Church and the science of evolution. Without many resources available to me, but with a strong belief in the Church I was representing, I came to think that maybe the Church of Jesus

Christ is against evolution. This saddened me, but I was determined to investigate this further when I got home from my mission. And so I did. I read many books, articles, and resources and found differing opinions held by various members and leaders of the Church. I came out of this experience mostly confused. Luckily, shortly after my mission, I started school at BYU, and the first class I attended was Biology 130. A few weeks into the course, my professor addressed the subject using a reconciliation approach. That class became pivotal in helping me resolve all my evolution concerns. Talk about a reconciliation event!

Learning about evolution has helped me to understand the "natural man" (Mosiah 3:19) inherent in humanity. I see great value in recognizing and studying our connections to other animals and our ancient nonhuman ancestors. As someone training to be a physician, I find the study of evolutionary biology riveting, especially as it relates to developing cures for diseases and fighting off natural human frailties. I can now say with full faith that I feel perfectly comfortable accepting evolution. Though the Church is neutral on the matter, my faith and the theory of evolution are reconciled.

Cassidy

I graduated from BYU in 2020 with a bachelor's degree in biology, and shortly after, I worked for the Smithsonian in the National Museum of Natural History as part of the David H. Koch Hall of Human Origins. I am now substitute teaching science and preparing to pursue a graduate degree in genetic counseling.

I grew up in a small town in Idaho and do not remember evolution being discussed. I had never heard evolution referred to as "evil-u-shun"; I don't remember people saying that evolution was contrary to the idea of a Creator. Evolution was never a topic I even thought to consider. But then, when I was in tenth grade, all of a sudden it was in every conversation. And the general attitude toward it was that acknowledging the idea of evolution made God less powerful and narrowed his role in our existence. At

this same time, I discovered my love of biology. I had an incredible teacher who worked with a diverse background of religions. When we reached the evolution section, she emphasized that, in the context of her class, evolution simply referred to a change in allele frequencies (that is, varieties of genetic features) over time. The broad impact of those changes (for example, speciation events or the idea of a common ancestor of humanity) was not talked about very much, but I remember feeling some discomfort with the subject. In my mind, the existence of evolution seemed to imply that there was no place for the core beliefs I had held my entire life. If humans were the result of random changes in genetic features over time, what made me distinct from any other living creature on the planet? What made me a child of God? This thought scared me so much that I couldn't stand to dwell on it.

Fast-forward to twenty-year-old me walking around Ecuador on my mission, sharing my beliefs and taking time to contemplate my place in the world. I loved coming up with questions that made me reevaluate my role and purpose in life. I spent hours trying to understand why I was here and where I came from. This trail of thought brought me back to the question of not only why I was here but also how I came to be here. This time, I felt less fear and more curiosity. So when I got home from my mission and attended another semester of classes at BYU, I took a biology course. I had so many questions, but none loomed larger than that of human origins. This time, when my classmates and I reached the section on evolution, there was no shying away from the implications of change over time. I was fascinated. More than that, when my professor talked about how his faith and his absolute and complete acceptance of evolution were not mutually exclusive, I discovered that I no longer feared my questions. It was one of very few times in my life when I felt my understanding of God and his plan grow instantaneously.

I still have many questions, most of which I realize I won't be able to fully answer with the range of information available to me at this time. And I still pursue answers, because as I learn more

about the origins of human life, I gain greater appreciation for Heavenly Father and the awesome scope of his plan.

What Do BYU Students Think about Evolution?

Over several years, we, as student researchers in the Jensen lab, surveyed students enrolled in introductory biology courses regarding their acceptance of evolution at the beginning and end of the semester. In conjunction with each survey, Dr. Jensen asked students to write a short essay about their thoughts on evolution. In between the two surveys, students were taught evolution with the inclusion of a reconciliation module. Survey data show that students almost universally increase their acceptance of evolution after that module.[20] Student essays reveal that students' feelings toward evolution vary greatly, but a few common themes clearly emerge. The following explanations and quotes are taken from these essays to illustrate these themes.

Student Quotes about . . .

. . . feeling trepidation toward learning about evolution, prior to class.

- When the word "evolution" comes to my mind, I feel a sort of spirit of confusion or contention.
- Evolution makes me think of atheists and arguing with an atheist friend of mine. . . . While there is some truth to the theory of evolution, I believe it to be largely false.

. . . looking for ways to reconcile science and religion.

- I recognize the evolution of species all around me. . . . I can clearly see the resemblance between primates and humans. We

20. Manwaring and others, "Influencing Highly Religious Undergraduate Perceptions"; Lindsay and others, "Using a Reconciliation Module"; Daniel G. Ferguson and Jamie L. Jensen, "Role Models, Compatibility, and Knowledge Lead to Increased Evolution Acceptance," *Evolution: Education and Outreach* 14, no. 1 (2021): article 16, https://doi.org/10.1186/s12052-021-00155-x.

are so alike. We look, think, reason, and even feel in similar ways. Evolution makes sense to me. . . . I know that God is the Creator. I know that the [biblical] account of the Creation is true. It does not make sense to me that humans are a coincidence that happened by some chance of evolution. My source for this belief is different than that for evolution. . . . Now the trouble, or the "unknown," comes when I try to combine both of these truths. Archeological, geological, and any other "-logical" evidence one may find doesn't disprove the scriptural accounts. . . . Frankly, I have thought of how to combine them, and how to make them work together, and have gotten almost nowhere, or at least not anywhere that makes sense to me.

- I honestly have no clue what to think about evolution. All I know is that I have constantly struggled with the view of my church versus my view of evolution. . . . Thinking about evolution scares me because if it's true, does that mean my religion is false? I would hope that both my religious beliefs and evolution could exist in harmony and fit together somehow. For right now though, I don't know if that is possible or if that works, but I would like to see if it does.
- I have always been confused as to how evolution and religion can . . . coexist, [since] they seem to be separate explanations for our existence.
- I could see Heavenly Father using evolution to create humans, or maybe he just made us without evolution. I don't know. I'm not opposed to either way.

. . . their appreciation of a role model.

- I feel like Dr. [Jamie] Jensen had a really good way of combining the theory of evolution with religion, making it a lot more feasible for students to accept who maybe were uncomfortable with the subject or don't really understand it.
- [I liked] how she [Dr. Jamie Jensen] can actually show that, you know, religion and evolution aren't trying to contradict one another; like they don't have to be that way. You can . . . look at evolution from a gospel-centered perspective. . . . [Evolution is] not contradicting anything necessarily about whether God

exists or not. . . . [It's] just taking the facts that we have and trying to understand them as we see them at the moment. . . . We're working towards finding that complete truth or the best understanding we have.

. . . their ability to reconcile.

- Now, I still may not have a "concrete" opinion, but I can say that the more information I have learned about evolution, [the more it] has helped me to grow my acceptance and understanding of why we have evolution. I can see why some people would say that Christians should not believe in evolution, but when looking at the facts, however simple or complex, one can really understand how evolution would fit into a religious or other belief's values and timeline.
- I would say my thoughts on evolution have changed significantly since the beginning of the semester. In the beginning, I was very against it. Now, while I don't think it is 100 percent proven, I do think that it is a possible explanation for how organisms came to be on earth.
- Before this unit I would not have entertained the thought of evolution. . . . I then learned that the Church hasn't made a statement confirming or denying that evolution is real. This means that believing in evolution or not believing in evolution is neither right nor wrong. This makes me lean more toward the idea that evolution is real.
- At the beginning of this unit, I was still very skeptical about evolution. I thought that it conflicted with the teachings of the Church, especially relating to the origin of [humanity]. But now I've learned that the Church doesn't actually have a decided stance on the subject and that what I'd read was not the official position of the Church. This helped me to be much more open to the concept of evolution.

. . . finding peace from being able to reconcile.

- I feel like I can talk more intelligently about things, and . . . I wasn't necessarily . . . at peace with things before, but . . . I am at peace with things now.

- It increased [my testimony]. . . . It was cool. . . . It's not so much that it gave me new information; rather [it] gave me different ways to collect information. It gave me a different mindset that was a little bit more open to realizing that I might be wrong.

As shown by the quotes above, prior to the course, many students express a hesitation at—even at times a fear of—learning about evolution. Many are seeking ways to bring science and evolution together but, up to this point, have been given no bridge to help them reconcile. Students appreciate a role model who can provide them with tools to bring the science and their faith together. As you can see from the quotes we shared, many students find ways to successfully bridge this gap, and they find peace in doing so. As past BYU students who went through what these students have, and as researchers who studied this process, we want to emphasize that it is encouraging and comforting to learn that we can reconcile the religion we love with the science we learn.

Conclusion

As members of a religious community and as students invested in science, reconciling religion and evolution is a fundamental step on our path to becoming successful scientists and faithful religious individuals. The long-standing opposition between the two ways of knowing has left many students feeling like they have to choose one or the other. By forcing this choice, we lose out on the incredible benefits offered by embracing both ways of knowing. As a religious university, if we leave our students with no way to harmonize these two ways of knowing, have we done our best to educate them and promote the critical thinking they will need to confront all the other theological challenges they will encounter?

Each of the students who contributed to this piece has had different experiences with opposition to the theory of evolution. The quotes and experiences gathered from biology classes

indicate that this issue affects a large portion of our student population and that a great deal of confusion continues to surround the subject. For some here at BYU, the perceived conflict between science and religion has been a source of much doubt and uncertainty, but it does not have to be that way. As research suggests, the reconciliation approach is not only effective in helping students learn about and accept evolution, but it also has the potential to ease some of the doubts students experience with their religious beliefs. When students leave their classrooms at BYU, the goal is for them to be prepared for success in all aspects of their lives. By helping them to reconcile their doubts and questions in issues pertaining to science and religion, BYU faculty are providing them with a template for seeking understanding in relation not only to evolution but to every other major question they may encounter.

Danny Ferguson is currently a postdoctoral researcher in the Department of Biology at North Dakota State University. He studies biology education with an emphasis on evolution and is currently working to understand the impact of systems thinking skills and modeling on students' evolution knowledge. He is married to Gina, and together they have five kids.

Ethan Tolman first began pursuing a career in the life sciences as a volunteer and then employee at the Aquarium of Boise in high school. He went on to earn a bachelor's of science in genetics, genomics, and biotechnology from Brigham Young University. As an undergraduate, Ethan worked as a research assistant and published papers on several projects related to public acceptance of evolutionary theory and willingness to engage in nonpharmaceutical interventions to curb the spread of COVID-19. Ethan then earned a PhD in evolution, ecology, and behavioral biology through the City University of New York and Richard Gilder Graduate School at the American Museum of Natural History's Partner Program, where he studied the evolutionary and conservation genomics of Odonata (dragonflies and damselflies). Ethan is currently a postdoctoral research associate in the Department of Biological Sciences at Virginia Tech University. His research interests include: resolving the evolutionary history of dragonflies and damselflies, the role of hybridization as a driver of biodiversity, and the genomics of habitat specialists.

Spencer Shumway is currently a medical student at the University of Oklahoma College of Medicine. Prior to medical school, in 2023, Spencer graduated with a bachelor's of science in biochemistry from BYU. As an undergraduate researcher at BYU, Spencer attended and presented at national conferences and published

several papers. He is a devoted husband and father of two children. Spencer enjoys spending time with his family, gardening, playing basketball, and is an avid film enthusiast.

Cassidy graduated from Brigham Young University in 2020 with a bachelor's degree in biology. Since then she has worked as an independent contractor for the Smithsonian natural history museum, an HR specialist for a biostatistics company, and has recently returned to her love of teaching as a substitute teacher in the charter schools of Las Vegas. She is also preparing applications to genetic counseling programs across the United States and Canada. She still loves to talk about the reconciliation research that she participated in at BYU and loves to see its practical application as friends and family are able to see the connections between science and the gospel.

To the Latter-day Saint Audience . . . from Scientists Who Care

Jamie L. Jensen,
with Constance M. Bertka and Lee Meadows

Science is often portrayed as the antithesis of religion, a constant force trying to undermine the merits or existence of divinity. As a member of The Church of Jesus Christ of Latter-day Saints and therefore a religious scientist (a supposed oxymoron in itself), I have sometimes felt this strain between my religionist identity and my scientist identity. However, that has changed through two experiences: first, the efforts I have put in to understand the true nature of these two ways of knowing; and second, my interactions with a special group of scientists whose purpose of gathering is to engage in and encourage constructive dialogue on the science of human origins and religious belief that moves beyond a common conflict motif and maintains the integrity of both ways of knowing. These scientists are members of the Broader Social Impacts Committee (BSIC) of the Human Origins Program at the Smithsonian Institution's National Museum of Natural History.[1] I have reached out to two prominent past and present members of this team (dear colleagues who are not members of our church but who would consider themselves religious scientists) to speak directly to you, as Latter-day Saints,

1. "Human Origins Initiative Broader Social Impacts Committee," Smithsonian National Museum of Natural History, updated February 3, 2022, https://humanorigins.si.edu/about/broader-social-impacts-committee.

about the efforts that are going on in the scientific community to help address the schism between science and religion.[2]

Dr. Connie Bertka is the past cochair of the BSIC and a Unitarian Universalist. Having completed a bachelor of science in geology at the University of Cincinnati, Bertka was offered an internship at the Lunar and Planetary Institute in Houston, Texas, where she worked with the curator of the lunar rock collection. That experience ignited a passion for viewing Earth as one piece of a larger puzzle. Her graduate career began at Arizona State University with a NASA Graduate Student Researcher Fellowship, where she studied the interior of Mars. Bertka was a predoctoral fellow at the Geophysical Laboratory of the Carnegie Institution for Science in Washington, and after receiving her PhD in geology from Arizona State University, she continued as a postdoctoral fellow and then a senior research associate at Carnegie. While an interdisciplinary effort to explore the origin, extent, and future of life (astrobiology) was gaining momentum at NASA, Bertka had begun taking courses at Wesley Theological Seminary to pursue a personal and scholarly interest in the relationship between science and religion and their influence on public understanding of science. In 2000, she joined the American Association for the Advancement of Science's (AAAS) program of Dialogue on Science, Ethics, and Religion (DoSER) and was program director until 2008. She completed a master of theological studies at Wesley Theological Seminary and accepted an invitation to teach a course on contemporary issues in science and religion at the seminary. One effort she led at AAAS was a multiyear workshop series to encourage the exchange of ideas between astrobiology scientists and humanities scholars. She is the editor of a volume resulting from that work, *Exploring the Origin, Extent, and Future of Life: Philosophical, Ethical, and*

2. These two scientists, Dr. Connie Bertka and Dr. Lee Meadows, are quoted extensively throughout this manuscript. Their quotes come from direct written correspondence with the author.

Theological Perspectives.[3] Currently Bertka's work is focused on science education and public engagement, continuing to nurture conversations between the scientific community and religious communities.

Dr. Lee Meadows is a member of the BSIC and a Presbyterian (PCA) who grew up in Christian Fundamentalism. After finishing an undergraduate degree focused on premedical studies, he opted out of medical school, instead becoming a high school chemistry and physics teacher after a brief stint as a youth director in a Southern Baptist church. He earned a master's degree in science education from the University of Texas at Austin and a PhD in the same field from the University of Georgia. He served on the faculty as a science educator with the University of Alabama at Birmingham (UAB) for most of his career, where he focused on preparing the next generation of science teachers. Meadows helped lead the development of UABTeach, the first UTeach site in Alabama. His work on the teaching of evolution in religious contexts spans multiple decades, including many peer-reviewed publications and two books. He is now the executive director of the Alabama STEM Council.

Bertka's and Meadows's words are full of wisdom and of hope for a better future where religious individuals can fully embrace the blessings brought by science, and where scientists (even nonbelievers) can respect the merits of religious belief to those who believe. It is my hope that you will read their words with humility and with a desire to understand and appreciate their efforts and the efforts of those they describe. I have paraphrased or directly quoted their words to convey several important messages. These messages are as follows:

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3. Constance M. Bertka, ed., *Exploring the Origin, Extent, and Future of Life: Philosophical, Ethical, and Theological Perspectives* (Cambridge: Cambridge University Press, 2009).

1. The "science versus religion" warfare model is a myth.
2. Not all scientists are antireligious; both sides of the aisle have contributed to this misconception.
3. Monumental efforts are being undertaken by scientists (some religious and others not) to bridge the gap between science and religion.
4. There is hope for reconciliation.

The "Science versus Religion" Warfare Model Is a Myth

Bertka skillfully outlines the history of the intersection between science and religion over the centuries. She argues that "historians who have studied the relation between science and religion through time would remind us that many scientists and clergy from historical times would have been puzzled by a question about reconciliation." Bertka points out that among the early church fathers, Augustinian logic reigned, which emphasized "using the truth learned from the study of nature in biblical exegesis or apologetics"; only one, Tertullian, seemed opposed to harmonizing faith and science, and this view was mislabeled as the prevailing viewpoint by two mistaken individuals, John William Draper and Andrew Dickson White, and it has carried into the twenty-first century.[4] Meadows remarked, "Early in my career as a science educator, I became tired of the warfare mentality between creationism and evolution. I saw it as a dead end as far as teachers and students were concerned." And I would agree.

Even during the second thousand years of Christianity, Bertka emphasizes that "it was within the monastic communities that classical manuscripts were collected and copied, leading to the preservation of the natural sciences, . . . [and] much of it created no controversy for existing theological thought." This coalescent

4. See John W. Draper, *History of the Conflict between Religion and Science* (London: Henry S. King, 1876); Andrew W. White, *A History of the Warfare of Science with Theology in Christendom* (New York: Appleton, 1896).

view prevailed through the Scientific Revolution, especially since those studying science were as religious as the general population.[5] However, historians have noted that while secularism grew as science progressed, the correlation between the two is complicated. As John Brooke rightly pointed out, "Instead of regarding science as the agent of an inexorable secularization, it is surely more accurate to say that scientific theories have been susceptible of both theistic and atheistic readings. Historically they have provided resources for both. Sometimes the same scientific concept, in different hands, has been manipulated to generate a sense of the sacred or the profane."[6]

Bertka concludes, "While there is not a simple association between advancement in science and decline in religious belief or authority, it is also the case that by the mid-twentieth century, theologians largely viewed science as 'irrelevant to theology.'" This approach has continued until the present day. Meadows comments that in the high school classroom, the traditional view is either "Check your religion at the door. We don't talk about that in biology," or a simpler approach of just avoiding teaching evolution at all.[7] Meadows pleads, "Teachers needed a third alternative," and Bertka warns that "this gap of irrelevancy [is] dangerous to both humanity and more broadly nature," and they are not alone in these thoughts. This has led to many tremendous efforts on the part of scientists to bridge this gap, many of which I will discuss below.

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5. John Henry, "Religion and the Scientific Revolution," in *The Cambridge Companion to Science and Religion,* ed. Peter Harrison (Cambridge: Cambridge University Press, 2010), 39–58.

6. John H. Brooke, "Science and Secularization," in *The Cambridge Companion to Science and Religion*, ed. Peter Harrison (Cambridge: Cambridge University Press, 2010), 110.

7. Michael Berkman and Eric Plutzer, "An Evolving Controversy: The Struggle to Teach Science in Science Classes," *American Educator* 36, no. 2 (Summer 2012): 12–40.

Not All Scientists Are Antireligious; Both Sides of the Aisle Have Contributed to This Misconception

But first, let us dispel this misconception that all scientists are antireligious. As Bertka so aptly points out, "many people assume that scientists are antireligious, a caricature unfortunately popularized by both the media's common portrayal of science and religion in conflict and the highly publicized views of some well-known scientists like Richard Dawkins."[8] But then she asks, "What do we know about the religious beliefs of scientists and how scientists view the relationship between science and religion?" Let's find out.

In a detailed study of scientists (biologists and physicists) from eight regions of the world (France, Hong Kong, India, Italy, Taiwan, Turkey, the United Kingdom, and the United States) in 2011 and 2012, Elaine H. Ecklund and her colleagues found that most scientists are more secular than the general population.[9] However, the assumption that the majority embrace a *Conflict* approach (that is, that evolution and religion are in direct conflict and therefore only one can be true) is wrong. In fact, in the United States, 51 percent favored an *Independence* approach (that is, that evolution and religion approach truths from independent, nonoverlapping views), while only 29 percent ascribed to *Conflict.* Interestingly, Ecklund and colleagues found that only 22 percent would agree that learning science had made them less religious. Bertka asks a poignant question: "If learning about science does not necessarily erode religious belief, then what accounts for the lower percentage of religious scientists compared to the religiosity of the general public?" Researchers have suggested that it is a result of most of the scientists growing up in homes where

8. Elaine H. Ecklund and others, "Religion among Scientists in International Context: A New Study of Scientists in Eight Regions," *Socius: Sociological Research for a Dynamic World* 2 (2016): 1–9.

9. Ecklund and others, "Religion among Scientists," 1–9.

religion was not prevalent.[10] Consequently, Bertka points out, "We might be concerned that their absence in religious communities is a challenge for the communication of science to a religious public." Indeed, Bertka asks, "If scientific discoveries are viewed as threatening to religious beliefs, how can scientists unfamiliar with a religious tradition respond to these concerns?" This leads to less-than-culturally-sensitive responses from scientists to religious individuals that may drive the wedge between science and religion deeper.

But how have religionists approached this divide? Sometimes it has been in ways that cause great harm to those trying to reconcile. Meadows teaches evolution in the Deep South, and as he explains, "The American South is often seen as the toughest U.S. region for the teaching of evolution." This is most likely due to "white Evangelical churches [that] typically object to evolution;[11] . . . this opposition is rooted in Fundamentalism and its literal interpretation of the Bible."[12] When applied to biblical Creation, the only conclusion is to hold to a young earth; "any form [of] Evolutionary Creationism is seen as deeply suspect and probably heretical by most white Evangelicals in the South. This is chiefly because they view evolution as in conflict with Biblical revelation."[13] This creates issues with biology teachers who themselves are Evangelical Christians but who feel ostracized for teaching the science they love. One teacher commented to Meadows, "Lee, I would love to teach evolution. It's the right thing to do. It's the science my students need to know. But if I teach evolution

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10. Elaine H. Ecklund, *Science vs. Religion: What Scientists Really Think* (New York: Oxford University Press, 2010).

11. See David Masci, "Overview: The Conflict between Religion and Evolution," Pew Research Center, updated February 3, 2014, https://www.pewforum.org/2009/02/04/overview-the-conflict-between-religion-and-evolution.

12. See Joseph W. Shane and others, *Making Sense of Science and Religion: Strategies for the Classroom and Beyond* (Arlington, Va.: National Science Teachers Association, 2019).

13. "What Is Evolutionary Creationism?," Biologos, updated February 18, 2020, https://biologos.org/common-questions/what-is-evolutionary-creation.

in my community, people at my church will never speak to me again." In fact, in his youth, Meadows heard this message from his own church: "Son, people who ask those kinds of questions [that is, about evolution] end up in Hell." Meadows concludes, "Teaching evolution in many Southern communities is too high of a personal price for biology teachers to pay, and they don't teach it." What are teachers to do when they are forced to feel that their "eternal soul and the souls of those around [them stand] in the balance"? What are students to do when they have questions about science, but their religious leaders are telling them not to ask? They likely do as Meadows did as a teenager: "I stopped asking questions, which is often a tragic choice for a child to make. I learned to keep all my questions inside."

It wasn't until Meadows began to understand the true nature of science that he was able to reopen his curiosity and start to attempt reconciliation of these truths.

> When I entered a Ph.D. program in science education, . . . I began to better understand the nature of science. As I began to see how scientific knowledge is developed, I had a major flash of insight. Why was I expecting science and the Bible to agree when they came to be in such different ways? This was my break with Fundamentalism. Up until that point, I had accepted the fundamentalist idea that "All truth is God's truth." This idea had required me to always try to figure out whether evolution or the Bible was true when they disagreed. According to Fundamentalism, there is always only one truth, and I was supposed to find it. As I began to realize humans had multiple ways of knowing, I started to feel free finally to learn about evolution without feeling that my eternal destiny was in the balance. . . . I [had] missed the opportunity to learn about evolution in high school and college because I feared for my soul. The churches I was in forced a dichotomy between faith and science.

Never should truth from one way of knowing be set at odds with truth from another. As then-Elder Russell M. Nelson, now

President of The Church of Jesus Christ of Latter-day Saints, so aptly put it, "All truth is part of the gospel of Jesus Christ. Whether truth comes from a scientific laboratory or by revelation from the Lord, it is compatible."[14] Our students should never fear for their souls when seeking truth.

Monumental Efforts Are Being Undertaken by Scientists (Some Religious and Others Not) to Bridge the Gap between Science and Religion

Lest we, as Latter-day Saints, feel alone in this struggle to bridge the gap between science and religion, I would like to outline the efforts of religious scientists of all walks of faith to do this same thing in very public and productive ways that may have escaped the notice of many in our community. In fact, Bertka points out this major challenge that cannot be overlooked (and of which you, as a reader, can likely appreciate the gravity): "New efforts at broader public engagement are noteworthy and hopefully will continue to grow; however, it still remains the case that many people in the pews are unaware of the field, and most religious leaders, including those who receive advanced degrees from seminaries, are not required to explore the relationship between science and religion."

To amend this oversight, and with the help of Bertka and Meadows, I will outline some notable efforts below:

1. Perhaps most famous in this area is Ian Barbour, a Christian scientist who published a book on this topic, *Issues in Science and Religion.*[15] In 1997, at the request of the Holy See, Barbour published a chapter titled, "Ways of Relating Science and Theology."[16]

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14. Russell M. Nelson, quoted in "Life Sciences Building Dedicated," Brigham Young University, accessed May 2, 2022, https://lifesciences.byu.edu/life-sciences-building-dedicated.

15. Ian G Barbour, *Issues in Science and Religion* (New York: Harper and Row, 1966).

16. Ian G Barbour, "Ways of Relating Science and Theology," in *Physics, Philosophy, and Theology: A Common Quest for Understanding,* 3rd ed., ed. Robert J.

Briefly, he described four options: First is *Conflict,* the assumption that both science and theology make "contrasting literal statements about the history of nature" (one that Barbour disfavors). Second is *Independence,* the idea that science and religion have boundaries that do not overlap. Bertka describes it best: "This implies, for example, that the creation stories in Genesis can be read as providing insight into the relation between God and humans and God and the world, a message that remains important even when the cosmology prevalent at the time the stories were written is at odds with current scientific understanding. Science is about the business of understanding the natural world using explanations drawn from observations of the natural world and experimentation." Third is *Dialogue,* an approach that allows for discussions at the intersection but does not require that either be reformulated to fit together as a systematic whole. And fourth is *Integration,* an approach that encourages the crossing of boundaries to align theological doctrines with scientific discoveries. (These can be explored further in Barbour's essay "Ways of Relating Science and Theology"; also note that we, as authors, use both *Dialogue* and *Integration* approaches in our work.)

2. Ralph Wendell Burhoe, a Unitarian Universalist and then a professor of "theology and the sciences" at Meadville Lombard Theological School, helped to establish the Institute on Religion in an Age of Science (IRAS) in 1954 and published the first issue of an academic journal committed to the topic of religion and science, *Zygon,* in 1966. Bertka points out, "To this day IRAS is engaged in the publication of the journal *Zygon* and continues to hold yearly conferences on topics at the intersection of religion and science on Star Island [New Hampshire]. From its conception, IRAS envisioned the promotion of dialogue between science and religion as in the best interest of humanity and 'worldwide cooperation.'" By the 1980s, two more centers were established, the

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Russell, William J. Stoeger, and George V. Coyne (Vatican City State: Vatican Observatory Foundation, 1997): 21–48.

Center for Theology and Natural Sciences and the Zygon Center for Religion and Science, encouraging scholarly work in this area. And in 2003, a second scholarly academic journal was created, *Theology and Science*.

3. Additional societies have been established through other channels: the European Society for the Study of Science and Theology, established in the mid-1980s, and the International Society for Science and Religion, established in 2002.

4. In 1995, the world's premier scientific association, the American Association for the Advancement of Science, created the program Dialogue on Science, Ethics, and Religion. Their purpose is to "facilitate communication between scientific and religious communities."[17] What began as a gathering of scholars, both religious and nonreligious, interested in the intersection of science and religion has now grown into a community-based, public outreach movement aimed at encouraging an active dialogue between science and religion. Their efforts are frequently reported in AAAS's own journal, *Science*.

5. In 2009, Dr. Rick Potts, a paleoanthropologist with the Smithsonian National Museum of Natural History, invited Dr. Connie Bertka and Dr. James Miller to create and cochair a Broader Social Impacts Committee in conjunction with the building of a new exhibit, the *Hall of Human Origins*, with the title "Exploring Human Origins: What Does It Mean to Be Human?" As Bertka explains, "Rather than dismiss or ignore religious concerns about the science of human origins, the Smithsonian *Hall of Human Origins,* under Dr. Potts's leadership, acknowledges these concerns and works to nurture respectful understandings." She further describes, "In a seminar room located among the massive rows of the collections of the Smithsonian's National Museum of Natural History, theologians, clergy, scientists, and educators have been meeting . . . [and discussing] the possibilities

17. "About DoSER," AAAS DoSER, accessed September 24, 2020, https://www.aaas.org/programs/dialogue-science-ethics-and-religion/about.

that open up if *Conflict* and *Independence* approaches to science and religion are not permitted to curtail further discussion." As part of this effort, Potts and his team have created a traveling exhibit of the *Hall of Human Origins* that has been on display at nineteen public libraries around the country, "bringing the science of human origins to these communities, creating a welcoming space for them to explore that science, encouraging them to connect human evolution to their own lives, and perhaps most importantly, hearing their perspectives on the topic."

6. In 2009, Lee Meadows published a book, *The Missing Link: An Inquiry Approach for Teaching All Students about Evolution*, outlining how to teach evolution to high school students without making them feel like their faith is under assault.[18] In this approach, Meadows emphasizes that teachers "just ask students to understand, as best they are able, evolution as a powerful scientific idea explaining large amounts of evidence. Teachers do not, however, ask students to change their deeply held beliefs, especially their religious beliefs." From there, as part of an NSF-funded project led by Dr. Briana Pobiner of the Smithsonian's Human Origins Project "Learning Unity and Diversity in Alabama (LUDA)," Meadows is recruiting Alabama teachers to field-test the LUDA curriculum, leading the charge to teach human evolution in Alabama in a way that allows for students to retain their religious beliefs while learning the foundational theory of biology.[19] In response to the LUDA program, one teacher remarked, "[LUDA] not only validated where kids were at; . . . it gave them a voice, . . . which helped them buy in."[20]

7. In 2017, the Howard Hughes Medical Institute Department of Science Education began funding a series of workshops to facilitate collaborations between university-level biology

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18. Lee Meadows, *The Missing Link: An Inquiry Approach for Teaching All Students about Evolution* (Portsmouth, N.H.: Heinemann, 2009).

19. Dobzhansky Theodosius, "Nothing in Biology Makes Sense except in the Light of Evolution," *American Biology Teacher* 35, no. 3 (March 1973): 125–29.

20. Lee Meadows, unpublished interview data.

teachers, university theologians, and local pastors and ministers from the community to discuss ways to encourage *Integration* of the science of evolution with religious beliefs for a variety of religious affiliations. The project, held at Brigham Young University, has produced curricular materials for university faculty to use in their classrooms to facilitate *Integration,* as well as a series of video resources discussing ways that participants have reconciled evolution and their religious beliefs.[21] This has become a rich resource for educators across the country and has resulted in several publications outlining its effectiveness in increasing evolution acceptance without decreasing religiosity.[22]

There Is Hope for Reconciliation

Throughout these efforts, it is clear that there are several promising solutions for achieving some form of *Integration* or *Reconciliation* between the science of evolution and religious faith. Two of the most prominent solutions seem to be (1) "boundary pioneers," such as Francis Collins (an evangelical Christian, the director of the National Institutes of Health, author of *The Language of God,* founder of BioLogos, and most recently the recipient of the prestigious 2020 Templeton Prize), Connie Bertka, and Lee Meadows, who are willing to openly and publicly discuss ways to reconcile science and faith; and (2) science education researchers who are willing to study ways to teach culturally controversial

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21. "Reconciling Evolution: About Us," BYU College of Life Sciences, accessed February 11, 2025, https://biology.byu.edu/reconciling-evolution.

22. Daniel G. Ferguson and Jamie L. Jensen, "Role Models, Compatibility, and Knowledge Lead to Increased Evolution Acceptance," *Evolution: Education and Outreach* 14, no. 16 (2021), https://doi.org/10.1186/s12052-021-00155-x; Mahealani Kaloi and others, "Exploring the Relationship Between Science, Religion, and Attitudes toward Evolution Education," *American Biology Teacher* 84, no. 2 (2022): 75–81; Ethan R. Tolman and others, "Barriers to Teaching Evolution in Higher Education," *Evolution: Education and Outreach* 14, no. 12 (2021), article 12; Ethan R. Tolman and others, "Reconciling Evolution: Evidence from a Biology and Theology Course," *Evolution: Education and Outreach* 13, no. 19 (2020), article 19; John Lindsay and others, "Using a Reconciliation Module Leads to Large Gains in Evolution Acceptance," *CBE-Life Sciences Education* 18, no. 58 (Winter 2019): 1–11.

issues in high schools and colleges. Regarding the latter, I would like to highlight the evidence we have accumulated for the success of reconciliation efforts in the classroom, specifically when teaching about evolution. Researchers suggest (and they have evidence to back it up) that the best way forward for educators is to dismiss the idea that student religious beliefs are misconceptions in need of correction and instead to acknowledge them in a culturally competent way as part of the students' worldviews and to encourage *dialogue* and potential *integration.*[23] Even in public

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23. Lawrence C. Scharmann, "Teaching Evolution: Designing Successful Instruction," *American Biology Teacher* 55, no. 8 (November–December 1993): 481–86; Mike U. Smith, "Counterpoint: Belief, Understanding, and the Teaching of Evolution," *Journal of Research in Science Teaching* 31, no. 5 (May 1994): 591–97; Zoubeida R. Dagher and Saouma BaouJaoude, "Scientific Views and Religious Beliefs of College Students: The Case of Biological Evolution," *Journal of Research in Science Teaching* 34, no. 5 (May 1997): 429–45; C. Sheldon Woods and Lawrence C. Scharmann, "High School Students' Perceptions of Evolutionary Theory," *Journal of Science Education* 6, no. 2 (2001): 1–20; Lawrence C. Scharmann, "A Proactive Strategy for Teaching Evolution," *American Biology Teacher* 67, no. 1 (January 2005): 12–16; Steven D. Verhey, "The Effect of Engaging Prior Learning on Student Attitudes toward Creationism and Evolution," *BioScience* 55, no. 11 (November 2005): 996–1003; Ronald S. Hermann, "Evolution as a Controversial Issue: A Review of Instructional Approaches," *Science and Education* 17 (2008): 1011–32; Mike U. Smith, "Current Status of Research in Teaching and Learning Evolution: I. Philosophical/Epistemological Issues," *Science and Education* 19 (2010): 523–38; Sherry A. Southerland and Lawrence C. Scharmann, "Acknowledging the Religious Beliefs Students Bring into the Science Classroom: Using the Bounded Nature of Science," *Theory Into Practice* 52, no. 1 (2013): 59–65; Katie F. Manwaring and others, "Influencing Highly Religious Undergraduate Perceptions of Evolution: Mormons as a Case Study," *Evolution: Education and Outreach* 8, no. 23 (2015), https://doi.org/10.1186/s12052-015-0051-6; M. Elizabeth Barnes and Sara E. Brownell, "A Call to Use Cultural Competence When Teaching Evolution to Religious College Students: Introducing Religious Cultural Competence in Evolution Education (ReCCEE)," *CBE-Life Sciences Education* 16, no. 4 (Winter 2017): 1–10; Jasmine M. Truong, M. Elizabeth Barnes, and Sara E. Brownell, "Can Six Minutes of Culturally Competent Evolution Education Reduce Students' Level of Perceived Conflict between Evolution and Religion?," *The American Biology Teacher* 80, no. 2 (February 2018): 106–15; Lindsay and others, "Using a Reconciliation Module"; Tolman and others, "Reconciling Evolution"; Jason R. Wiles and Brian Alters, "Effects of an Education Experience Incorporating an Inventory of Factors Potentially Influencing Student Acceptance of Biological Evolution," *International Journal of Science Education* 33, no. 18 (December 2011): 2559–85; Jason R. Wiles, "Gifted Students' Perceptions of Their Acceptance of Evolution, Changes in Acceptance, and Factors Involved Therein," *Evolution: Education and Outreach* 7, no. 4 (2014),

high schools, where concerns about separation of church and state arise, efforts have proven to be acceptable and successful. For example, Bertka and others (2019) developed a "Cultural and Religious Sensitivity (CRS) Teaching Strategies Resource" as part of the *Teaching Evolution through Human Examples* project,[24] an exploratory design-based study that created four curriculum units for advanced placement (AP) biology classes.[25] The CRS aids teachers in creating a positive learning experience for students encountering the topic of evolution by encouraging both an acknowledgement of students' religious or cultural concerns about evolution and an introduction to the variety of possible relationships between science and religion.

Bertka notes, "What is particularly encouraging to [me] is that [these studies], all of which encourage a proactive approach to acknowledging religious belief in the science classroom, were supported with funding from the National Science Foundation (NSF)." Meadows explains that the LUDA project is also funded by NSF and has proven to be largely impactful in decreasing conflict in one of the hardest places in the country to teach evolution. I hope it is abundantly evident that the scientific community is not the antithesis to the religious community; that many, many scientists and the large national organizations to which they belong care deeply about this issue and are putting forth tremendous effort to help bridge the gap between science and religion; and that we still have much to learn about the mechanisms by which to do this. It is surely a picture of hope.

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article 4; Pratchayapong Yasri and Rebecca Mancy, "Student Positions on the Relationship between Evolution and Creation: What Kind of Changes Occur and for What Reasons?," *Journal of Research in Science Teaching* 53, no. 3 (2016): 384–99; Constance M. Bertka and others, "Acknowledging Students' Concerns about Evolution: A Proactive Teaching Strategy," *Evolution: Education and Outreach* 12, no. 3 (2019), https://doi.org/10.1186/s12052-019-0095-0.

24. Bertka, "Acknowledging Students' Concerns."

25. Briana Pobiner and others, "Using Human Case Studies to Teach Evolution in High School Biology Classrooms," *Evo.Edu.Outreach* 11, no. 3 (2018), https://doi.org/10.1186/s12052-018-0077-7.

Conclusion

Bertka began her remarks with an interesting question: "Reconciling science and religion: Whose job is it?" I hope through this essay it is apparent that there are many in the scientific community who believe at least part of that job falls to them. I would agree with Bertka's answer to this question: "Renewed efforts by the scientific community to encourage and support this broader conversation illustrate that the task of reconciliation between science and religion need not be ignored or delegated to the purview of religious institutions only. Science is supported by society and, in turn, through an openness to this conversation, [science] can offer its support to a society struggling to utilize 'the two most important forces in today's world' (Rolston 1987, vi),[26] science and religion."

Let us, as Latter-day Saints, join hands with our fellow brothers and sisters of other religions across the globe and, with our religious scientist friends, be an active part of this incredible effort.

Jamie L. Jensen is a professor in the Department of Biology at Brigham Young University. Her research program focuses on educational implementations for teaching biology, and a large part of her work examines the reconciliation of religious faith with topics in science, especially evolution. As a member of the Broader Social Impacts Committee of the Human Origins Project at the Smithsonian's National Museum of Natural History, she works with scientists from a variety of religious denominations to help the public feel more comfortable with human evolution. In addition, with generous funding from the Department of Science Education at the Howard Hughes Medical Institute, she has brought together biologists, theologians, and local pastors and ministers from a variety of religions to help students accept the science of evolution without losing religious faith. She has built a website full of resources for the faithful seekers of reconciliation (https://biology.byu.edu/reconciling-evolution/) Her most fulfilling role, however, is being a wife and a mother of four boys.

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26. Holmes Rolston III, *Science and Religion: A Critical Survey* (Philadelphia: Temple University Press, 1987), vi.

On the Official Position of The Church of Jesus Christ of Latter-day Saints on Evolution

The 1909 and 1925 First Presidency Statements in Historical and Scientific Contexts

T. Benjamin Spackman

Since 1992 there has been an approved packet of readings on evolution and the origin of man for BYU students. The introduction to it says, "Formal statements by the First Presidency are the definitive source of official Church positions." The 1909 First Presidency statement, "The Origin of Man," and the 1925 First Presidency statement, "'Mormon' View of Evolution," are included in the packet. Both statements affirm the divine creation of mankind declared in the scriptures.[1] Latter-day prophets have thus unequivocally and repeatedly declared that God created all people in his image. At the same time, the First Presidency has refrained from explaining how God created his children, presumably because "nothing has been revealed concerning evolution."[2]

The purpose of this chapter is to situate the 1909 and 1925 First Presidency statements in historical and scientific contexts.

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1. Both statements are included in the official Brigham Young University evolution packet approved by the board of trustees. For the packet's history, see William E. Evenson, "Introduction—the *BYU Evolution Packet* and Cover Sheet," in *Mormonism and Evolution: The Authoritative LDS Statements,* ed. William E. Evenson and Duane E. Jeffery (Salt Lake City: Greg Kofford Books, 2005), 1–5. Compare Stephen Ott, "An Explanation of the BYU Library Packet on Evolution," *Perspective* (2004): 30–37. The packet itself is available in BYU's Harold B. Lee Library and various places online.

2. "What Does the Church Believe about Evolution?," *New Era* 45, no. 10 (October 2016): 41.

Reading them in context makes it clear that *individual* leaders held and preached strong and varied views on evolution. It also clarifies that Church leaders have considered scientific research a valid way to seek knowledge about human origins and have not excluded evolution as a means by which God created. This history of the 1909 and 1925 First Presidency statements also shows that the Church's official view of evolution in the early twentieth century was more cautious, tentative, and open than has often been assumed.

Scientific Contexts: Darwin's Eclipse and Changing Conceptions of Science

The period from the 1880s through the 1920s is known as the "eclipse of Darwinism." During this eclipse, "many biologists believed that [Darwin's] theory of natural selection could not adequately account for organic evolution. The criticism of Darwinism by scientists misled many laypeople into concluding that the scientific community had lost faith in organic evolution generally."[3]

That was overly simple. In fact, the increasing evidence that plant and animal life had evolved over geological lengths of time convinced many scientists of the reality of evolution, but many scientists also perceived Darwin's proposed mechanism as having serious scientific issues.[4] Consequently, laypeople and even scientists outside of biology often perceived technical critiques of Darwin or natural selection as critiques of evolution itself. James E. Talmage showed his awareness of this distinction (as well as the pre-Darwinian history of evolutionary ideas) in an

3. Ronald L. Numbers, "George Frederick Wright: From Christian Darwinist to Fundamentalist," *Isis* 79, no. 4 (December 1988): 640. Compare Peter J. Bowler, "The Eclipse of Darwinism: Scientific Evolutionism, 1875–1925," in *Evolution—the History of an Idea*, 25th anniversary ed. (Berkeley: University of California Press, 2009), 224–73.

4. Alternative mechanisms for evolution were entertained, but they are beyond the scope of this paper. For more details, see Bowler, "Eclipse of Darwinism."

1890 public lecture: "Evolutionism is not Darwinism. There were many evolutionists, and indeed some Darwinians before Darwin."[5]

The rediscovery of Mendelian rules of inheritance and the new science of population genetics led scientists back to natural selection in the 1920s and 1930s. The combination of these separate fields, data, and observations came together neatly as the "modern synthesis" (so named in 1942). The additional discoveries of DNA, its structure, and its role as the mechanism of inheritance—that is, genetics—in the late 1940s and early 1950s further augmented the "modern synthesis." As one popular history book puts it, "Darwin's ideas gained their true explanatory power in the light of modern genetics."[6]

This all happened within a larger context of debate about what "science" is and how we recognize it. How do we distinguish good science from bad science, nonscience, or pseudoscience? Philosophers of science refer to these questions as the "demarcation problem." The competing answers have changed over time, and these questions remain somewhat unresolved today.[7]

In the 1600s, the dominant conception of "science" shifted away from Aristotle toward Isaac Newton and Francis Bacon. In simplified terms, Bacon invented much of what would become "modern" science—empirical gathering of facts, experimentation, extensive observation of nature, and inductive reasoning.[8] However, Baconian science led to an overly stark distinction: to

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5. James E. Talmage, "The Theory of Evolution," lecture, Utah County Teachers' Association, Provo, Utah, March 8, 1890, 6.

6. Adam Laats, *Creationism USA: Bridging the Impasse on Teaching Evolution* (New York: Oxford University Press, 2021), 56.

7. See, for example, Massimo Pigliucci, *Nonsense on Stilts: How to Tell Science from Bunk* (Chicago: University of Chicago Press, 2010); Michael D. Gordin, *On the Fringe: Where Science Meets Pseudoscience* (New York: Oxford University Press, 2021); and Michael D. Gordin, *The Pseudo-science Wars: Immanuel Velikovsky and the Birth of the Modern Fringe* (Chicago: University of Chicago Press, 2012).

8. These are not without real problems. See Richard DeWitt, *Worldviews: An Introduction to the History and Philosophy of Science,* 2nd ed. (Malden, Mass.: Wiley-Blackwell, 2010).

qualify as scientific, something had to be measurable, quantifiable, and demonstrable in a laboratory. Facts were scientific, but explanations of those facts never could be. At the extreme, Baconian science preferred to gather data forever without trying to provide comprehensive (and reliable) explanations of that data—in other words, scientific theories.

In nineteenth-century America and the British Isles, a dominating Baconian perspective morphed into a newer philosophy called Scottish common sense realism. This popular view applied Baconian ideas to religion as well as science, in the sense that both nature *and* scripture were accessible and understandable to the common person and subject to common sense.[9] Common sense realism was "unquestionably *the* American philosophy . . . [and] above all democratic or anti-elitist."[10] God revealed facts, both in scripture and in nature, and the way to discover truth was simply to catalogue and arrange all those facts that God had revealed. An 1872 statement from influential Presbyterian Princeton Seminary professor Charles Hodge is often cited to illustrate this view: "The Bible is to the theologian what nature is to the man of science. It is his store-house of facts; and his method of ascertaining what the Bible teaches, is the same as that which the natural philosopher adopts to ascertain what nature teaches."[11]

Enter the early twentieth-century debate over evolution, science, and scripture: Was evolution "scientific" by the popular Baconian standard? Did it pass the "common sense" test? Did scripture constitute a divine encyclopedia of relevant geological and biological facts?

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9. See the other chapters as well, but especially George M. Marsden, "Everyone One's Own Interpreter? The Bible, Science, and Authority in Mid-Nineteenth-Century America," in *The Bible in America,* ed. Nathan O. Hatch and Mark A. Noll (New York: Oxford University Press, 1982), 79–100.

10. George M. Marsden, *Fundamentalism and American Culture: The Shaping of Twentieth-Century Evangelicalism, 1870–1925,* 2nd ed. (New York: Oxford University Press, 2006), 14.

11. Charles Hodge, *Systematic Theology,* vol. 1 (New York: Charles Scribner, 1872), 10.

Historians have collected examples showing how common sense philosophy and contested conceptions of "science" affected the debate at the time. With regards to common sense, many Americans cast a skeptical eye at trained scientists making evolutionary claims because "in spite of so much learning [scientists] arrived at conclusions that common sense knew to be patently unscientific."[12] Apes did not birth humans; everyone knew that. (Of course, that rhetoric did not reflect what scientists actually claimed.) As for Baconian standards of science, they had already started shifting; in 1861, Darwin had remarked that there had been "much talk that geologists ought only to observe and not theorise; and I well remember some one saying that at this rate a man might as well go into a gravel-pit and count the pebbles and describe the colours."[13]

However, Baconian ideals remained strong in religious contexts, particularly among those opposed to evolution. Historian George Marsden observed that fundamentalists in the early twentieth century "resisted Darwin, . . . but they were not opposed to science as such. Rather, they were judging the standards of the later scientific revolution by the standards of the first—the revolution of Bacon and Newton. In their view, science depended on fact and demonstration, and Darwinism, so far as they could see was based on neither."[14]

Ronald Numbers, preeminent historian of science and creationism in America, writes that anti-evolutionists "insiste[d] on the factual, nontheoretical nature of science harmoniz[ing] with the once-venerated teachings of the English philosopher Francis Bacon, whose name in nineteenth-century America had symbolized correct scientific method. By narrowly drawing the boundaries of science and emphasizing its empirical nature,

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12. Marsden, *Fundamentalism,* 213.

13. Charles Darwin, quoted in Frederick Burkhardt, ed., *The Correspondence of Charles Darwin,* vol. 9 (Cambridge: Cambridge University Press, 1994), 269. My thanks to Jared Patch for making me aware of this citation.

14. Marsden, *Fundamentalism,* 214.

creationists could at the same time label evolution as false science, claim equality with scientific authorities in comprehending facts, and deny the charge of being antiscience."[15]

The "warfare" or "conflict hypothesis" was another late-nineteenth-century intellectual trend. It portrayed "science" and "religion" as fixed historical concepts that had been and inevitably would be at war with each other. This simplistic "conflict hypothesis" and its founding historical falsehoods—like Columbus and a flat earth—became culturally pervasive and remain widely believed to the present day.[16] This particular context is a reason why many people today instinctively frame the evolution issue in terms of "science versus religion."

It may be surprising to learn, then, that one cannot neatly equate "scientists" with evolution and "Christians" against it; most scientists *were* Christians (and fell into both pro- and anti-evolution camps), and many Christians *supported* evolution. The Christian objections to evolution tended to draw not on scientific or Biblical arguments, but philosophical and theological ones. What did evolution mean for humans as a divine creation, as indicated by Psalm 8:5? Even William Jennings Bryan, the major anti-evolution figure in the 1925 Scopes Trial over evolution, believed in an old earth and allowed for the evolution of plants and animals other than humans.[17]

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15. Ronald L. Numbers, *The Creationists*: *From Scientific Creationism to Intelligent Design,* expanded ed. (Cambridge: Harvard University Press, 2006), 65.

16. For a brief accessible overview, see this short and very helpful video by historians of science Edward Davis and Lawrence Principe, "Science and Religion: The Draper-White Conflict Thesis," Dialogue on Science, Ethics, and Religion, published February 14, 2020, https://sciencereligiondialogue.org/resources/science-and-religion-the-draper-white-conflict-thesis-2/. See also the classic treatment in chapter 1 of James R. Moore, *The Post-Darwinian Controversies*: *A Study of the Protestant Struggle to Come to Terms with Darwin in Great Britain and America, 1870–1900* (Cambridge: Cambridge University Press, 1981); and Jeff Hardin, Ronald L. Numbers, and Ronald A. Binzley, eds., *The Warfare between Science and Religion: The Idea That Wouldn't Die* (Baltimore: Johns Hopkins University Press, 2018).

17. See footnote 66 below.

In summary, "it is unhelpful," one scholar writes, "to frame the discussion in terms of science versus religion. It is better to speak of *evolution supporters* and *evolution opponents* with differing beliefs about the nature of *science,* the nature of *faith,* and where science leaves off and faith begins."[18] Although public debate and polemical perspectives often focus on scientific claims and counterclaims, the evolution conflict has not really been over established facts of science; nor is it a fight between science and religion, between godless scientists and faithful Christians. It is, rather, about how we understand and interpret nature (that is, science), scripture, and their relationship to each other.

One scholar of science and religion expresses a common analysis, that "the [evolution] debate has tended to take place on scientific grounds, focusing on the interpretation of scientific data and theories rather than *the interpretation of Scripture.*"[19] And on the scientific side, note this parallel observation: "Much of the literature of the creation-evolution debates focuses on the details and interpretation of scientific data, but we suggest that *the deeper issues of the debates concern the nature and practice of science.*"[20] At its root then, this debate concerns (1) the nature of science and (2) the nature of scripture, and how to interpret and understand them. Discussions of evolution-religion conflict that do not focus on those things have rarely changed minds.

With this historical hindsight illustrating the intellectual atmosphere in which early-twentieth-century Latter-day Saints and their

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18. J. C. Blokhuis, "Book Review: Adam Laats and Harvey Siegel, *Teaching Evolution in a Creation Nation,*" *Theory and Research in Education* 15, no. 3 (November 2017): 346–49, https://doi.org/10.1177/1477878517734688.

19. Mark Harris, *The Nature of Creation: Examining the Bible and Science* (London: Routledge, 2013), 2, emphasis added.

20. Finn R. Pond and Jean L. Pond, "Scientific Authority in the Creation-Evolution Debates," *Evolution: Education and Outreach* 3, no. 4 (July 2010): 642, emphasis added. On the nature of science, see Steven L. Peck, "Why the Latter-day Saint Community Can Trust Science (in the Same Way Scientists Do)," herein, 119–41. Compare Barry R. Bickmore and David A. Grandy, "Science as Storytelling," *BYU Studies Quarterly* 53, no. 4 (2014): 37–60, https://byustudies.byu.edu/article/science-as-storytelling.

leaders were discussing science and scripture, certain aspects of the debate become more understandable. Indeed, the dynamics of the larger debate are all recognizably present in early-twentieth-century LDS discourse about evolution.[21] Awareness of that fact helps us discover the historical significance of the language of specific statements. For example, a December 1910 Christmas message from the First Presidency reflected several aspects of Baconian science and Scottish realism with its common-sense reference to "*real* science" and the equation of "theory" with "mere speculation": "Our religion is not hostile to real science. That which is demonstrated, we accept with joy; but vain philosophy, human theory and mere speculations of men, we do not accept nor do we adopt anything contrary to divine revelation or to good common sense."[22] One sees the same premises in the 1909 First Presidency statement as it describes the Creation accounts in scripture as divinely revealed scientific facts: "The inspired author of the book of Genesis made known to the world the truth concerning the origin of the human family, . . . the facts relating to man's origin."

The 1909 Statement

In 1882, Elder Orson F. Whitney expressed strong anti-evolution views in terms that reveal how he thought about "true" versus "false" science: "True science never taught any man to look for his progenitor in an ape."[23] Nearly three decades later, in early

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21. Notably, this philosophy amplified Latter-day Saint "literalism" in approaching scripture, particularly through Orson and Parley Pratt. See Philip L. Barlow, *Mormons and the Bible: The Place of the Latter-day Saints in American Religion,* rev. ed. (New York: Oxford University Press, 2013); and Terryl L. Givens and Matthew J. Grow, *Parley P. Pratt: The Apostle Paul of Mormonism* (New York: Oxford University Press, 2011), 88–93.

22. Originally, Joseph F. Smith, Anthon H. Lund, and John Henry Smith, "Words in Season from the First Presidency," *Deseret Evening News,* December 17, 1910, 3. This is excerpted in the official BYU evolution packet, "Evolution and the Origin of Man," Brigham Young University, published June 1992, https://biology.byu.edu/00000172-29e6-d079-ab7e-69efe5890000/byu-evolution-packet.

23. Orson F. Whitney, "Man's Origin and Destiny," *Contributor* 3, no. 9 (June 1882): 268–70.

September 1909, the First Presidency assigned Elder Whitney to draft a statement on their behalf.[24] Elder Whitney's draft of the 1909 statement sounded similar to his 1882 article. The draft misrepresented the claims of scientists and made the following strong doctrinal statements. (Italicized portions did not make it into the final First Presidency statement in 1909):

- "The Church of Jesus Christ of Latter-day Saints *holds to the doctrine of the fixity of species as against the evolution that disregards that doctrine.*"
- "[Jesus] came as men had been coming for ages, and as man has continued to come ever since, and *that, too, without having an ape for an ancestor, or a tadpole for a prototype.*"
- "Some Christian ministers have felt impelled to make such concessions to Darwinism. . . .[25] *The Latter-day Saint makes no such concession. . . . This shuts out the evolutionary process completely. . . . Therefore there was no chance—no opening for evolution, at least of the Darwinian kind, when the original human being was created. . . . But monkeys are the offspring of monkeys, and have been from time immemorial. There is no instance where a baboon ever evolved into a human being, and science, in attempting to unearth a 'missing link,' to connect mankind with monkey-kind, is like a blind man hunting through a haystack for a needle that is not there.*"[26]

Whitney sent this draft to John Widtsoe for his "criticisms, if any," wanting to provide them to President Joseph F. Smith along with

24. See Thomas M. Martin, Duane E. Jeffery, and Randy L. Bennett, "'Christ Is Scientist of This Earth': President Joseph F. Smith's Attitudes and Policies toward Science," in *Times of Transition: Proceedings of the 2000 Symposium of the Joseph Fielding Smith Institute for Latter-day Saint History at Brigham Young University,* ed. Thomas G. Alexander (Provo, Utah: Joseph Fielding Smith Institute for Latter-day Saint History, 2003), 75–81.

25. This language reveals a "science vs. religion" framework, wherein one could only accept evolution as a "concession" with concomitant rejection of true religion.

26. Orson F. Whitney to John Widtsoe, October 12, 1909, CR 712/2, John A. Widtsoe Papers, Church History Library, The Church of Jesus Christ of Latter-day Saints, Salt Lake City.

the draft.[27] Widtsoe had earned a PhD in chemistry, was president of the Agricultural College of Utah (now Utah State University), and would be called as an Apostle in 1921. He replied that the draft was "undoubtedly an excellent statement of the scriptural view of the origin of man," but scientifically speaking it was a straw man: "Of course, it does not in any sense deal with the law of evolution or the theory of animal descent as believed by many evolutionists. . . . Undoubtedly, the comment will be made upon it that it does not after all answer the questions propounded by the evolutionist."[28]

In his detailed notes, Widtsoe added, "This declaration is made in answer to numerous questions concerning the origin of man; and not to use the authority of the Church in settling one of the scientific issues of the day."[29] The First Presidency chose not to use Elder Whitney's strong language, which would have committed the Church to an explicit doctrinal position against evolution.

In November 1909, the First Presidency statement was published, prompting much discussion and many letters to Church leaders, who responded with an unsigned letter published in the "Priesthood Quorums' Table" of the *Improvement Era.*[30] "This column was the established source of definitive statements to the Church's quorums."[31] The letter explained that "the authentic statements of scripture, ancient and modern," did *not* answer the question of "whether the mortal bodies of man evolved in natural processes to present perfection, through the direction and power of God." It added, these "questions [are] not fully answered in the revealed word of God."[32] This letter shows that the 1909 statement did not eliminate the possibility of divinely guided evolution.

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27. Whitney to Widtsoe, October 12, 1909.

28. John Widtsoe to Orson F. Whitney, October 23, 1909, MS 6628, Church History Library.

29. Widtsoe to Whitney, October 23, 1909.

30. "Priesthood Quorums' Table," *Improvement Era* 13, no. 6 (April 1910): 570.

31. Martin, Jeffery, and Bennett, "Christ Is Scientist of This Earth," 77.

32. See further analysis in Martin, Jeffery, and Bennett, "Christ Is Scientist of This Earth."

Church Leaders and Scientific Expertise

Some Church leaders expressed an explicit belief that science could provide valid knowledge of human origins. Widtsoe's detailed comments on Whitney's draft suggested that, to avoid misunderstanding on this point,

> it may be necessary to say, that the Church accepts all truth revealed to man, whether by the direct voice of God, by inspiration from God, or by the patient toil of intelligent searchers for truth in the laboratories,[33] or the earth, the air, the ocean or in space. Prophets, poets and scientists, speaking with the love of truth in their hearts, give to the world a measure of God's truth. . . . "When any man-made doctrine, through the accumulation of incontestable evidence, has passed beyond the stage of [hypothesis] to that of fact, the Church accepts it gladly." . . . The Church is aware that the doctrine of evolution, as a working hypothesis, connecting logically a host of biological phenomena, has been a mighty instrument in enabling man to push into regions of truth formerly unknown.[34] [Regarding human evolution,] this is far from being the case *at the present time.*[35]

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33. Several Latter-day Saints thought that clarity on Creation and evolution could come through revelation *or* science. An article by Elder Stephen L Richards is accompanied by a sidebar reading, "In the progress of time, through advancing science or direct revelation, further light may be shed on the many problems that arise when the origin of life on earth is discussed." Stephen L Richards, "A Belief That Welcomes All Truth," *Improvement Era* 39, no. 9 (September 1936): 527.

34. Similarly, President Joseph F. Smith wrote in praise of Darwin in 1912, "I regard Charles Darwin as one of the most able and devoted students of Nature the world has known, and as an investigator whose labors have been of incalculable good to mankind. I do not accept, however, his hypotheses as facts. . . . I believe that the facts and truths enunciated by Darwin are substantial and valuable additions to our scientific knowledge. . . . [However,] many of the surmises and unproved theories associated in the popular mind with Darwin's name are, and of right ought to be, rejected by the leading thinkers of the world." Joseph F. Smith to Elmer Kneale, March 9, 1912, transcript, MSS 1542, box 2, folder 8, L. Tom Perry Special Collections, Harold B. Lee Library, Brigham Young University, Provo, Utah.

35. Widtsoe to Whitney, October 23, 1909, emphasis added.

Widtsoe's views reflected the "eclipse of Darwin" but not yet the "modern synthesis." The most influential LDS scientists then were not biologists—a class of scientists more and more accepting of human evolution although doubtful of Darwin's proposed mechanism—but rather geologists, chemists, and physicists.[36] Two of them were called as Apostles after the 1909 statement: geologist James E. Talmage (ordained 1911) and, as noted above, chemist John A. Widtsoe (ordained 1921). Thus, the Quorum of the Twelve Apostles had immediate access to trusted scientists from different disciplines—although not biology—in quorum discussions. Church leaders also sought expert knowledge available outside the quorum. Between 1909 and 1925, Church leaders requested information on evolution from at least two other LDS scientists: biologist Martin P. Henderson and geologist Frederick Pack.

Henderson had earned a PhD from the University of Wisconsin (1914) and then become dean of BYU's new School of Arts and Sciences, teaching zoology, botany, and other science classes.[37] Around 1920, by invitation, Henderson presented "a course . . . to members of the Quorum of the Twelve on the theory of evolution."[38] The *outline* of this course fills twenty-four detailed and technical pages about the state of evolutionary science at the time. Henderson presented both the perceived flaws of natural selection and the evidence in favor of evolution. Henderson himself believed in an old earth, the operation of death on the earth for far more than six thousand years—hereafter termed "long death"—and evolution.[39]

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36. Joseph F. Merrill, a PhD in physics and electrical engineering, would not join the quorum until 1931.

37. Ernest L. Wilkinson, ed., *Brigham Young University: The First One Hundred Years*, 4 vols. (Provo, Utah: Brigham Young University Press, 1975), 2:97, 118. Henderson was the only BYU faculty member with a doctorate at that time.

38. "Martin P. Henderson, notes, circa 1920," Church History Catalog, accessed February 2, 2022, https://catalog.churchofjesuschrist.org/record/ef6ede65-8a09-4596-8c24-7310f11ba2c9/0?view=summary.

39. Among others, Helen Candland Stark remembers being one of the students "fortunate enough to attend Martin P. Henderson's classes [and standing] in awe

Frederick Pack's interactions with Church leaders were more extensive. He married Heber J. Grant's niece Sadie Grant in 1896, and it may be that Pack first came to "Uncle Heber's" attention that way.[40] Pack was close friends with Talmage, reportedly close to President Anthon H. Lund (Grant's cousin), and a regular part of Elder George F. Richards's prayer group.[41] A paleontologist and geologist with an interest in biology, Pack received his PhD from Columbia in 1906. Shortly afterward, he replaced James E. Talmage as the Deseret Chair of Geology at the University of Utah.[42] Pack believed in an old earth and long death and leaned strongly toward evolution. Church leaders were well aware of his views. Indeed, "few Latter-day Saints have been more open about their acceptance of organic mutability than Fredrick Pack."[43]

By early 1911, Pack had published several articles in the *Improvement Era* on creation and science.[44] The First Presidency created a standing committee to hear Pack's views, made up of the Church Commissioner of Education Horace Cummings and Elders Charles Penrose, David O. McKay, John A. Widtsoe, and James E. Talmage.[45]

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before the intricacy of a living cell and the antiquity of its evolutionary beginning." Helen Candland Stark, "Prophet: A Meditation," *Sunstone* 22 (July–August 1980): 36.

40. Pack refers to Grant as "Uncle Heber" in his autobiography. Frederick J. Pack papers, MS 0423, box 1, Special Collections, J. Willard Marriott Library, University of Utah, Salt Lake City.

41. Pack, autobiography, 31, 45. Prior to 1978, Latter-day Saints used to gather for prayer circles outside LDS temples in approved spaces. See George S. Tate, "Prayer Circle," in *Encyclopedia of Mormonism*, ed. Daniel H. Ludlow, 4 vols. (New York: Macmillan, 1992), 1120–21.

42. Pack, autobiography, 31.

43. Richard Sherlock, "A Turbulent Spectrum: Mormon Reactions to the Darwinist Legacy," in *The Search for Harmony: Essays on Science and Mormonism,* ed. Gene A. Sessions and Craig J. Oberg (Salt Lake City: Signature Books, 1993), 77.

44. One of these was published in three parts. Frederick J. Pack, "The Creation of the Earth," *Improvement Era* 13, no. 11 (September 1910): 1023–27; 13, no. 12 (October 1910): 1121–27; 14, no. 3 (January 1911): 220–30.

45. Cummings was opposed to evolution and was also involved in the 1911 BYU controversy involving evolution and biblical criticism. See Gary James Bergera, "The 1911 Evolution Controversy at Brigham Young University," in Sessions and Oberg, *Search for Harmony,* 25–28. See also Thomas W. Simpson, *American Universities and the Birth of Modern Mormonism, 1867–1940* (Chapel Hill, N.C.: UNC Press, 2016), 54–91; and Mary Jane Woodger and Joseph H. Groberg,

The Presidency explained to Talmage that Pack had "endeavored to show the harmony existing between the record of the Creation by Moses, and what geology teaches. And he believes that evolution, when rightly understood, is in harmony with revelation, and is studying with a view to be able to prove this. We encouraged Dr. Pack to continue his studies along this line of thought."[46]

The First Presidency continued listening to Pack, including his lengthy and repeated critiques of anti-evolution articles published in the *Improvement Era* by "Robert C. Webb," an alias for a man who was neither a Latter-day Saint nor a scientist or doctor, though often called "Dr. Webb."[47] According to President Lund, Pack "thought the articles published by Webb were doing harm to our young people. . . . He held that Webb made some unwarranted assertions against evolution. Dr. Pack is a good argumentative talker."[48] Elder Talmage's journal recorded that he was present on another occasion at "an important interview at the office of the First Presidency at which Dr. Fred J. Pack . . . was present. We listened to Dr. Pack's statement of his views concerning the evolution hypothesis."[49]

Several months later, at the First Presidency's request, Pack submitted a sixteen-page paper outlining common problems of

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"George H. Brimhall's Legacy of Service to Brigham Young University," *BYU Studies* 43, no. 2 (2004): 24–29, https://byustudies.byu.edu/article/george-h-brimhalls-legacy-of-service-to-brigham-young-university.

46. First Presidency to James E. Talmage, March 10, 1911, James E. Talmage collection, MS 1232, LDS Church History Library, https://catalog.churchofjesuschrist.org/assets/367e43bd-378b-4a32-b80a-361450fb71d2/0/4.

47. "Robert C. Webb" was a pen name for James Homans. To my knowledge, there is nothing published on Homans/Webb, though I am aware of several unpublished papers. Accessible is this blog post by Kevin Barney, "Robert C. Webb," By Common Consent, published October 18, 2006, accessed March 30, 2022, https://bycommonconsent.com/2006/10/18/robert-c-webb/.

48. Because Webb/Homans held no PhD or MD, I have removed the repeated use of the title "Dr." from this quotation. Anthon H. Lund, Journal, September 28, 1914, in *Danish Apostle: The Diaries of Anthon H. Lund, 1890–1921,* ed. John P. Hatch (Salt Lake City: Signature Books, 2006), 551. Compare September 22, 1914, in Hatch, *Danish Apostle,* 550.

49. James E. Talmage, Journal, September 28, 1914, Perry Special Collections, https://contentdm.lib.byu.edu/digital/collection/p15999coll20/id/51850/rec/23.

many evolution critiques such as Webb's.[50] One major issue was the conflation of scientific and religious perspectives. When it came to *scientific* evaluation of evolution, Pack said, one needed to both understand and stick to the science.[51] "In this discussion laymen have no place, and theological objections are wholly foreign to the question." He warned of those who were "guilty of denouncing scientific doctrines with which they themselves were but superficially acquainted."[52] When it came to *religious* critique of evolution, Pack's views echoed Widtsoe's (above).

> Entirely different methods are employed [herein than with scientific critique]. The theist here is objecting to the claims of science not because they are unscientific but because they are incompatible with his own system of religious belief. To be consistent he must first prove that his own theological views are well founded . . . and then show that the claims of science are out of harmony with them. In other words if the claims of science are untrue because they are contrary to theology, and not necessarily contrary to science, therefore theology and science are incompatible. . . . It appears that

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50. Frederick J. Pack to President Joseph F. Smith and counselors, December 1, 1914, copy in Eugene Thompson research collection, MSS 1542, 20th Century Western and Mormon Manuscripts, Perry Special Collections. Compare Anthon Lund, Journal, December 18, 1914: "We read part of an article by Bro. Pack on evolution."

51. A similar statement appeared several decades later in a pro-evolution article explicitly approved for publication by President David O. McKay: "One must have a broad understanding of biology to be competent to judge whether evolution is true or not." Bertrand F. Harrison, "The Relatedness of Living Things," *Instructor* 2 (July 1965): 76. For background and details, see Ben Spackman, "David O. McKay on Evolution and Reading Genesis," Ben Spackman (blog), June 28, 2016, http://benspackman.com/2016/06/david-o-mckay-on-evolution-and-reading-genesis/.

52. On May 4, 1884, James E. Talmage recorded the following experience in his journal: "Have just returned tonight from service at the Westminster Presbyterian Church. The minister spoke against belief in Darwinism and like most ministers whose remarks I have heard or read upon this subject—showed his ignorance. He spoke much as an ordinary person would—'Darwin?! Oh yes—says we come from monkeys'—then condemns. I certainly think 'tis the ministers themselves who have bred the disgust with which most scientific people regard them—because they will dabble with matters from which their ignorance should keep them at a safe distance." James E. Talmage, private journal, 2:38, Perry Special Collections, https://contentdm.lib.byu.edu/digital/collection/p15999coll20/id/35641/rec/16.

> theology should never pass upon the truth or falsity of scientific doctrines; it does not constitute a jury designed for that purpose; it has for the object of its existence a far different mission. On the other hand scientific claims must be scrutinized and passed upon by judicial tribunals composed of the world's most learned scientists.[53]

Pack argued that science could say nothing about the existence of God and that evolution, properly understood, posed no threat to that fundamental doctrine. He also cautioned about the effects on faith of anti-evolution articles in Church periodicals: "Years of experience with both college men and college women has convinced the writer that the attitude of the theist towards science is responsible for the making of many-fold more materialists than all the sciences combined."[54] Finally, Pack critiqued Webb's arguments from an academic perspective:

> His most frequent quotations are taken from the writings of Huxley published fully forty years ago, at a time when the doctrine of organic evolution was scarcely beyond its infancy, and the science of vertebrate paleontology was in its merest beginnings. . . . The problem of today is not the problem of forty years ago. . . . Webb's articles might have been tolerated forty years ago, but they have no place in modern literature. . . . From almost every point of view, Webb has shown his inability . . . to grasp the significance of the matter in hand—his method of approach, his confusion of science with materialism, his inaccuracy in the use of scientific facts and theories, his lack of acquaintance with scientific literature, his failure to grasp the matter in its present light[—]all seriously mitigate against the reliability of the articles in question.[55]

Pack's pro-evolution, old-earth views and critiques of anti-evolutionary thought in Church periodicals did not put him out

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53. Pack to Smith and counselors, December 1, 1914.

54. Pack to Smith and counselors, December 1, 1914.

55. Pack to Smith and counselors, December 1, 1914. Pack apparently did not know that "Dr." Webb/Homans was not actually a scientist.

of favor with Church leaders, who appointed him to the Sunday School general board in 1920 and later as chairman of the Gospel Doctrine Committee. In 1924, the Deseret News Press published his book *Science and Belief in God: A Discussion of Certain Phases of Science and Their Bearing upon Belief in the Supreme Being*. It was a "strong defense of evolution and impressive attempt to reconcile evolution with religion."[56] In 1925, Pack spoke to seminary and institute teachers on "What Shall Our Attitude Be on Issues Raised by Science and Religion?" expressing a pro-evolutionary position.

Later that year, Rudger Clawson, President of the Quorum of the Twelve Apostles, invited Pack to speak over the radio.[57] Pack took as his topic "Evolution, Its Relation to Religious Thought" and addressed the issue of God and evolution in the context of the Scopes Trial. Pack compared religious anti-evolutionary responses to past religious responses to Copernicus and geology; in evolution and the Scopes trial, "again, the theistic world *thought* it saw an effort to dethrone Deity from the universe." But, he argued, science deals primarily with the question, "'How does nature operate?' It is not the duty nor the privilege of the scientist to ask the question, 'By whom were things created?'"[58]

In 1932, Church President Heber J. Grant invited Professor Pack to give a series of twenty-six lectures over KSL Radio, which publicized some of Pack's views from his lengthy 1914 report to the First Presidency. Those lectures were then published by the Church as pamphlets and widely distributed. According to Pack's autobiography, "Brother Talmage told me that more than twenty thousand of my sermons were distributed *weekly*, a number somewhat in excess of the sermons given by previous speakers. Later, the Deseret Book Company had a number of those sermons bound in book form. . . . We received hundreds of letters from various parts of the West including areas as far away

56. Erich Robert Paul, *Science, Religion, and Mormon Cosmology* (Champaign: University of Illinois Press, 1992), 26.

57. See Pack, autobiography, 129.

58. Pack included the text in his autobiography, 129, emphasis added.

as Alberta, Florida, Texas, Southern California, Hawaiian Island, and Alaska."[59] President Rudger Clawson had earlier spoken of "false evolution" in general conference in 1923, saying "one kind of animal never changes into another."[60] Nevertheless, in 1932 he wrote on behalf of the Twelve to express their appreciation to Professor Pack "and congratulate you on the truly excellent work you have done. Your talks were timely and practical and the good influence emanating therefrom has been felt throughout the Church."[61]

Pack's widely distributed, Church-published pamphlets included statements like this: "The geologist concludes that life appeared upon the earth in primitive form many millions of years ago, and through succeeding ages progressively developed into the various forms which now inhabit it."[62] Pack's title, "All Truth Acceptable—Irrespective of Its Source," summarized the paradigm he shared with other Latter-day Saint scholars and some Church leaders—that evolutionary conflict could be clarified either by further revelation *or* through science.[63] Pack had written earlier in his book that "as people become more and more anxious to know the truth [about human origins, God] will supply means for their enlightenment, but no one would care to say whether this enlightenment will come as a direct revelation from God or through the searchers of science."[64]

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59. Pack, autobiography, 194.

60. Rudger Clawson, in *Ninety-Fourth Semi-annual Conference of The Church of Jesus Christ of Latter-day Saints* (Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 1923), 86, https://archive.org/details/conferencereport1923sa/page/86/mode/2up.

61. Pack, autobiography, 193.

62. Frederick J. Pack, "All Truth Acceptable—Irrespective of Its Source," KSL Radio, September 18, 1932, The Church of Jesus Christ of Latter-day Saints, no. 25 (Salt Lake City), 7.

63. Pack, "All Truth Acceptable," 7. According to a recent Church publication, "Nothing has been revealed concerning evolution." "What Does the Church Believe about Evolution?," *New Era* 45, no. 10 (October 2016): 41. The vast majority of scientists today see biological evolution as the great unifying theory among multiple fields.

64. As quoted in Sherlock, "Turbulent Spectrum," 48, citing Frederick Pack, *Science and Belief in God* (Salt Lake City: Deseret News Press, 1924), 296, 206, 179.

Frederick Pack, Gordon B. Hinckley, and Science

President Gordon B. Hinckley occasionally remarked on evolution and geology. "Studied all about it. Didn't worry me then. Doesn't worry me now."[1] "I remember when I was a college student there were great discussions on the question of organic evolution. I took classes in geology and biology and heard the whole story of Darwinism as it was then taught."[2] Frederick Pack had been his teacher in these areas. LDS geologist Lee Stokes recounted a conversation with Hinckley: "He had problems as a student, and he took the courses from Fred Pack, and he's never worried about geology and religion since. Yet he took his course[s] from a prominent Latter-day Saint who was an evolutionist and yet he found that a rather comforting and delightful experience."[3] Hinckley wrote in a private letter, "I attended classes in geology taught by Dr. Frederick Pack. I believe it was in 1931 that I took two quarters and received 'A' grades from these courses. After sixty years I still remember some of the things I learned. Dr. Pack was for me a stimulating and able teacher. While geology was not my major, his classes stirred within me a great interest in this subject."[4] BYU geologist Morris Petersen recounted this conversation: "When [Hinckley] asked what I did for a living, I told him I was a geologist at the Y. And he said, 'Ohhh . . . You know, probably the best class I had at the U of U was my geology class.' I thought

1. As interviewed and quoted by Larry Witham, *Where Darwin Meets the Bible: Creationists and Evolutionists in America* (New York: Oxford University Press, 2002), 177.

2. Gordon B. Hinckley, "God Hath Not Given Us the Spirit of Fear," *Ensign* 14, no. 10 (October 1984): 5.

3. William Lee Stokes, interview by Robert Miller for the Everett L. Cooley Oral History Project, Acc 814, interview no. 339, Marriot Library, 1985, 146.

4. Gordon B. Hinckley to William Lee Stokes, September 3, 1991, Stokes Collection, box 13, folder 23.

that was fascinating. Apparently [death before the Fall] was no problem for him."[5] On a different occasion, Hinckley told Petersen that his favorite uncle as a boy had been BYU geologist Edwin Hinckley, who used to bring him rocks.[6] In 1903, Hinckley taught a "Geological Biology" BYU course that focused on "a study of fossil forms, their life-history, and the evolution of our earth and its organisms" and assigned a pro-evolution (and theistic) textbook.[7]

5. Morris Petersen fireside, February 1986, transcript in my possession. Petersen was asked by Church leaders that same year to write an *Ensign* article about the age of the earth, fossils, and geology. Morris S. Petersen, "Do We Know How the Earth's History as Indicated from Fossils Fits with the Earth's History as the Scriptures Present It?," *Ensign* 17, no. 9 (September 1987): 28–29.

6. Morris Petersen, interview with author, September 12, 2021.

7. See *Brigham Young Academy and Church Normal Training School: Catalogues and Announcements for the Twenty-Eighth Academic Year, 1903–1904* (Provo, Utah: Brigham Young Academy, n.d.), 48, https://archive.org/details/cataloguesannoun19031904brig/page/48/mode/2up.

The 1925 Scopes Trial and the Dog That Didn't Bark[65]

The 1925 Scopes Trial generated massive national interest and extensive media attention. While it narrowly concerned the legality of teaching evolution in Tennessee public schools, the trial itself and discussion spilled over into issues of biblical interpretation and science. The Scopes Trial thus served as the historical impetus and context for the First Presidency's 1925 statement to the world.

65. In the Sherlock Holmes story "Silver Blaze," the fact that a dog didn't bark provided evidence that the culprit was familiar to the dog. The phrase has come to refer to the significance of the absence of expected facts or events, as is the case here in LDS history. See Mike Skotnicki, "'The Dog That Didn't Bark': What We Can Learn from Sir Arthur Conan Doyle about Using the Absence of Expected Facts," Briefly Writing (blog), July 25, 2012, https://brieflywriting.com/2012/07/25/the-dog-that-didnt-bark-what-we-can-learn-from-sir-arthur-conan-doyle-about-using-the-absence-of-expected-facts/.

One of the major figures in the Scopes trial, William Jennings Bryan helped lead the 1920s fundamentalist charge against evolution.[66] Church leaders were familiar with Bryan and his ideas. Bryan had carried Utah in the 1896 Presidential election, the only time a Democrat won the state but not the national election. He had spoken in Utah on several occasions and attended general conference once (where he was impressed), and some Church leaders had met with him. His sermons had been printed in Church magazines several times, and he once delivered a speech on a Church-owned radio station. President Heber J. Grant felt a strong affiliation with Bryan's published views. President Grant underlined many passages in his well-worn copy of *The Prince of Peace*, including "Darwinism is not science at all; it is guesses strung together. There is more science in the twenty-fourth verse of the first chapter of Genesis . . . than in all that Darwin wrote." At the back of his copy, Grant wrote, "One of the most valuable books I have ever read," and signed his name with a flourish. The First Presidency gifted thousands of copies of *The Prince of Peace* to missionaries in 1925–26.[67] When Bryan died shortly after the Scopes trial, Church leaders praised him in the September 1925 *Improvement Era* and October 1925 general conference.[68] They also printed his "Undelivered Argument on the Anti-Evolution

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66. Bryan, the prosecutor in the Scopes trial, has been unfairly caricatured as the epitome of unthinking "literalism" or a young-earth creationist. This is both anachronistic—such views didn't become popular or widespread until the early 1960s—and inaccurate; Bryan strongly opposed human evolution for reasons more humanitarian and theological than scriptural or scientific, but he didn't take issues with plant or animal evolution and believed the earth was very old, as did the vast majority of American Christians at the time. For more about the Scopes trial, see the Pulitzer Prize–winning book by Edward J. Larson, *Summer for the Gods: The Scopes Trial and America's Continuing Debate over Science and Religion* (New York: Basic Books, 2006).

67. Cris Baird, "'One of the Most Valuable Books I Have Ever Read': The Influence of William Jennings Bryan on 20th Century Mormon Responses to the Theory of Evolution" (presentation, Mormon History Association conference, 2018), copy, images, and research notes in my possession.

68. William Jennings Bryan, *Improvement Era* 28, no. 11 (September 1925): 1092–93. Compare Joseph Fielding Smith, "Was the Hero's Death So Bad?," *Deseret News,* October 31, 1936, 1.

Law" as the lead article of the October 1925 *Improvement Era*.[69] In that article, Bryan reflected Baconian science and common sense realism: "Religion is not hostile to learning; . . . [but Christians] oppose the teaching of guesses that encourage Godlessness among the students. . . . It is not scientific truth to which Christians object, for true science is classified knowledge, and nothing therefore can be scientific unless it is true. Evolution is not truth; it is merely an hypothesis—it is millions of guesses strung together."[70] At the trial, Bryan expressed a populist common sense approach to scripture: "The one beauty about the word of God is, it does not take an expert to understand it."[71]

By 1925, several things might have suggested that the Church had an official position against evolution: the enthusiasm for Bryan and his ideas, the 1909 First Presidency statement, the 1911 so-called "evolution controversy" at BYU,[72] and the strong publicly

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69. William Jennings Bryan, "The Tennessee Case: The Undelivered Argument on the Anti-evolution Law," *Improvement Era* 28, no. 12 (October 1925): 1109–31.

70. Bryan, "Tennessee Case," 1112–13.

71. Leslie H. Allen, ed., *Bryan and Darrow at Dayton: The Record and Documents of the "Bible-Evolution Trial"* (New York: Arthur Lee, 1925), 78, https://www.google.com/books/edition/Bryan_and_Darrow_at_Dayton/L0tYAAAAMAAJ?hl=en&gbpv=0. Compare Philip L. Barlow, who argues that "Mormonism had been a radical part of the antebellum movement to reduce the role of a learned clergy, which was perceived to have come between the common folk and the direct word of God in scripture. The Saints were not anxious to replace a professional clergy, which they had earlier banished, with bookish academics." Barlow, *Mormons and the Bible: The Place of the Latter-day Saints in American Religion* (New York: Oxford University Press, 1991), 119.

72. For more details on the 1911 evolution controversy, see Bergera, "1911 Evolution Controversy at Brigham Young University." BYU's Mary Jane Woodger agrees with Richard Sherlock that although "this incident is often called 'BYU's evolution controversy,' the real crisis . . . came over the teaching of higher criticism in which scientific theories were used to explain the development of theological beliefs." Woodger and Groberg, "George H. Brimhall's Legacy of Service," 24–29, quote on 25. Thomas Simpson describes it as the "evolution and higher criticism controversy" in *American Universities and the Birth of Modern Mormonism,* xiii. Drawing on the official history of BYU, however, Thomas M. Martin, Duane E. Jeffery, and Randy L. Bennett state that the faculty issues were "a matter of personality conflicts and confrontational attitudes perhaps as much as conflicts over basic Church doctrine." Martin, Jeffery, and Bennett, "Christ Is Scientist of This Earth," 78.

expressed anti-evolutionary views of individual Apostles, including Joseph Fielding Smith and Orson F. Whitney.[73]

But that dog didn't bark. Three things show that the Church did not have such a position. First, in 1925, the First Presidency issued a new statement that was significantly more open to evolution than the 1909 statement. Second, Utah did not restrict the teaching of evolution in schools, and, in fact, evolution was taught in the Church Educational System (CES), including at BYU. Third, people who taught evolution in Church-sponsored positions were not removed but, in some cases, given a broader and more authoritative platform. The significance of each of these facts is explored below.

First, the Scopes Trial had generated unprecedented national interest, including record-setting radio and newspaper coverage. The Church responded to newspaper inquiries for its position on evolution. One might have expected the leadership to simply refer journalists to the 1909 statement or produce a concise new statement against evolution. The Church's response—"A 'Mormon' View of Evolution: A Statement by the First Presidency of the Church of Jesus Christ of Latter-day Saints"—appeared in the July 18, 1925, *Deseret News,* then in the same September *Improvement Era* issue that praised Bryan and (according to the *Deseret News* editor's note) in "many prominent newspapers throughout the country."[74]

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73. See, for example, Joseph Fielding Smith, "The Origin and Destiny of Man, with a Sidelight on Evolution—the Great 'Miracle of Unbelief,'" *Improvement Era* 23, no. 5 (March 1920): 375–93; Orson F. Whitney, in *Ninety-Sixth Semi-annual Conference of The Church of Jesus Christ of Latter-day Saints* (Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 1925): 100–106.

74. I have located three printings in other newspapers: the *St. Louis Star and Times,* June 22, 1925, 13; the *Akron Beacon Journal,* June 23, 1925, 20; and the *Honolulu Star Bulletin,* December 5, 1925, 15. A later letter to a *Deseret News* columnist asked what papers the article had been in. The columnist replied, "The 'Mormon View of Evolution' appeared in the Hearst papers throughout the U.S.—East and West." *Deseret News,* October 9, 1925, 6.

The formal 1909 statement was 2,707 words that did not include the absolute, anti-evolution language of Elder Orson F. Whitney's draft. The 1925 statement is only 533 words. It does not include words and phrases the 1909 statement shared with anti-evolution arguments of the time and since. In short, if the 1909 statement's primary purpose had been to establish a doctrinal barrier between Latter-day Saints and evolution, we would expect to see that core purpose reflected in the 1925 statement on evolution. However, what the First Presidency conveyed to the world in 1925 as the Latter-day Saint position on evolution was neither a short reiteration of the 1909 statement nor a hard line against even the possibility of evolution, but an affirmation of the hand of God in creation.

Second, unlike leaders of the fundamentalist movement, the First Presidency did *not* condemn the teaching of evolution in schools.[75] While at least twenty states considered legislation against teaching evolution and five passed laws to that effect, in Utah, "professional educators spoke out in favor of scientific education, the libraries escaped censorship, and the state legislature passed no legislation restricting the teaching of evolution."[76] Speaking in Cincinnati in 1926, Levi Edgar Young, a member of the First Quorum of the Seventy and a BYU professor, was reported as saying that "whatever may happen, Utah will never pass an anti-evolution bill."[77]

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75. Heber J. Grant, in *One Hundred and Second Annual Conference of The Church of Jesus Christ of Latter-day Saints* (Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 1932), 123. See Ben Spackman, "Through a Glass, Less Darkly: The 20th Century History of Genesis and Evolution" (presentation, FAIR Conference, August 2021), https://www.fairlatterdaysaints.org/blog/2022/01/03/fair-conference-podcast-73-ben-spackman-through-a-glass-less-darkly-the-20th-century-history-of-genesis-and-evolution.

76. Ann Weaver Hart, "Religion and Education: The Scopes Controversy in Utah," *Utah Historical Quarterly* 51, no. 2 (Spring 1983): 185; compare Ann Weaver Hart, "Utah and the Scopes Trial: A Conservative Irony" (master's thesis, University of Utah, 1981). Ronald L. Numbers, "Creationism in 20th-Century America," *Science* 218, no. 4572 (November 1982): 538; and Adam Laats, *Fundamentalism and Education in the Scopes Era* (London: Palgrave Macmillan, 2010).

77. "Utah Educator Heard," *Cincinnati Enquirer,* June 10, 1926, 14. My thanks to Ardis Parshall for this reference.

Third, evolution was taught in Church settings; BYU professors including Martin Henderson (biology), Vasco Tanner (zoology), George Hansen (geology), and Walter Cottam (botany) were all teaching an old earth, long death, and evolution as part of their courses. Indeed, Henderson, who had been invited to lecture to Church leaders in 1920, apparently taught pro-evolution courses to CES personnel as part of their summer school training. Seminary teacher and administrator John M. Whitaker wrote that he took courses from Henderson "on Evolution and Creation." Whitaker explained that he was thankful for the experience. "And I believe I voice the sentiment of the seminary teachers when I say we have been delighted with the privilege of going into a subject of biology dealing with the existence and progress of life forms, that I think in the past we have put it off and put it off. I never was so grateful in my life as I am for one of our teachers, Brother Henderson. I want to say that instead of weakening my faith when we have gone down into some of the fundamentals of life, it has great[ly] strengthened. I am an evolutionist. Don't get concerned. I mean by that, I believe in change. I believe more than I ever believed before in my life my religion."[78]

Church leaders had likewise provided Frederick Pack with prominent public and private platforms to express his views on science, religion, and evolution as an LDS geologist and then called him into a position where he could influence seminary and institute teachers. Pack was not the only one to receive such treatment. Adam S. Bennion, for example, served as the equivalent of the Church Commissioner of Education from 1919 to 1927.[79]

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78. John Mills Whitaker collection, MSS 0002, box 15, folder 35, Special Collections, Marriott Library. Punctuation standardized. Whitaker elsewhere described Henderson as "one of the clearest Biological think[er]s, and teacher of evolution, and the cycle of the cell I have ever met." Memorandum from Whitaker Journal, n.d., but clearly referring to 1920/21. Compare Whitaker box 15, which has the list of courses for 1921 summer school, listing M. P. Henderson for teaching "Creation from a Scientific Point of View" and Guy C. Wilson for teaching "Creation from a Theological Standpoint."

79. This title existed at that time but with different functionality than today. Elder David O. McKay held the title at the time.

On several recorded occasions, Bennion promoted evolution-friendly views to seminary, institute, and BYU teachers. In 1925, he provided training at the Aspen Grove summer school titled "Evolution and Christian Faith."[80] In 1926, he published the following statement in a Church magazine:

> We talk a good bit about evolution. It is forced upon all thinking men and women these days. President Ivins [Counselor to President Grant]—and let me say, I am delighted to see among the leaders of this Church men with such comprehensive liberality—President Ivins says,[81] in the face of evolution, to seek truth and find it. I beg of you older men and women, be similarly charitable. Because you may have been given a prejudice in your youth, do not feel to ask this institution, in the light of all recent learning, to close its doors to honest investigation. Such an institution ought to be our light upon a hill to point our way to truth. Mere theories, of course, it should consider as such, ever pointing out the distinction between such theories and established truths.[82]

Bennion was ordained an Apostle in 1953 upon the death of John A. Widtsoe.

Conclusions and Post-1925 Trajectories

Situating the First Presidency's 1909 and 1925 statements in context demonstrates several things. First, the 1909 First Presidency

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80. Bennion drew explicitly on Henry Higgins (H. H.) Lane, *Evolution and Christian Faith* (Princeton: Princeton University Press, 1923).

81. I do not know if Bennion had a particular discourse in mind. Ivins had spoken skeptically of evolution at the October 1917 general conference but concluded only with affirming God's hand in Creation: "Whatever of development there is in the world, whatever of evolution has come, leading from lesser to greater things, from worse to better conditions, are the results of the intelligence of God." Anthony W. Ivins, in *Eighty-Eighth Semi-annual Conference of The Church of Jesus Christ of Latter-day Saints* (Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 1917), 67.

82. Adam S. Bennion, "An Unpublished Chapter in the History of BYU," *Utah Genealogical and Historical Magazine* 17, no. 1 (January 1926): 18–24, punctuation edited slightly for readability.

statement was not understood to constitute a final declaration on science or to exclude the possibility of divinely guided evolution. Second, Church leaders sought out varied views and expressed their own *individual* views, without imposing them on the Church as a whole. Among the perspectives the First Presidency sought were those of scientists who accepted evolution, or aspects of it, such as an old earth and the long operation of death. Some of these scientists were ordained as Apostles in this period. Other scientists were also consulted. Third, Church leaders knowingly gave teachers space to teach the compatibility of evolutionary thought with God and scripture. The most recent First Presidency statement published to the world declaring the Church position on evolution is the 1925 "'Mormon' View of Evolution." It similarly leaves open the possibility of the doctrinal compatibility of God, scripture, and evolution.

These choices and changes were influenced by the "eclipse of Darwinism," during which evidence for evolution was increasing but many biologists simultaneously criticized natural selection and "Darwinism" as inadequate for explaining evolution. In turn, many laypeople concluded that science had undermined organic evolution itself.[83]

At the same time, the increasing specialization of science, along with the changing and disputed nature of "science" itself, contributed to the misunderstandings and cultural friction around evolution. Latter-day Saints could be found on all sides of these shifting ideas and frictions. Church leaders tolerated the expression of a variety of strong and incompatible views, only maintaining as non-negotiable that God created people on purpose according to a plan.

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83. Ronald L. Numbers, "George Frederick Wright: From Christian Darwinist to Fundamentalist," *Isis* 79, no. 4 (December 1988): 640; compare Peter J. Bowler, "The Eclipse of Darwinism: Scientific Evolutionism, 1875–1925," in *Evolution—the History of an Idea*, 25th anniversary ed. (Berkeley: University of California Press, 2009), 224–73.

The First Presidency statements that came out of this period of history kept the Church *collectively* from espousing or advocating any of the views of *individual* Apostles like Orson Whitney, Joseph Fielding Smith, and others (who rejected evolution) or the views of James E. Talmage, John A. Widtsoe, and others (who were tentatively open to evolution).[84] Elder Widtsoe cautioned the Quorum of the Twelve that Apostles "are bound to have individual views, but they should not be pressed as certainties."[85]

Quorum members recognized that God was, in effect, revealing knowledge about the details of human origins on the earth through science. While Joseph Fielding Smith disagreed with scientists on a number of topics, he also interpreted Joel 2:28 on multiple occasions to mean that God inspired scientific discoveries and progress.[86] (It was common for some Saints to disparage evolution as *science* because they understood scientific research to be inspired by God and leading to truth.) Apostles John A. Widtsoe and James E. Talmage believed that contextual information—including scientific knowledge—should influence the interpretation of scripture. Talmage said, "We should be very careful in taking what we consider the one and only interpretation or application of a passage of scripture, and sweeping away as utterly wrong all accumulated knowledge that may seem to point to another interpretation. . . . We have to recognize fact whether it be called scripture or science; and it is unwise to

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84. See "Organic Evolution," Church History Topics, The Church of Jesus Christ of Latter-day Saints, https://www.churchofjesuschrist.org/study/history/topics/organic-evolution, reprinted herein, 5–10; *Saints: The Story of the Church of Jesus Christ in the Latter Days,* vol. 3, *Boldly, Nobly, and Independent, 1893–1955* (Salt Lake City: The Church of Jesus Christ of Latter-day Saints, 2022), 247–49.

85. Widtsoe to Rudger Clawson and members of the Council of the Twelve, September 9, 1931. Copy in Robert L. Miller papers, ACCN 2064, box 51, folder 4, Special Collections, Marriott Library.

86. See, for example, Joseph Fielding Smith, *Doctrines of Salvation,* 3 vols. (Salt Lake City: Bookcraft, 1954), 1:178, where President Smith said, "There has never has been a step taken . . . , in discovery or invention, where the Spirit of the Lord . . . was not the prevailing force, resting upon the individual, which caused him to make the discovery or the invention."

attempt to pass upon demonstrated fact and call it false because it has been brought forth through the labors of trained men in the field of science."[87]

In 1931, the First Presidency would adjudicate that there was no doctrinal position on either the existence of people or death before Adam, Eve, and the Fall.[88] And in 1934—as the "eclipse of Darwinism" waned—Elder Widtsoe wrote the following to James E. Talmage's son Sterling (like his father, a PhD in geology):

> We all recognize or should recognize at this time that the principle or law of evolution cannot be gainsaid. Whether in the operation of that law the body of man is a product of the same line of ancestry which lies back of other animal forms is, of course, quite another question. . . . After considerable reading and study and thought, I have come to the conclusion

87. James E. Talmage to Heber Timothy, January 28, 1932, Talmage collection, https://catalog.churchofjesuschrist.org/assets/c40ebd1d-8381-4d0f-8140-425828ec49c3/0/64.

88. See the April 5, 1931, First Presidency memo, printed in Evenson and Jeffery, *Mormonism and Evolution*, beginning at 54. This document is discussed at length by Sherlock, "Turbulent Spectrum," and Jeffery, "Seers, Savants, and Evolution: The Uncomfortable Interface," in Sessions and Oberg, *Search for Harmony*, 173–75. Although the memo mentions only preadamites, both Talmage and Widtsoe recorded it as a statement of neutrality on both preadamites *and* the question of death before the Fall. The two issues are logically connected; if the Church had a position disallowing death before the Fall, it could not logically allow preadamites. Talmage records: "Involved in this question is that of the beginning of life upon the earth, and as to whether there was death either of animal or plant before the fall of Adam. . . . The decision reached by the First Presidency, and announced to this morning's assembly, was in answer to a specific question[,] that obviously the doctrine of the existence of races of human beings upon the earth prior to the fall of Adam was not a doctrine of the Church; and further that the conception embodied in the belief of many to the effect that there were no such Preadamite races, and that there was no death upon the earth prior to Adam's fall is likewise declared to be no doctrine of the Church." Talmage, Journal, April 7, 1931. Widtsoe, serving as mission president in England, and thus observing from a distance, wrote in October 1931 that he understood "the Presidency had ruled on the matter, and that was the end of the controversy as far as I was concerned." What was "the matter"? The two issues raised by Joseph Fielding Smith, which had escalated to the First Presidency, namely, "1. That no men lived before Adam; and 2. That there was no death before Adam." See John Widtsoe to Susa Young Gates, October 30, 1931, copy in my possession.

> that for one I must hold my judgment with respect to the origin of man in suspense. *I am doing this not because of any fear of being in opposition to Church doctrine but candidly because existing facts do not satisfy my mind upon the subject.* It should not hurt my feelings at all if in the wisdom of the Almighty the body of man was prepared in just the way you outline in your article, and then that the spirit of man, the eternal ego, was placed within the body so prepared.[89]

In 1934, then, after being involved in two First Presidency statements and much internal discussion over evolution, the age of the earth, and death before the Fall, Elder Widtsoe saw no "Church doctrine" around evolution that he could be opposing; he thought the "law of evolution" had been clearly demonstrated, but science had not yet made it clear to him whether that law applied to the historical development of the human body. And yet, Widtsoe was not opposed to that conclusion should it turn out to be the case.[90]

In the early twentieth century, as shown by the actions of Church leaders and the contexts of the official statements made by the First Presidency, the position of The Church of Jesus Christ of Latter-day Saints was not against evolution per se, but against taking God out of Creation. Church leaders showed willingness to hear what science had to say on evolution while holding firm to the revealed truth that God was the purposeful Creator. Even if individual Apostles felt evolution was incompatible, Church leaders were collectively unwilling to commit the Church to particular interpretations of scripture that ruled out evolution as a mechanism of creation.

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89. John Widtsoe to Sterling B. Talmage, July 17, 1934, emphasis added, reprinted in Sterling B. Talmage, *Can Science Be Faith-Promoting?*, ed. Stan Larson (Salt Lake City: Blue Ribbon Books, 2001), 228–29.

90. Elder Stephen L Richards similarly wrote, "If the evolutionary hypothesis of the creation of life and matter in the universe is ultimately found to be correct, and I shall neither be disappointed nor displeased if it shall turn out so to be, in my humble opinion the Biblical account is sufficiently comprehensive to include the whole of the process." Stephen L Richards, "An Open Letter to College Students," *Improvement Era* 36, no. 8 (June 1933): 484.

The history of the 1909 and 1925 First Presidency statements shows both change and continuity over time. Together with other contemporary sources of knowledge about this issue, the statements show the First Presidency's reluctance to explain how God created people and a disinclination to restrict the views of individual members, including leaders and teachers, to reason for or against evolution, except in cases where their views upset the revealed truth that God created. On that point the First Presidency has been clear and consistent and true to the fullness of the restored gospel of Jesus Christ.[91]

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91. "'Mormon' View of Evolution," *Improvement Era* 28, no. 11 (September 1925): 1090–91, excerpted in "Evolution and the Origin of Man" and reprinted herein, 345–46.

Appendix A

Organic Evolution

[This brief entry on evolution is part of a collection of historical topics published by the Church History Department in conjunction with Saints: The Story of the Church of Jesus Christ in the Latter Days. *These Church History Topics can be found on churchofjesuschrist.org and in the Church History section of the Gospel Library app.]*

The modern science of evolution can be traced back to the work of Charles Darwin and Gregor Mendel in the mid-1800s.[1] Based on his study of animal species, Darwin noted that environmental conditions favor some individuals within a population better than others. Members of a species that developed certain traits were better suited to survive and reproduce across generations. Over generations, he argued, this process of "natural selection" could give rise to new species.[2] Meanwhile, Mendel

1. Martinez Hewlett, "Evolution: The Controversy with Creationism," in Lindsay Jones, ed., *Encyclopedia of Religion,* 2nd ed., 14 vols. (New York: Macmillan, 2005), 5:2908–9; Phillip Sloan, "Darwin: From *Origin of Species* to *Descent of Man,*" in Edward N. Zalta, ed., *The Stanford Encyclopedia of Philosophy,* Winter 2019 ed., https://plato.stanford.edu/entries/origin-descent.

2. Sloan, "Darwin." Although concepts of natural changes to species dated to ancient philosophers, Darwin argued that random mutations within a species' population could lead to new, more complex forms of life. See Phillip Sloan, "Evolutionary Thought before Darwin," in Edward N. Zalta, ed., *The Stanford*

tracked variations in plant reproduction and argued that some of their traits are transmitted through genes.

As scientists debated Darwin's and Mendel's theories over the following decades, people of faith grappled with the implications of organic evolution for human origins, the Creation of the earth, and the meaning of scripture.[3] In the early 20th century, public controversy about evolution centered on "Darwinism," or Darwin's explanation of natural selection through random mutation. Theologians were divided over whether the findings of scientists attested to God's creative power or denied His role in the Creation.[4]

Leaders of The Church of Jesus Christ of Latter-day Saints at the time did not take an official stance on the theory of evolution, but they did take steps to clarify the Church's teachings related to human origins. In 1909, President Joseph F. Smith and his counselors in the First Presidency published an official declaration entitled, "The Origin of Man." Drafted by Elder Orson F. Whitney, the declaration affirmed our divine nature as children of God.[5] The next year, President Smith urged Church leaders not to undertake "to say how much of evolution is true, or how much is false."[6]

In 1925, a high school science instructor named John Scopes stood trial in the southern United States for teaching human

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Encyclopedia of Philosophy, Winter 2019 ed., https://plato.stanford.edu/entries/evolution-before-darwin.

3. Robert C. Fuller, "Religious Responses to Modern Science, 1865–1945," chapter 24 in Stephen J. Stein, ed., *The Cambridge History of Religions in America,* 3 vols. (Cambridge: Cambridge University Press, 2012), 2:523–44; see also Ronald L. Numbers, *Darwinism Comes to America* (Cambridge, Massachusetts: Harvard University Press, 1998).

4. Fuller, "Religious Responses," 2:526–28.

5. Joseph F. Smith, John R. Winder, and Anthon H. Lund, "The Origin of Man," *Improvement Era,* vol. 8, no. 1 (Nov. 1909), 75–81; "What Does the Church Believe about Evolution?," *New Era,* Oct. 2016, https://churchofjesuschrist.org/study/new-era/2016/10/to-the-point/what-does-the-church-believe-about-evolution.

6. Joseph F. Smith, "Philosophy and the Church Schools," *The Juvenile Instructor,* vol. 46, no. 4 (Apr. 1911), 208–9.

evolution in violation of a Tennessee state law prohibiting the promotion of "any theory that denies the story of the Divine Creation of man as taught in the Bible."[7] During this trial, courtroom arguments over science and scriptural interpretation attracted widespread attention, amplifying the debate about the Bible's account of human origins.[8]

As international interest in the trial grew, several prominent newspapers asked Church leaders for the position of Latter-day Saints on evolution. The First Presidency issued a condensed version of "The Origin of Man" in 1925 that reiterated, "All men and women are in the similitude of the universal Father and Mother, and are literally sons and daughters of Deity." Both versions of this statement affirmed the doctrine of human divinity, as supported by ancient and modern scripture, and used the term "evolve" in a positive sense, pointing forward to the "ages and eons" of the eternities in which human beings could continue to progress toward godhood themselves.[9]

In the wake of the Scopes trial, Christians in the United States became increasingly divided over the question of human origins. "Modernist" Christians embraced scientific discovery and reasoning and were open to many approaches to biblical interpretation. Christians who opposed modernism, often labeled "fundamentalists," regarded the idea that humankind evolved from other species as blasphemous.[10] Latter-day Saints and their leaders found themselves on both sides of this issue. James E.

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7. Numbers, *Darwinism Comes to America,* 77–78.

8. Edward J. Larson, *Summer for the Gods: The Scopes Trial and America's Continuing Debate over Science and Religion* (New York: Basic Books, 1997); Stefaan Blancke, Hans Henrik Hjermitslev, and Peter C. Kjærgaard, eds., *Creationism in Europe* (Baltimore: Johns Hopkins University Press, 2014), 3, 9–13, 229; Numbers, *Darwinism Comes to America,* 4–23, 88; Fuller, "Religious Responses," 2:541–43.

9. "'Mormon' View of Evolution," *Deseret News,* July 18, 1925, section 3, 5; see also T. Benjamin Spackman, "The 1909 and 1925 First Presidency Statements in Historical and Scientific Contexts," herein, 299–329.

10. George M. Marsden, *Fundamentalism and American Culture,* 2nd ed. (New York: Oxford University Press, 2006), 3–4, 234.

Talmage and John A. Widtsoe, two professional scientists who became Apostles, regarded scientific discovery of truth as evidence of God's use of natural laws to govern the universe.[11] Meanwhile, Apostle and future Church President Joseph Fielding Smith believed that the biblical account of the Creation did not allow for the long spans required for species to multiply through evolution.[12] Addressing these differing opinions, Church President Heber J. Grant and his counselors in the First Presidency urged leaders not to take sides on the issue, requesting in 1931 that they "leave Geology, Biology, Archaeology and Anthropology, no one of which has to do with the salvation of the souls of mankind, to scientific research, while we magnify our calling in the realm of the Church."[13]

As time went on, faithful Latter-day Saints continued to hold diverse views on the topic of evolution.[14] Joseph Fielding Smith

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11. James E. Talmage, *The Articles of Faith: A Series of Lectures on the Principal Doctrines of the Church of Jesus Christ of Latter-day Saints* (Salt Lake City: Deseret News, 1899), 3, 30–34; John A. Widtsoe, *Joseph Smith as Scientist: A Contribution to Mormon Philosophy* (Salt Lake City: Young Mens Mutual Improvement Associations General Board, 1908), 1–2, 103–14; John A. Widtsoe, "Evidences and Reconciliations: To What Extent Should the Doctrine of Evolution Be Accepted?," *Improvement Era,* vol. 42, no. 7 (Jul. 1939), 417, 444–45, 447.

12. Erich Robert Paul, *Science, Religion, and Mormon Cosmology* (Urbana: University of Illinois Press, 1992), 179; see also Joseph Fielding Smith, "Faith Leads to a Fulness of Truth and Righteousness," *The Utah Genealogical and Historical Magazine,* vol. 21, no. 4 (Oct. 1930), 145–158; Joseph Fielding Smith, *Man: His Origin and Destiny* (Salt Lake City: Deseret Book, 1954).

13. First Presidency, Memorandum to the Council of the Twelve, First Council of the Seventy, and Presiding Bishopric, 5 April 1931, Document C, in William E. Evenson and Duane E. Jeffery, *Mormonism and Evolution: The Authoritative LDS Statements* (Salt Lake City: Greg Kofford Books, 2005), 54–67.

14. Compare Paul R. Green, comp., *Science and Your Faith in God: A Selected Compilation of Writings and Talks by Prominent Latter-day Saints Scientists on the Subjects of Science and Religion* (Salt Lake City: Bookcraft, 1958); Marion G. Romney, in *Conference Report,* Apr. 1959, 10; Marion G. Romney, "Records of Great Worth," *Ensign,* Sep. 1980, https://www.churchofjesuschrist.org/study/ensign/1980/09/records-of-great-worth; Russell M. Nelson, "The Magnificence of Man," Brigham Young University devotional, March 29, 1987, https://speeches.byu.edu/talks/russell-m-nelson/magnificence-man; William S. Bradshaw, Andrea J. Phillips, Seth M. Bybee, Richard A. Gill, Steven L. Peck, and Jamie L. Jensen, "A Longitudinal Study of Attitudes toward Evolution among Undergraduates Who Are Members of the

in his influential writings maintained the reliability of scripture as a guide to the Creation timeline. Henry Eyring, a prominent scientist and Sunday School general board member, welcomed evidence of evolutionary change and reiterated the teachings of Brigham Young, who taught that the gospel encompassed all truth, scientific or otherwise.[15] In 1965, Church President David O. McKay worked with Bertrand F. Harrison, a botany professor at Brigham Young University, to foster greater understanding between Saints with differing viewpoints on evolution.[16]

In the late 20th century, Church-sponsored schools expanded their educational offerings in the sciences. In 1992, the First Presidency and board of trustees at Brigham Young University approved a packet of reading material for use in science classes that presented the official 1909 and 1925 statements and other statements from members of the First Presidency on the faithful application of scientific truth.[17] The packet also included an entry from the 1992 publication *The Encyclopedia of Mormonism*, produced with Church leader approval, which explained that "the scriptures tell why man was created, but they do not tell how."[18] In 2016, the Church's youth magazine published articles on the pursuit of scientific truth. These articles reiterated that

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Church of Jesus Christ of Latter-day Saints," *PLoS One*, vol. 13, no. 11 (Nov. 7, 2018), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6221276.

15. See Henry J. Eyring, *Mormon Scientist: The Life and Faith of Henry Eyring* (Salt Lake City: Deseret Book, 2007), 60–70; Henry Eyring, *The Faith of a Scientist* (Salt Lake City: Bookcraft, 1967); Joseph Fielding Smith, *Man: His Origin and Destiny*; Joseph Fielding Smith, "Evolution," chapter 9 in *Doctrines of Salvation: Sermons and Writings of Joseph Fielding Smith,* 3 vols. (Salt Lake City: Deseret Book, 1954), 1:139–51. See also "The Gospel Defined," chapter 2 in *Teachings of Presidents of the Church: Brigham Young,* https://www.churchofjesuschrist.org/study/manual/teachings-brigham-young/chapter-2.

16. Bertrand F. Harrison, "The Relatedness of Living Things," *The Instructor,* Jul. 1965, 272–76, https://archive.org/details/instructor1007dese/page/n17/mode/2up.

17. William E. Evenson, "Evolution Packet Defined," *The Daily Universe,* Nov. 12, 1992, 3, in Evolution Packet, Collection on Brigham Young University Evolution Packet, Harold B. Lee Library, Brigham Young University.

18. William E. Evenson, "Evolution," in Daniel H. Ludlow, ed., *The Encyclopedia of Mormonism* (New York: Macmillan, 1992), 478.

"the Church has no official position on the theory of evolution" and characterized it as a "matter for scientific study." Echoing countless statements of Church leaders, the articles once again affirmed God's role in creation and our relationship to our Heavenly Father as His children.[19]

Church Resources

First Presidency, "Gospel Classics: The Origin of Man," *Ensign,* Feb. 2002, https://www.churchofjesuschrist.org/study/ensign/2002/02/the-origin-of-man.

First Presidency, "'Mormon' View of Evolution," *Improvement Era,* Sept. 1925, https://archive.org/details/improvementera28011unse/page/1088/mode/2up.

"What Does the Church Believe about Evolution?" *New Era,* Oct. 2016, https://churchofjesuschrist.org/study/new-era/2016/10/to-the-point/what-does-the-church-believe-about-evolution.

Alicia K. Stanton, "Science and Our Search for Truth," *New Era,* Jul. 2016, https://www.churchofjesuschrist.org/study/new-era/2016/07/science-and-our-search-for-truth.

Related Topics

Joseph F. Smith, Heber J. Grant, B. H. Roberts, John and Leah Widtsoe

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19. Alicia K. Stanton, "Science and Our Search for Truth," *New Era,* July 2016, https://www.churchofjesuschrist.org/study/new-era/2016/07/science-and-our-search-for-truth; "What Does the Church Believe about Evolution?," *New Era,* Oct. 2016, https://churchofjesuschrist.org/study/new-era/2016/10/to-the-point/what-does-the-church-believe-about-evolution.

Appendix B

The Origin of Man

The First Presidency of the Church

[From Improvement Era *13, no. 1 (November 1909): 75–81, https://archive.org/details/improvementera1301unse/page/74/mode/2up; capitalization, punctuation, paragraphing, and spelling standardized.]*

"God created man in his own image." [Gen. 1:27]

Inquiries arise from time to time respecting the attitude of The Church of Jesus Christ of Latter-day Saints upon questions which, though not vital from a doctrinal standpoint, are closely connected with the fundamental principles of salvation. The latest inquiry of this kind that has reached us is in relation to the origin of man. It is believed that a statement of the position held by the Church upon this subject will be timely and productive of good.

In presenting the statement that follows we are not conscious of putting forth anything essentially new; neither is it our desire so to do. Truth is what we wish to present, and truth—eternal truth—is fundamentally old. A restatement of the original attitude of the Church relative to this matter is all that will be attempted here. To tell the truth as God has revealed it, and commend it to the acceptance of those who need to conform their opinions thereto, is the sole purpose of this presentation.

"God created man in his own image, in the image of God created he him; male and female created he them." In these plain and pointed words the inspired author of the book of Genesis made known to the world the truth concerning the origin of the human family. Moses, the prophet-historian—"learned," as we are told, "in all the wisdom of the Egyptians"—when making this important announcement was not voicing a mere opinion, a theory derived from his researches into the occult lore of that ancient people. He was speaking as the mouthpiece of God, and his solemn declaration was for all time and for all people. No subsequent revelator of the truth has contradicted the great leader and lawgiver of Israel. All who have since spoken by divine authority upon this theme have confirmed his simple and sublime proclamation. Nor could it be otherwise. Truth has but one source, and all revelations from heaven are harmonious with each other. The omnipotent Creator, the maker of heaven and earth, had shown unto Moses everything pertaining to this planet, including the facts relating to man's origin, and the authoritative pronouncement of that mighty prophet and seer to the house of Israel, and through Israel to the whole world, is couched in the simple clause: "God created man in his own image" (Genesis 1:27; Pearl of Great Price—book of Moses 1:27–41).

The creation was twofold—first spiritual, secondly temporal. This truth, also, Moses plainly taught—much more plainly than it has come down to us in the imperfect translations of the Bible that are now in use. Therein the fact of a spiritual creation, antedating the temporal creation, is strongly implied, but the proof of it is not so clear and conclusive as in other records held by the Latter-day Saints to be of equal authority with the Jewish scriptures. The partial obscurity of the latter upon the point in question is owing, no doubt, to the loss of those "plain and precious" parts of sacred writ, which, as the Book of Mormon informs us, have been taken away from the Bible during its passage down the centuries (I Nephi 13:24–29). Some of these missing parts the Prophet Joseph Smith undertook to restore when he revised those scriptures by the spirit of revelation, the result being that more complete account of the

Creation which is found in the book of Moses, previously cited. Note the following passages:

> And now, behold, I say unto you, that these are the generations of the heaven and of the earth, when they were created, in the day that I, the Lord God, made the heaven and the earth,
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> And every plant of the field before it was in the earth, and every herb of the field before it grew. For I, the Lord God, created all things of which I have spoken, spiritually, before they were naturally upon the face of the earth. For I, the Lord God, had not caused it to rain upon the face of the earth. And I, the Lord God, had created all the children of men; and not yet a man to till the ground; for in heaven created I them, and there was not yet flesh upon the earth, neither in the water, neither in the air;
>
> But, I, the Lord God, spake, and there went up a mist from the earth, and watered the whole face of the ground.
>
> And I, the Lord God, formed man from the dust of the ground, and breathed into his nostrils the breath of life; and man became a living soul, the first flesh upon the earth, the first man also; nevertheless, all things were before created; but spiritually were they created and made according to my word. (Pearl of Great Price—book of Moses 3:4–7. See also [Moses] chapters 1 and 2, and compare with Genesis 1 and 2)

These two points being established, namely, the creation of man in the image of God, and the twofold character of the Creation, let us now inquire: What was the form of man, in the spirit and in the body, as originally created? In a general way the answer is given in the words chosen as the text of this treatise. "God created man in his own image." It is more explicitly rendered in the Book of Mormon thus: "All men were created in the beginning after mine own image" (Ether 3:15). . . . If, therefore, we can ascertain the form of the "Father of spirits," "the God of the spirits of all flesh," we shall be able to discover the form of the original man.

Jesus Christ, the Son of God, is "the express image" of His Father's person (Hebrews 1:3). He walked the earth as a human being, as a perfect man, and said, in answer to a question put to

Him: "He that hath seen me hath seen the Father" (John 14:9). This alone ought to solve the problem to the satisfaction of every thoughtful, reverent mind. The conclusion is irresistible, that if the Son of God be the express image (that is, likeness) of His Father's person, then His Father is in the form of a man; for that was the form of the Son of God, not only during His mortal life, but before His mortal birth, and after His Resurrection. It was in this form that the Father and the Son, as two personages, appeared to Joseph Smith, when, as a boy of 14 years, he received his first vision. Then if God made man—the first man—in His own image and likeness, He must have made him like unto Christ, and consequently like unto men of Christ's time and of the present day. That man was made in the image of Christ is positively stated in the book of Moses: "And I, God, said unto mine Only Begotten, which was with me from the beginning, Let us make man in our image, after our likeness; and it was so. . . . And I, God, created man in mine own image, in the image of mine Only Begotten created I him; male and female created I them" (2:26–27).

The Father of Jesus is our Father also. Jesus Himself taught this truth when He instructed His disciples how to pray: "Our Father which art in heaven," etc. Jesus, however, is the firstborn among all the sons of God—the first begotten in the spirit, and the only begotten in the flesh. He is our elder brother, and we, like Him, are in the image of God. All men and women are in the similitude of the universal Father and Mother and are literally the sons and daughters of Deity.

"God created man in His own image." This is just as true of the spirit as it is of the body, which is only the clothing of the spirit, its complement—the two together constituting the soul. The spirit of man is in the form of man, and the spirits of all creatures are in the likeness of their bodies. This was plainly taught by the Prophet Joseph Smith (see Doctrine and Covenants, 77:2).

Here is further evidence of the fact. More than 700 years before Moses was shown the things pertaining to this earth, another great prophet, known to us as the brother of Jared, was

similarly favored by the Lord. He was even permitted to behold the spirit-body of the foreordained Savior, prior to His incarnation; and so like the body of a man was gazing upon a being of flesh and blood. He first saw the finger and then the entire body of the Lord—all in the spirit. The Book of Mormon says of this wonderful manifestation:

> And it came to pass that when the brother of Jared had said these words, behold, the Lord stretched forth his hand and touched the stones one by one with his finger. And the veil was taken from off the eyes of the brother of Jared, and he saw the finger of the Lord; and it was as the finger of a man, like unto flesh and blood; and the brother of Jared fell down before the Lord, for he was struck with fear.
>
> And the Lord saw that the brother of Jared had fallen to the earth; and the Lord said to him: Arise, why hast thou fallen?
>
> And he saith unto the Lord: I saw the finger of the Lord, and I feared lest he should smite me; for I knew not that the Lord had flesh and blood.
>
> And the Lord said unto him: Because of thy faith thou hast seen that I shall take upon me flesh and blood; and never has man come before me with such exceeding faith as thou hast; for were it not so ye could not have seen my finger. Sawest thou more than this?
>
> And he answered: Nay; Lord, show thyself unto me.
>
> And the Lord said unto him: Believest thou the words which I shall speak?
>
> And he answered, Yea, Lord, I know that thou speakest the truth, for thou art a God of truth, and canst not lie.
>
> And when he had said these words, behold, the Lord showed himself unto him, and said: Because thou knowest these things ye are redeemed from the fall; therefore ye are brought back into my presence; therefore I show myself unto you.
>
> Behold, I am he who was prepared from the foundation of the world to redeem my people. Behold, I am Jesus Christ. I am the Father and the Son. In me shall all mankind have

> life, and that eternally, even they who shall believe on my name; and they shall become my sons and my daughters.
>
> And never have I showed myself unto man whom I have created, for never has man believed in me as thou hast. Seest thou that ye are created after mine own image? Yea, even all men were created in the beginning after mine own image.
>
> Behold, this body, which ye now behold, is the body of my spirit; and man have I created after the body of my spirit; and even as I appear unto thee to be in the spirit will I appear unto my people in the flesh. (Ether 3:6–16)

What more is needed to convince us that man, both in spirit and in body, is the image and likeness of God and that God Himself is in the form of a man?

When the divine Being whose spirit-body the brother of Jared beheld took upon Him flesh and blood, He appeared as a man, having "body, parts and passions," like other men, though vastly superior to all others, because He was God, even the Son of God, the Word made flesh: in Him "dwelt the fulness of the Godhead bodily." And why should He not appear as a man? That was the form of His spirit, and it must needs have an appropriate covering, a suitable tabernacle. He came into the world as He had promised to come (see III Nephi 1:13), taking an infant tabernacle and developing it gradually to the fulness of His spirit stature. He came as man had been coming for ages and as man has continued to come ever since. Jesus, however, as shown, was the Only Begotten of God in the flesh.

Adam, our first progenitor, "the first man," was, like Christ, a preexistent spirit, and like Christ he took upon him an appropriate body, the body of a man, and so became a "living soul." The doctrine of the preexistence—revealed so plainly, particularly in latter days—pours a wonderful flood of light upon the otherwise mysterious problem of man's origin. It shows that man, as a spirit, was begotten and born of heavenly parents and reared to maturity in the eternal mansions of the Father, prior to coming upon the earth in a temporal body to undergo an

experience in mortality. It teaches that all men existed in the spirit before any man existed in the flesh and that all who have inhabited the earth since Adam have taken bodies and become souls in like manner.

It is held by some that Adam was not the first man upon this earth and that the original human being was a development from lower orders of the animal creation. These, however, are the theories of men. The word of the Lord declared that Adam was "the first man of all men" (Moses 1:34), and we are therefore in duty bound to regard him as the primal parent of our race. It was shown to the brother of Jared that all men were created in the beginning after the image of God; whether we take this to mean the spirit or the body, or both, it commits us to the same conclusion: Man began life as a human being, in the likeness of our Heavenly Father.

True it is that the body of man enters upon its career as a tiny germ embryo, which becomes an infant, quickened at a certain stage by the spirit whose tabernacle it is, and the child, after being born, develops into a man. There is nothing in this, however, to indicate that the original man, the first of our race, began life as anything less than a man, or less than the human germ or embryo that becomes a man.

Man, by searching, cannot find out God. Never, unaided, will he discover the truth about the beginning of human life. The Lord must reveal Himself or remain unrevealed; and the same is true of the facts relating to the origin of Adam's race—God alone can reveal them. Some of these facts, however, are already known, and what has been made known it is our duty to receive and retain.

The Church of Jesus Christ of Latter-day Saints, basing its belief on divine revelation, ancient and modern, proclaims man to be the direct and lineal offspring of Deity. God Himself is an exalted man, perfected, enthroned, and supreme. By His almighty power He organized the earth and all that it contains, from spirit and element, which exist coeternally with Himself. He formed

every plant that grows and every animal that breathes, each after its own kind, spiritually and temporally—"that which is spiritual being in the likeness of that which is temporal, and that which is temporal in the likeness of that which is spiritual." He made the tadpole and the ape, the lion and the elephant, but He did not make them in His own image, nor endow them with godlike reason and intelligence. Nevertheless, the whole animal creation will be perfected and perpetuated in the Hereafter, each class in its "distinct order or sphere," and will enjoy "eternal felicity." That fact has been made plain in this dispensation (Doctrine and Covenants 77:3).

Man is the child of God, formed in the divine image and endowed with divine attributes, and even as the infant son of an earthly father and mother is capable in due time of becoming a man, so the undeveloped offspring of celestial parentage is capable, by experience through ages and aeons, of evolving into a God.

Joseph F. Smith
John R. Winder
Anthon H. Lund
First Presidency of the Church of
Jesus Christ of Latter-day Saints

Appendix C

"Mormon" View of Evolution

The First Presidency of the Church

[From Improvement Era *28, no. 11 (September 1925): 1090–91, https://archive.org/details/improvementera28011unse/page/1088/mode/2up.]*

A statement by the First Presidency of the Church of Jesus Christ of Latter-day Saints

God created man in his own image, in the image of God created he him; male and female created he them."

In these plain and pointed words the inspired author of the book of Genesis made known to the world the truth concerning the origin of the human family. Moses, the prophet-historian, who was "learned," we are told, "in all the wisdom of the Egyptians," when making this important announcement, was not voicing a mere opinion. He was speaking as the mouthpiece of God, and his solemn declaration was for all time and for all people. No subsequent revelator of the truth has contradicted the great leader and law-giver of Israel. All who have since spoken by divine authority upon this theme have confirmed his simple and sublime proclamation. Nor could it be otherwise. Truth has but one source, and all revelations from heaven are harmonious one with the other.

Jesus Christ, the Son of God, is "the express image" of his Father's person (Hebrews 1:3). He walked the earth as a human being, as a perfect man, and said, in answer to a question put

to him: "He that hath seen me hath seen the Father" (John 14:9). This alone ought to solve the problem to the satisfaction of every thoughtful, reverent mind. It was in this form that the Father and the Son, as two distinct personages, appeared to Joseph Smith, when, as a boy of fourteen years, he received his first vision.

The Father of Jesus Christ is our Father also. Jesus himself taught this truth, when he instructed his disciples how to pray: "Our Father which art in heaven," etc. Jesus, however, is the first born among all the sons of God—the first begotten in the spirit, and the only begotten in the flesh. He is our elder brother, and we, like him, are in the image of God. All men and women are in the similitude of the universal Father and Mother, and are literally sons and daughters of Deity.

Adam, our great progenitor, "the first man," was, like Christ, a pre-existent spirit, and, like Christ, he took upon him an appropriate body, the body of a man, and so became a "living soul." The doctrine of pre-existence pours a wonderful flood of light upon the otherwise mysterious problem of man's origin. It shows that man, as a spirit, was begotten and born of heavenly parents, and reared to maturity in the eternal mansions of the Father, prior to coming upon the earth in a temporal body to undergo an experience in mortality.

The Church of Jesus Christ of Latter-day Saints, basing its belief on divine revelation, ancient and modern, proclaims man to be the direct and lineal offspring of Deity. By his Almighty power God organized the earth, and all that it contains, from spirit and element, which exist co-eternally with himself.

Man is the child of God, formed in the divine image and endowed with divine attributes, and even as the infant son of an earthly father and mother is capable in due time of becoming a man, so the undeveloped offspring of celestial parentage is capable, by experience through ages and aeons, of evolving into a God.

Heber J. Grant,
Anthony W. Ivins,
Charles W. Nibley,
First Presidency.

Appendix D

What Does the Church Believe about Evolution?

[From New Era *45 [46], no. 10 (October 2016): 41, https://churchofjesuschrist.org/study/new-era/2016/10/to-the-point/what-does-the-church-believe-about-evolution.]*

The Church has no official position on the theory of evolution. Organic evolution, or changes to species' inherited traits over time, is a matter for scientific study. Nothing has been revealed concerning evolution. Though the details of what happened on earth before Adam and Eve, including how their bodies were created, have not been revealed, our teachings regarding man's origin are clear and come from revelation.

Before we were born on earth, we were spirit children of heavenly parents, with bodies in their image. God directed the creation of Adam and Eve and placed their spirits in their bodies. We are all descendants of Adam and Eve, our first parents, who were created in God's image. There were no spirit children of Heavenly Father on the earth before Adam and Eve were created. In addition, "for a time they lived alone in a paradisiacal setting where there was neither human death nor future family." They fell from that state, and this Fall was an essential part of Heavenly Father's plan for us to become like Him. (See Elder Jeffrey R. Holland of the Quorum of the Twelve Apostles, "Where Justice, Love, and Mercy Meet," Apr. 2015 general conference.)

Appendix E

What Does the Church Believe about Dinosaurs?

[From New Era *46, no. 2 (February 2016): 41, https://www.churchofjesuschrist.org/study/new-era/2016/02/to-the-point/what-does-the-church-believe-about-dinosaurs]*

Did dinosaurs live and die on this earth long before man came along? There have been no revelations on this question, and the scientific evidence says yes. (You can learn more about it by studying paleontology if you like, even at Church-owned schools.)

The details of what happened on this planet before Adam and Eve aren't a huge doctrinal concern of ours. The accounts of the Creation in the scriptures are not meant to provide a literal, scientific explanation of the specific processes, time periods, or events involved. What matters to us is that as part of His plan for us, God created the earth and then created Adam and Eve, who were our first parents and were instrumental in bringing about the Fall, which enabled us to be born on earth and participate in God's plan. (See Jeffrey R. Holland, "Where Justice, Love, and Mercy Meet," *Ensign,* May 2015, 105.)

Appendix F

Science and Our Search for Truth

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[From New Era *45 [46], no. 7 (July 2016): 26–29, https://www.churchofjesuschrist.org/study/new-era/2016/07/science-and-our-search-for-truth.]*

Can you imagine going to the dermatologist with a bad case of acne and being told the treatment will be to drain some of your blood? That might sound absurd to you, but it wouldn't have been far-fetched a couple of centuries ago. Back then, withdrawing a sizable amount of blood was considered standard treatment for almost any medical condition, including indigestion, insanity, and even acne. Nobody questioned that. Why should they have? After all, bloodletting had been used for thousands of years by many different cultures.

It wasn't until doctors started approaching medicine from a scientific viewpoint that anyone questioned the practice. When bloodletting was finally examined more closely, doctors stopped using it for all but a few specific medical conditions.[1]

From this historical example, we see that just because a belief is widely accepted or has been around for a long time doesn't

1. See, for example, K. Codell Carter and Barbara R. Carter, *Childbed Fever: A Scientific Biography of Ignaz Semmelweis* (1994).

necessarily mean it's true. And we see that science can be a great tool in uncovering real truth.

For Latter-day Saints, that's a big deal. Not only does knowing truth give us a better basis for making practical decisions ("No, I won't have my blood drained today, thanks!"), but it also adds to our understanding of the gospel. As President Brigham Young (1801–77) taught, "There is no truth but what belongs to the Gospel. . . . If you can find a truth in heaven [or] earth, . . . it belongs to our doctrine."[2]

The Why versus the How

Of course, when we talk about how science contributes to the truths we know, we've got to be sure we understand what kind of truth science can uncover—and what kind it can't. One way to look at it is to ask what kinds of questions science can and can't answer.

Sister Ellen Mangrum, who studied chemical engineering at Rensselaer Polytechnic Institute in New York, USA, explains it this way: "Science explains the how. But it stops short of explaining the why." She adds that religion is what explains the why, such as why the earth was created and why we were put here.

The famous physicist Albert Einstein also believed that religion and science have different, complementary purposes.

"Science can only ascertain what is, but not what should be," he wrote. "Outside of [science's] domain value judgments of all kinds remain necessary."[3]

What does that mean to Latter-day Saints? First, we know scientific understanding will keep changing. After all, science is all about trying to find better ways to understand the "hows" of the world around us. Knowing that, we don't need to look to the latest study to understand the "whys" or "shoulds" of life. We can

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2. *Teachings of Presidents of the Church: Brigham Young* (1997), 16.

3. Albert Einstein, in "Science and Religion," in Ken Wilber, *Quantum Questions: Mystical Writings of the World's Greatest Physicists* (1984).

depend on the unchanging gospel of Jesus Christ to help us make decisions between right and wrong.

It All Fits

President Russell M. Nelson, President of the Quorum of the Twelve Apostles and a renowned heart surgeon, has talked about how religion and science fit together.

"There is no conflict between science and religion," he said. "Conflict only arises from an incomplete knowledge of either science or religion, or both. . . . Whether truth comes from a scientific laboratory or by revelation from the Lord, it is compatible."[4]

So if you've ever had questions about how the age of the earth or dinosaurs or evolution or anything else you've learned in a science class fits into the gospel, that's great! It does all fit together, but there are still a lot of questions because there's still a lot that we're learning. Brother Brian Down, a pharmaceutical scientist in Quebec, Canada, said that he looks forward to the time when everything will be revealed to us (see D&C 101:32–34).

In the meantime, "we are limited in our ability to comprehend all the mysteries of the world around us through scientific endeavors," he says. "Likewise, we are limited in our understanding of the mysteries of God and His grand design for His children."

There's no need to worry, then, if there seems to be a conflict between your understanding of the gospel and what you learn through science. In reality, nothing that science reveals can disprove your faith.

So if you like science, learn all you can about your area of interest! Your faith can even give you an advantage. Brother Richard Gardner, an associate professor of biology at Southern Virginia University, says that his faith in the gospel of Jesus Christ has been a big help to him.

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4. Russell M. Nelson, in Marianne Holman Prescott, "Church Leaders Gather at BYU's Life Sciences Building for Dedication," *Church News,* Apr. 17, 2015, LDS.org.

"At times when research got difficult, and nothing seemed to be working—research is like that a lot—having a perspective on the blessings of the gospel helped me get through it," he says.

Brother Down also feels that his faith has helped him with his work in science.

"I always worked with the faith that there was logic and order in everything and that if I pursued a question long and hard enough, Heavenly Father would eventually open my mind to the answer," he says.

Rejoicing in Scientific Discovery

Our faith in Christ and His gospel can also help us stay humble and open to the truth we're seeking, whether it's scientific or spiritual.

"There is a lot we don't know in science and a lot about God that He has not yet revealed," Professor Gardner says. "So it is important to keep an open mind as more information comes to us and not to get worried in the meantime."

For example, some people believe in God simply because they see no other explanation for their observations of the world. This is called believing in a "God of the gaps," and it can make people feel nervous about scientific discovery. Professor Gardner gives an example:

"Some people have believed in God because there are gaps in the fossil record (meaning, to them, that evolution cannot explain how we got here). But what happens to our faith when these gaps are closed by the discovery of new fossils? Rather, we need to obtain positive evidence of God, through the Holy Ghost, and then we can rejoice in any scientific discovery instead of worrying about it."

When we take this approach, we remember that both science and religion can help us along in our search for truth and that, ultimately, all of that truth comes from the same source: God.

"God could reveal anything He wants to, including all scientific facts," Professor Gardner says. "And He definitely has inspired

scientists, inventors, and engineers—but He doesn't just give them all the answers. He wants them, and us, to use our brains, so He lets us work out the science, and His revelations to the Church are instead about how to organize the Church and especially how we can come to Christ and be saved.

"His personal revelations to us may be on any subject, but especially to let us know that He lives and loves us, that Christ put into effect the plan of salvation, that we have a living prophet today, that we can follow God's plan, and that it is totally worth it to do so."