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In This Issue …

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

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Perspectives on Science and Christian Faith

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James C. Peterson

Part II: Evangelicals, Neural Organoids, and Chimeras

In the March editorial, I briefly described four points of contact between evangelicals and the ethics of developing human neural organoids. The topic was raised by a working group at the National Academy of Sciences that consulted with me on possible concerns. A frequent first step in seeking to understand any malady is to find or develop an animal or lab model. Seeking to address Alzheimer's, depression, autism, and other neural issues, human neural organoids have been grown now to the point of significant neural activity. In the March editorial, we listed some of those concerns and left more detail for this issue on the moral status of animals and human beings, and distinguishing absolute and *prima facie* principles.

Jesus directed his people to love their neighbors as themselves. When in human development is there a neighbor present to love? While not as monolithic as sometimes assumed, according to the Pew Research Center,[1] roughly two-thirds of evangelicals consider human embryos to be present human persons as embryos. By this view, the human embryo is a human person with potential, not just a potential person. The embryo is already a human being because it has all the individual genetic information and means for design and development to be born—if supported and allowed to. This reading of moral status entails not sacrificing human embryos to obtain stem cells. Granted, their moral standing is not absolute any more than an adult's moral standing is absolute. One could end the life of a human embryo, say in surgery for an ectopic pregnancy whereby a life is saved even as another is foreseeably lost.

Seeing the embryo as a human person has no objection to obtaining and using stem cells from induced pluripotent stem cells (iPSC). How would this perspective address SHEEFs? A SHEEF is a "synthetic human entity with embryo-like features." It temporarily functions like an embryo, but does not have the genetic instructions to develop beyond the embryo state. If a human being is present because all the necessary genetic information is present for an individual to grow to birth, then a SHEEF, which is designed without that further development information, would not seem to meet the minimum standard of this view of already being a human being. It would be human tissue without what is needed to be a human being.

The one-third of evangelicals who do not see a person present from fertilization, most often hold a threshold developmental view, a view more akin to the early church consensus through to fairly recently. As taught by Saint Thomas Aquinas, there is not an ensouled body (a person) until there is a body to ensoul. Aquinas saw this point of formation, as Aristotle defined it, as forty-five or more days into pregnancy. With more information available now about development, those who argue for formation as the first actual presence of a fellow human being usually do so either at the first heartbeat that develops about a month after fertilization, or at the start of brain activity roughly two months after fertilization. By these views, procedures such as a morning-after pill or prenatal genetic diagnosis (PGD) done with good reason, can be appropriate because the intervention is before a fellow human being is present.

Beyond matters of life and death, the neighbor love that seeks to help others to flourish, including the vulnerable or marginalized, calls one to avoid inflicting suffering. Suffering can include pain, frustration, and loss of opportunity. We all experience consciousness, but to date we do not know how exactly to measure it externally. That is already a challenge we have with comatose patients who have had a clear history of consciousness. So how can it be measured for a subject who has never been conscious but may be developing toward it? Granted, it would be desirable to keep increasing the similarity of neural organoids toward more human-like physiology and experience, to provide a more applicable research

model for testing drugs and new therapies, but models similar enough to study autism or schizophrenia, might be complex enough to experience neural pain or eventually, the pain of frustration and loss. The desire to articulate language in thought, and the desire to communicate, are hard wired into the human brain. The pain of not being able to articulate language, or not being able to communicate, or to expect a body but not have one, would be genuine pain in an organoid that is complex enough to simulate the structure of a human brain but isolated from a human body. We should be vigilant not to create a chimera or organoid that consciously experiences suffering or may be approaching that experience. A being complex enough to be able to experience some kind of suffering, but anesthetized, would be high risk and thus difficult to justify. Enhancing the intelligence of nonhuman animals beyond species-typical norms, or conferring human-like cognitive capacities, would create a mismatch in the animal, or worse, a locked-in experience to the degree human.

As we do science, we usually do not know what is going to be the most fruitful avenue of investigation. Taking that into account, one might think of the above obligation not to harm a subject, by the standard philosophical definition of a *prima facie* obligation. An absolute prohibition has no exceptions. Most of our medical ethics principles cannot be absolute. For example, "do no harm" is transgressed dramatically when we do open heart surgery, but it can be justified harm if the obligation not to harm is *prima facie*. A *prima facie* obligation is a genuine obligation, but it is not absolute. It cannot be broken lightly, but under certain circumstances and guidelines, it can be overridden. In this case, that might be that one has an obligation not to inflict intentional harm on a fellow creature (with the highest fellow standing for a primate) unless that obligation is overridden (1) by a higher moral concern, for example, ridding us of Alzheimer's or autism, (2) as a last resort—the alternatives are found to be inadequate, (3) as minimally as possible—this is not authorizing limitless intervention, and (4) by the pursuit of amends—healing, if possible, and consolation for the subject who was in some way harmed.

So, returning to the application of the March editorial, from an evangelical perspective, research using unconscious tissue inside an animal model or in a lab setting is welcome. In parallel to raising food, harvesting a porcine heart valve to replace an ailing human heart valve, is already welcome, as long as no suffering was inflicted on the animal source. The animal was part of God's creation too. If we could develop a way for an animal to grow a whole human organ such as a kidney for transplant to a human, that would be welcome, if the animal has a good life and suffering is avoided in obtaining the organ. Growing a human organ or some portion outside of a human body, for study or transplant, would also be welcome. Growing brain tissue not networked to the point of potential suffering, in an animal host or lab, for transplant to a human being to support a damaged brain, or for study, would be welcome.

The likely boundary for evangelicals will be against enhancing the intelligence of nonhuman animals beyond species-typical norms, or conferring human-like cognitive capacities to an entity, because these would cause suffering from a mismatch in the animal, or worse, a locked-in experience to the degree that there is presence of humanity. Scientific research and medical technologies, animal models and sources, building lab tissue models and sources, including neural organoids for research, are welcome practices toward understanding, healing, and stewardship, as long as they do not involve killing a fellow human being, or cause an unjustified negative experience for any living creature. This latter concern might be met at a *prima facie* level. ✞

Note

[1]Religious Landscape Study, "Views about Abortion among Evangelical Protestants by Religious Group," Pew Research Center, 2014, https://www.pewforum.org/religious-landscape-study/compare/views-about-abortion/by/religious-family/among/religious-tradition/evangelical-protestant/.

James C. Peterson
Editor-in-Chief

D. Gareth Jones

A Christian Perspective on New Zealand's Response to COVID-19

D. Gareth Jones

The COVID-19 pandemic has had horrendous consequences for much of the world with huge swathes of serious illness and alarming rates of premature death. Surprisingly, some of the most affluent and technologically sophisticated countries have been the worst affected. The current article aims to investigate this counterintuitive state of affairs by reference to a small country, New Zealand, that has escaped the worst effects of the pandemic. Some of the lessons that emerge include the prominent role played by science in undergirding political decision-making, decisive empathic leadership, and the subsequent high level of trust placed by the community in the political decision makers. The willingness of political leaders to listen to scientific advice and enter into dialogue with public health specialists and epidemiologists stood out as exemplary.

The dominant messages coming from the political leadership at the height of the pandemic highlighted the importance of community, the interests of one's neighbors, and the need to treat each other with kindness and consideration. While these were not put forward as Christian standards, they bear striking resemblance to the Christian values of loving one's neighbor, living for each other, putting the interests of others before one's own interests, and demonstrating the gifts of the Spirit. It was these that enabled the country to live through an early very harsh lockdown aimed at "eliminating" the virus from the population. While the New Zealand situation cannot be precisely replicated in much larger countries, many of the lessons coming out of the New Zealand experience throw considerable light on how reliable, insightful science and responsible leadership can bring glory to God and protect human dignity and worth.

In the midst of the horrific ongoing effects of the COVID-19 pandemic that has ravaged the world, a few countries have stood out as having coped remarkably well with controlling its worst effects. One of these is New Zealand, and as someone living there, it is possible to provide an insider's perspective on the measures that were taken, and continue to be taken, to accomplish this degree of control. This, in turn, provides an opportunity to reflect on the values lying behind these measures, and the extent to which they reflect Christian priorities. While New Zealand's response does not represent the only one that could have been taken, it serves as a useful model from which general lessons can be gleaned. It also shows the power of public health measures. Important as vaccines will undoubtedly prove, even in their absence, a great deal can be done to protect whole populations. This was discovered by people such as Martin Luther five hundred years ago, even though he and others were ignorant of the accumulated wisdom of public health experts.[1]

When a plague struck Wittenberg in 1527, Luther remained to minister to the sick and the frightened, in spite of being

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surrounded by death. Misunderstood as he was for this, he wrote a now famous letter: "Whether One May Flee from a Deadly Plague."[2] The bottom line for him was caring for one's neighbor and the community, and taking all necessary steps to protect others. He was driven by the centrality of serving. Even though he accepted that it was not necessarily wrong to flee from death, his first considerations were his community and family responsibilities. For Luther, people are bound to each other and are not to forsake others in their distress, and this led to an obligation to assist and help others. As a result, Luther urged people to take medicine, to disinfect their homes, and if at all possible, to avoid people and places in an effort to confine the disease.

Luther had found that elusive middle ground between panic and foolhardiness.[3] His pragmatism is striking since he possessed none of the epidemiological and public health knowledge available today. Strikingly, he was driven by his theology and biblical insights. His insistence that we have a duty toward our neighbor, even at the expense of our own health, stemmed from the fundamental premise that, as those bound together in Christ's body, we are to serve our neighbors both inside and outside the church. His biblically based actions aligned remarkably well with the scientifically based measures underlying contemporary public health policies.[4]

In his own way, he was demonstrating the close alliance of science and faith. He would probably not have thought in these terms, and yet, with hindsight, what he did was utilize the rudimentary scientific principles available to him and apply them to protect his parishioners as those made in God's image. This was the science-faith duopoly in action, public theology at its best.

When large numbers of lives are at stake, the question of what measures at our disposal will best protect and enhance human life and dignity, and uphold the value placed upon human life, becomes central. A pandemic calls attention to the need to protect life after birth, especially the aged, those in long-term care facilities, those with a range of underlying health conditions, essential workers, minority populations, and the less affluent. The pressing question for Christians is what will uphold the dignity of human life at a community level as opposed to an individual level? This is not a new dimension, since the suffering of entire populations as a result of starvation and endemic diseases, like measles and malaria that could be eradicated but are not, brings us face-to-face with the same dilemma. Unfortunately, these situations tend to be confined to impoverished countries and tend to be overlooked by those in the more affluent parts of the world. A pandemic serves as a learning moment for the affluent in that it confronts the privileged with needless misery and death. What ethical and theological tools do we have for addressing them using the ethical categories we regularly employ at the beginning of life?

Background

A small country like New Zealand has achieved global recognition for its sterling response to the COVID-19 pandemic. In this, it is not alone but sits alongside a number of Asian countries such as Taiwan, Thailand, Vietnam, and Singapore. Each has had different characteristics, but all have followed well-known public health measures.

New Zealand has experienced one of the lowest cumulative case counts, incidence, and mortality among higher-income countries in its first wave of COVID-19. It achieved the lowest death rate in the Organization for Economic Co-operation and Development (OECD) from the pandemic, equivalent to about 2,000 lives saved compared to the OECD average.[5] It was the only country to articulate an unambiguous "elimination" strategy which was achieved.[6] With twenty-five (now 26) deaths, the death rate was 54 times lower than the average for other island nations in the OECD, although it has to be admitted, that Taiwan had only seven deaths and a smaller number of cases.[7] The New Zealand result was brought about by early implementation and rapid escalation of national COVID-19 suppression strategies.[8]

Chief among these were border closures as a crucial means of reducing the burden of imported disease.[9] This commenced fifteen days after confirmation of the first case. Within two weeks, lockdown was associated with a substantial reduction in daily case infection rate and improving response performance measures. Most cases were detected by contact tracing, and there were decreasing average times to case notification and isolation, along with increasing population testing with effective targeting of higher-risk

groups. In terms of the degree of economic harm, New Zealand falls into the mid-range among OECD countries.[10]

It is fascinating to see that *Nature*, the world's leading multidisciplinary science journal, has included the New Zealand Prime Minister, Jacinda Ardern, as one of the ten people to shape science in 2020, even though she is not a scientist. On March 14, 2020, at a time when just six people in the country had tested positive for COVID-19, all linked to overseas travel, she announced a series of strict measures to slow the outbreak, including two weeks of self-isolation for everyone arriving in New Zealand, closure of sea ports to cruise ships, and restrictions on travel to vulnerable Pacific neighbors. Less than two weeks later, New Zealand entered a nationwide all-encompassing lockdown. This decisiveness has characterized all her subsequent decisions. As a consequence, New Zealand has twice stamped out community outbreaks, limiting cases to just over 2,000 and deaths to twenty-five.[11] To put this in perspective, the United States death toll when adjusted for population size is more than 170 times higher.[12]

This is not to suggest that the New Zealand response has been flawless. Commentators have pointed out how it could have been better if the country had been more prepared for a pandemic. Taiwan outshone New Zealand with its better border control early on, its extensive use of masks, and its superior use of digital technologies to support pandemic control.[13] Taiwan even managed the pandemic without a lockdown, although it is unlikely that New Zealand could have done the same in light of its inadequate prior preparation for a pandemic. New Zealand's lack of preparedness for a pandemic is illustrated by the fact that it ranked thirty-fifth out of 195 countries in the 2019 Global Health Security Index, which assesses countries' health security and capabilities, with a poor overall score of 54/100. This compared with first ranked United States, with an overall score of 83.5/100. This demonstrates how remarkably well the New Zealand government did, led by its Prime Minister, Jacinda Ardern, with her strong crisis leadership.[14]

The lack of prior advance planning shows very forcibly the central importance of specialist expertise, willingness to follow well-recognized effective agenda management, and eschewing any personal ego.[15] Repeatedly, the response to the crisis was framed as "our" response, to indicate the importance of national unity. As a result, "flattening of the curve" became a national challenge, with breaches deemed unacceptable. In one high profile case, a breach, on the part of a leading government minister, led eventually to his demotion. Framing the lockdown in terms of the "team of five million" served as a very effective message to "nudge" citizens' behavior.[16]

Another temptation that New Zealand resisted was opening up its borders and internal activities too early in response to demands from the business community, including tourist interests. In hindsight, not only did this save lives, it also allowed the economy to recover far more quickly than was generally forecast.[17]

In responding to the pandemic in this manner, the New Zealand government was probably influenced by equity considerations; some have argued that these provided the impetus for the COVID-19 elimination strategy.[18] The reasoning behind this assertion is that this strategy minimized cases and deaths that were widely expected to have a disproportionate effect on Māori and on those belonging to low socio-economic groups. A more general discussion of the ethical principles needed in a pandemic has highlighted solidarity, equal moral respect, equity, autonomy, vulnerability, and trust.[19] While these may not have directly informed the decision makers in New Zealand, the similarity between them is striking.

Overview of the New Zealand Response to COVID-19

New Zealand consists of two major islands and a large number of smaller ones. It is both small, with a population of five million, and isolated in the Southwestern Pacific Ocean. It is a bicultural nation with a formal treaty relationship (the 1840 Treaty of Waitangi) between the indigenous Māori and the British Crown. It is a developed nation, with legislative authority vested in an elected unicameral parliament, based on the British system. The majority of its population (around 70 per cent) is of European descent, with the indigenous Māori constituting the "first" peoples and the largest minority, followed by Asians and Pacific Islanders. There is also a growing cohort of Middle Eastern, Latin American, and African ethnicities.

Christianity is the predominant religion, but with a prominent secular strand running throughout the society. On Bloomberg's market crisis management index, New Zealand ranks very strongly for political stability, economic recovery, virus control, and social resilience.[20] This has proved beneficial for business continuity planning, even though the primary focus of the country's response was to limit the negative health effects of a rampant virus.

The first case of COVID-19 was reported in New Zealand on February 28, 2020. Prior to this, the government had been following the outbreak in a number of other countries, so that on February 3, 2020, entry from China was denied for foreign travelers, with only New Zealand citizens and permanent residents permitted to enter the country. The earliest reported cases were returning nationals and passengers from cruise ships. On March 21, the prime minister announced the establishment of a four-stage "alert" level system: level 1 (prepare; the disease is contained in New Zealand), level 2 (reduce; the disease is contained but the risk of community transmission remains), level 3 (restrict; high risk the disease is not contained) and level 4 (eliminate; likely the disease is not contained).[21]

On March 23, 2020, an epidemic notice was issued, and level 3 was announced with significant restrictions on personal movement, social contact, and travel. Two days later a national state of emergency was declared, about twelve hours before a move to level 4. At this most stringent of the levels, the entire population was to remain in their homes and associate with only their immediate family or household (their "bubble"). All public gatherings of any size, including funerals, were banned. All non-essential businesses, including educational institutions, bars and restaurants, hairdressers, and churches, had to close. Essential workers, who included health and residential care workers, first responders, grocery store and food distribution workers, and the media, were permitted to work under strict protocols. The border was closed, and all international and domestic air travel was suspended, except for relief flights and the transport of cargo. All arrivals were (and still are) required to undertake a fourteen-day government supervised quarantine. The intention of this harsh lockdown was to "eliminate" the virus from New Zealand.[22]

This level 4 lockdown was in place for four weeks, with the following two weeks at level 3. In effect, this meant that, for most people, it lasted for at least six weeks. Following this, it was decreased in stages to level 2 and then level 1, which is essentially normal existence except that the borders remain closed. Any recurrence of community transmission was addressed by an escalation back to levels 3 or 4. This has occurred twice in the country's largest city Auckland, and the case numbers were controlled within a few days or weeks.

Closure of the borders is not insignificant since numerous citizens originate in other countries and have relatives and friends in other countries, including nearby Australia. Consequently, the present near-normal state of affairs is not without its drawbacks, with families separated and unable to meet up even in times of grief, or indeed for celebrations of all kinds.

A particular feature of the handling of the pandemic for many weeks was the 1 pm press conference each day on both radio and TV. These daily briefings undertaken generally by the Prime Minister and Director-General of Health emerged as a major highlight with their openness and communication of hard data. The impression was given that there was nothing to hide and that all measures possible were being undertaken by the government and public health authorities to protect the public. The atmosphere of these press conferences was one of empathy and understanding, encouraging a mutuality of response across the whole country.[23] It was recognized that lockdowns were onerous and debilitating, but that they were aimed at protecting the citizens of the country and looking after their welfare.

Underlying these responses was close liaison between the government officials and their public health advisors, and the academic specialists and epidemiologists.[24] Differences of opinion between experts were freely aired and discussed publicly leading to positive discussion rather than acrimonious debate. Academic specialists were regularly featured in the media and this contributed to a general acceptance of what was a temporary suspension of civil liberties. A response of this severity was feasible on account of considerable public trust in central government and the media in times of crisis, so that public health messages that were clearly explained

were largely positively received. Much of this was made possible by the small size of the country and by its isolation, with ongoing border controls and extensive use of isolation facilities. Efforts to keep the virus out of the country at the borders proved demanding and on occasion failed.

Significant Messages

The main messages to emerge have been the ability and willingness to close the country's borders early, to have quick and very firm lockdowns when required, the extensive use of contact tracing, the concept of bubbles and staying within them, and the clarity of all official messages. The underlying messages propounded ceaselessly by the Prime Minister were "to be kind" and to remember that "we are a team of 5 million." No matter how these messages sound to those from other countries, they proved very powerful for the citizens at the height of the pandemic. They were reiterated repeatedly and were backed up by financial support for businesses suffering from border closures.

Underlying these responses was an ethical framework drawn up a few years earlier following the SARS epidemic,[25] with the object of reflecting the culture and beliefs of New Zealand and in particular significant Māori concepts. The emphasis upon kindness and the notion of the team of 5 million reflected ethical principles enunciated in that document, as did the commitment to openness and transparency evident in the daily briefings.[26] These responses were made possible by the solidarity evident among the community, a central ethical value for pandemic planning.[27] This is possible only if the population is united behind the decision makers and especially the politicians. The role of scientists has been to provide research-based information, and that of bioethicists to assess policies, but both have to recognize that ultimate decisions are political ones and reside in the politicians' court. This is an expression of solidarity that works only when there is respect and trust among all parties and an openness to productive dialogue and free discussion.

New Zealand was fortunate in being able to benefit from cross-national learning, since other countries had been affected earlier. This gave New Zealand policy makers time to absorb lessons emerging from these other countries. Consequently, they had access to sufficient modelling data and medical expertise to know that the only way of stopping widespread infection was to impose a very severe lockdown.[28] This was the only viable option if the country was to avoid a catastrophe, and if hospitals were not to be overrun with COVID-19 patients. In reality, this was a far from easy option politically. The business community was only too aware of the massive financial consequences of closing not only the borders but also most commercial ventures. Hospitality and tourism would be especially hard hit, since the country was heavily dependent upon international tourists, and there was little doubt that the tourist industry (New Zealand's biggest export industry) would be decimated. The decision to go "hard and fast" was a rational, but also a value-based decision for the Prime Minister. The following six-week lockdown under alert levels 3 and 4 was the most severe in any democracy, but accompanied by a huge spending package to support employees and businesses; it generated 87 percent public support.[29] There have been numerous challenges in the post-lockdown period, but the government's continued reliance upon ongoing expert advice, and willingness to make repeated tough decisions, have proved crucial.

The New Zealand response rejected any hint of populism and no hint whatsoever of a denigration of expertise. There was time to reflect on the best way forward, that is, a way based on research and serious analysis of data. Little room was left for political ideology or emotive responses, even when momentous decisions were being taken that would affect the lives of many people. One word that has been used to encapsulate this response has been "resilience," the ability to rely on experience with adverse consequences and the ability to develop a capacity to learn from the harm and bounce back.[30]

Essential Characteristics of the Response

A number of features emerge as crucial for a successful response to a pandemic such as COVID-19. While these are not explicitly Christian in nature, they align seamlessly with Christian imperatives. Prior to analyzing what these are, listing the features will set the scene for a Christian analysis of the response.

The enveloping context is that of trust in the government(s) and its decision-making, especially

when the latter will restrict the freedoms normally expected by citizens in a democratic society. All do not have to agree with every decision being made, but there has to be a level of acceptance that the decisions are aimed at protecting the society and its citizens. The readiness with which people will respond in this way is greatly assisted by empathic political leadership, whereby the leaders give the impression to citizens that the measures being implemented are for their good and apply to them personally as much as to everyone else in the country.[31] Any hint of personal ambition or disregard for the welfare of certain sections of society undermines trust and solidarity.

The political leaders must be seen to be led by science and not principally by political considerations. While there may be differences of scientific opinion, there should be opportunity for constructive open debate between appropriate scientific experts in public health, epidemiology, and virology. Once again, this calls for trust and respect among all concerned, the goal being to provide the highest standard of advice to government and political decision makers.

The expectation is that leaders will take advice from people knowledgeable in their respective fields, and be ready to respond to the changing realities that crop up from one day to the next. The last thing required is dogmatism based on preconceived ideas, that may have little to do with emerging data on viral spread. This requires astute scientific advice and a readiness of the authorities to respond with alacrity and decisiveness as well as humility on the part of decision makers, and a willingness to learn and adapt as infections spread and as detailed scientific and genomic sequencing evidence becomes available.

There is no set rule for the spread of a pandemic beyond having available the most detailed science possible and being prepared to shut down whole societies and sections of society as necessary, and communicating what is being done to those affected. One example of how science was used is the extensive application of genomic sequencing to reveal where a specific case had come from and whether it was related to others in an outbreak. For instance, during the first wave in New Zealand, it was revealed that there had been 277 separate introductions of the virus out of 649 cases analyzed. These data helped to quantify the effectiveness of public health interventions, and led to extensive use of sequencing of all cases identified at the border.[32]

These processes work only when most of the population is prepared to accept advice based on expert opinion—from public health professionals, epidemiologists, and those skilled in data analytics, to social scientists and policy makers, and on to leaders within numerous fields within the community, including religious leaders. This is the surest way of combatting the appallingly divisive effects of those pushing conspiracy theories and contributing to the infodemic.[33] While conspiracy theories concerning the COVID-19 pandemic are present in the community, they were not featured in the decision-making of the political leaders, who have been guided by scientific evidence. Strong empathic leadership is central, making difficult evidence-based decisions decisively and quickly when required.

Why did New Zealand act as it did? What does it tell us in Christian terms? New Zealand is a liberal and largely secular society characterized by considerable skepticism toward Christian/religious things. And yet it responded to COVID-19 in a way that has a great deal in common with Christian values. Additionally, closing churches was largely accepted with very little pushback, with a handful of possible exceptions—one church held clandestine prayer meetings during lockdown, and these became the source of a super spreader event, much to the chagrin of the church. However, this was atypical of the general responses of churches. In general, churches were not seen as being exceptions to the general rule of lockdown; they did what everyone else was doing and that was act in a way that would protect citizens and their health.

Unpacking a Christian Response

When asked what is the greatest commandment, Jesus reminded his listeners that it is to love God with every element of their being and to love their neighbor as themselves,[34] with its basis in the Old Testament law.[35] On another occasion, in response to the question of who is my neighbor, Jesus responded with the parable of the Good Samaritan.[36] Here, a man severely beaten was left by the roadside probably to die unless rescued by a passing traveler. The surprising and even shocking aspect of this story is

that those who would have been expected to assist walked past, leaving an alien, a Samaritan, to help and look after him. Together, these two incidents highlight the importance of looking after others, our neighbors, whoever they may be, those who may be affected by our actions and our attitudes in our communities and farther afield. Above all, we are to look beyond ourselves and our own individualistic interests. Like the Samaritan, the New Zealand response was that of a largely secular government determined to rescue the citizens and protect them from an unknown level of harm.

We are to use whatever means are available to protect those around us, those for whom we have responsibility. There are to be no exceptions. The applications of this teaching for the COVID-19 pandemic are legion. The well-being of the community is to be our first priority; we are to do everything possible to protect our neighbors from the vicissitudes of a rampant viral infection, a task that falls to everyone, since all are members of the community. In Christian terms, we are all members of the one body, so exquisitely demonstrated by the church as the body of Christ.[37] While this cannot be directly applied to those who are outside the church, and are not members of Christ's body, it points to the helpful notion that if one suffers, all parts of a community suffer. It also points to the contribution that all are to make to the well-being of the community, including the knowledge that experts bring to discussions about the best way forward.

The question that arises is how we best look after community interests when faced with a viral pandemic for which there is no immediate therapy in the form of effective vaccination. This is an obligation that rests upon all, especially those of the household of faith. The example provided by the New Zealand response is that this is accomplished by a rigorous application of the available science in the form of public health measures and epidemiology, and ultimately by the development of vaccines that will be safe, effective, and inexpensive, so that they can be made available very widely across all countries and populations irrespective of the weakness of their health systems. While Christians have no privileged roles in directly influencing public policy, they should be advocating for the good of their fellow believers in impoverished countries with failing health systems.

Lessons to Be Learned

The argument of this article is that the New Zealand response is inherently, if not explicitly, Christian.

Lesson 1: Taking science seriously

A scientific approach is not only amenable to Christian approaches, but is crucial when confronted with a creation that is broken and is groaning in its brokenness.[38] In Christian terms, public health and allied measures contribute to a partial restoration of creation, including the partial redemption of the bodies of human beings.[39] Consequently, Christians should support these efforts, no matter where they find themselves, as members of society, pastors, teachers, or lawyers. Those in public health, epidemiology, or virology should be encouraged to utilize their expertise to inform decision makers as best they can.

Lesson 2: The supremacy of truth

This should come as no surprise since Christians believe in the supremacy of truth, and a scientific approach to overcoming a viral pandemic is an illustration of discovering that which is truthful and factual. As a result, Christians should be the first to oppose falsehoods including "fake news" and conspiracy theories, as they are grateful for the scientific abilities made possible by God as a reflection of his providence.

Lesson 3: Good leadership

However, the availability of the necessary scientific expertise is of limited value if it remains unutilized. This points to an allied necessity, that of strong informed leadership, so amply exhibited in New Zealand by the dual political and health leadership of the Prime Minister and Director-General of Health. Once again, this is a manifestation of God's providence, regardless of the religious position of the leaders, who are acting on behalf of God when they seek the good of the whole population.[40]

Leaders who act in ways that protect and provide for God's creation are a sign of God's blessing. On the other hand, if leaders serve their own interests or the interests of certain sections of the public at the expense of the interests of ordinary people, including their health and well-being, they are failing to serve God.[41] All resources at our disposal during a pandemic come from the providence of God. That providence, which lay behind the daily supply of

manna to the Israelites,[42] has been expressed throughout history in human creativity and ingenuity. Good leadership shines through all the more clearly in an extreme situation like a pandemic and is particularly evident at the political level. Poor, uninformed leadership can lead (and has led) to many deaths that could have been avoided if the situation had been better handled. The derision shown in recent years in a number of countries toward "experts" has resulted in a lack of attention being paid to the one group of health experts that matter in this instance—public health specialists and epidemiologists. They do not have all the answers, and there are other inputs that have to be taken into account, but when politicians think that they can interpret trends better than appropriate experts, trouble is inevitable. This should be of deep concern to Christians.[43]

Lesson 4: Valuing human life

The practical relevance of valuing human life is obvious, as evidenced by the extensive loss of lives in some countries and the relatively small loss in others. This should be of profound concern to Christians with the high value they generally place on human dignity. As an illustration, compare Wales (population, three million) and New Zealand (population, five million): as at April 8, 2021, there had been 5,527 deaths in Wales compared with twenty-six in New Zealand.[44] This is not intended as a critique of the Welsh response (which differs in many respects from a country such as New Zealand), but as a broad indication of the lives saved by the New Zealand response. Whatever the precise factors in each instance, the New Zealand response has protected the health of numerous people. This depicts a willingness to put to good use means provided by God to overcome a destructive and debilitating force. For Christians, this is an apt illustration of the integration of science and faith.

Lesson 5: Living for others

Lockdown means living for others and providing a means of protecting them. It means acting for the community. All are united in a common purpose, namely, opposition to the virus and support for each other. There is no room for individualism, either by government ministers or churches. In responding to a pandemic, individualism and individual rights have to be sidelined, as the good of the population is placed above that of the autonomy of individuals. Once again, the Christian emphasis shines through.

It is fascinating that the New Zealand Prime Minister's mantras, "be kind to one another" and the "team of five million," are manifestations of Christian values. Kindness is one of the fruits of the Spirit,[45] and the team notion points indisputably to community interests. Alongside kindness can be placed other fruits of the Spirit, including forbearance, goodness, gentleness, and self-control. Each of these serves as an important contributor to the best way to respond to the restrictions imposed by stringent public health measures. In other words, Christian values shone through the New Zealand response, even if not explicitly articulated. It is not known whether the leaders were aware of the Christian roots of what they were advocating, although one of the two main spokespeople has a Christian background and the other is a practicing Christian.

Emphasis upon the centrality of the health and well-being of the community has an inevitable consequence, namely, rejection of individualism with its self-centered interests and thoughts only of oneself. Mask wearing, when required, reflects the significance of the "other," and hence it is an indication of the importance of the other as individuals made in God's image. An unexpected implication is that, important as vaccines are, they should not be viewed as the sole answer to pandemics, and definitely not as a savior. Nevertheless, efficient and safe vaccines are most definitely to be desired, but must not serve to obscure humanity's fundamental ills of excessive individualism and self-centeredness.

Lesson 6: The enduring relevance of vaccination

Most Christians accept that, historically, vaccination has been transformative for whole societies. They rejoice as they recognize God working through the creativity of scientists and the expertise of the medical profession. This follows from God's own creative nature, and from Paul's plea that the followers of Christ are to be transformed by the renewal of their minds.[46] Their thinking is to be transformed, and they are to gladly accept the healing of the body and mind through medical intervention, and the protection of whole populations by scientifically based responses to a pandemic. In this regard, the

COVID-19 pandemic fits into a long tradition of illnesses that Christians have had to face over the centuries, and have developed tools to combat them.

Any society that appears to readily accept the death of large numbers of its citizens demonstrates that it has lost touch with the possibilities opened up by God, who never wants any to perish needlessly. There is no virtue in suffering if remedies are available, vaccination included. Refusal to accept the principles of public health and virology, and now vaccination, amounts to rejection of means made available by God; it is the antithesis of a mark of spiritual maturity.

But enormous care has to be taken to ensure that worldwide vaccines are as evenly distributed as possible; otherwise inequality will be substantially worsened.[47] This is the heart of the Christian ethos—serving one another and laying down one's life (rights) for others. Countries like New Zealand that have coped well with the pandemic illustrate this truth, even if they have not done it ostensibly on Christian grounds. Nevertheless, this is Christian social responsibility in practice.

New Zealand, in part due to its success at keeping COVID-19 largely at bay, has been slow in obtaining and subsequently distributing vaccines. However, once this process gets under way, the government recognizes its responsibility to ensure that six Pacific Island nations (which have been shielded from the worst effects of the pandemic) receive adequate numbers of doses of vaccines for their populations.[48]

Lesson 7: Lockdown and consequences for mental health

As countries have striven to protect their populations from the pandemic, lockdowns of varying intensity have been employed; one feature is the closure of schools, even though children are not as severely affected by COVID-19 as other sections of the population. It has become clear that this has had short- and long-term psychological and mental health implications for children and adolescents.[49] Although the likelihood of such repercussions did not appear to feature in New Zealand's decisions about lockdown, confining them to a matter of weeks and avoiding too many repeat lockdowns meant that any negative mental health issues were less than might have been expected following months of long lockdowns. Little evidence is available to back up this statement, but it has become apparent that lockdown as a protective measure has debilitating effects on educational, psychological, and developmental attainment, especially for children with preexisting mental health conditions, and also on the economically underprivileged. Christians should welcome the message that the less lockdown the better, even as they strive to protect children and their parents from the ravages of a pandemic.

Concluding Remarks

The approach taken in this article is not the usual one encountered in Christian publications dealing with the COVID-19 pandemic. Others hone in on questions revolving around God's purposes in bringing about, or allowing, this particular coronavirus to run rampant throughout the world. This is akin to asking why there is cancer in the world, or why populations are ravaged by malaria, dengue fever, dysentery, or even widespread malnutrition. We live in a broken world, and the important theological question is what humans can do to rectify that which has gone wrong, and correct these problems to the best of our abilities. Humans, as God's creation, have all the attributes necessary to ameliorate these conditions—at least to a limited degree. We are to help where we can help, and correct where we can correct.

A basic failing so often encountered is that we do not utilize the instruments placed at our disposal by God, to cure where possible and always to care for those in need. While this is usually seen as a driving force behind conventional medicine, we are not used to thinking in these ways at a population level. We tend not to regard preventive medicine, that is, public health measures and epidemiology, in the same light as chemotherapy or surgery for cancer. We are often remiss in privileging the treatment of individuals above that of populations, failing to realize that serious threats to populations affect numerous individuals within them—hence, the importance of vaccination.

Approaching the COVID-19 pandemic in these terms enables us to see why Christians should make use of public health measures as the most effective way of controlling the virus in the absence of widely available and effective vaccines. It is not as alien a creature as we often make it out to be. Neither is it completely

beyond our control, if only we take seriously what we know from fundamental public health principles. The example of Martin Luther is a salutary one; he used the knowledge at his disposal, limited as that was from our perspective five hundred years later. Unfortunately, we have become so addicted to technological control over both our environment and ourselves that we have underestimated the value of the relatively low technological approaches of public health. It is also deeply to be regretted that as societies we tend to be impatient: an impatience and self-centeredness reflected all too clearly in political and business leaders who open up far too early in a forlorn attempt to protect the economy.[50] Western societies have also failed to take note of recent previous pandemics, such as Ebola, Zika, SARS, MERS and H1N1 influenza,[51] and of the manner in which they were responded to, mainly in a handful of Asian countries. It is a sad indictment on the church that it has failed to exercise its influence in modelling the Christian virtues of community, servanthood, and respect for truth and integrity.

A small, isolated country like New Zealand cannot be taken as the perfect example of how to respond to a pandemic; that would be naïve. And yet, much larger, less isolated countries have also responded amazingly well, mainly in Asia where they learned from their previous bitter experience of recent epidemics. As argued elsewhere, COVID-19 demonstrates that science has to be taken seriously.[52] The biblical writers cannot provide a direct answer that will alleviate the social and health dilemmas surrounding us, but they are fundamental in helping Christians confront the fear and uncertainty created by a viral pandemic. Public health measures and ongoing scientific enquiries are indications that God is at work in controlling nature and are integral to his provisions for humankind. Science and faith are vital partners in seeking ways in which faults in natural processes can be healed and a return to wholeness effected.

The focus in this article has deliberately been on New Zealand, and yet for larger countries to ignore its success in coping with the pandemic would be foolhardy. To date the death rate from COVID-19 in the US has been 1,529 deaths per million of population, and in the UK, 1,820 deaths per million of population.[53] The corresponding figure for New Zealand is five per million of population. This is not a simple aberration, but a direct outworking of public policy based on science, the positive response of the public to harsh lockdown measures, and an awareness of the need to protect the health of the community even at the expense of some individual liberties.

It may be argued that New Zealand's geographic isolation has protected it far more than other countries. However, its borders prepandemic were porous, since international air-based tourism was the country's biggest export industry, contributing twenty per cent of total exports. Additionally, around 110,000 New Zealanders travel overseas every year. It is also one of the most globalized economies and depends greatly on international trade, all of which expose the country to a viral pandemic.

As countries now move to the next stage in pandemic response, and the use of vaccines, many of the same principles apply. The trust in government and public policy that enabled New Zealand to act as it has done, is vitally important for the rollout of vaccines. The growth of vaccine hesitancy is an indication of lack of trust in political and scientific expertise and advocacy.[54] What is required within Christian circles is a mix of education about the safety of the vaccines, and teaching about the importance of our responsibility toward the well-being of the community. Achieving herd immunity through vaccination (not community spread of the pathogen) is integral to this, pointing as it does toward protection of, and love for, one's neighbor.[55] Vaccination alone is not the sole answer, spectacular as the scientific progress on vaccine development has been and for which Christians should be exceedingly grateful, since so many lives have already been lost. ✞

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William Horst

Creation's Slavery to (Human) Corruption: A Moral Interpretation of Romans 8:20–22

William Horst

In Romans, Paul describes creation groaning in anticipation of eschatological freedom from present slavery to corruption (Rom. 8:20–22). Scholars commonly interpret creation's slavery to corruption as an allusion to the curse God pronounces on the ground in response to the transgression of Adam and Eve (Gen. 3:17–19), which Paul understands as reflective of the corruption of creation by the introduction of physical death and decomposition. This article argues that "slavery to corruption" is better understood in reference to human moral corruption of the sort Paul describes in the preceding chapters (Romans 6–8). Under this interpretation, the groaning of creation is reminiscent of a number of biblical prophetic texts in which the earth is said to mourn over the detrimental effects of human sin. Such a reading has important implications for Christian theological reflections on both evolution and environmentalism.

In his letter to the Romans, Paul explicates a tension between future hope and present suffering:

> [18]I consider that the sufferings of the present time are not worthy of comparing to the glory that is about to be revealed to us. [19]For the eager expectation of the creation anticipates the revelation of the children of God. [20]For the creation was subjected to futility, not voluntarily, but because of the one who subjected it, in the hope [21]that the creation itself will be set free from slavery to corruption, resulting in the freedom of the glory of the children of God. [22]For we know that the entire creation groans and travails together until now, [23]and not just the creation, but also we ourselves, who have the first fruits of the Spirit, groan inwardly as we anticipate the adoption, the redemption of our bodies.[1] (Rom. 8:18–23)

Paul alludes to suffering that he and his audience experience—probably in the form of persecution[2]—as well as suffering that creation experiences in the form of subjection to futility (v. 20) and bondage to corruption (v. 21). In the midst of present suffering, Paul, his audience, and personified creation groan together in anticipation of deliverance and divine revelation.[3] In some sense, these parties can be said to share a common eschatological hope in the midst of the hardships of the present age.

Scholarly interpreters of Romans typically understand the subjection of creation to futility and corruption as an allusion to the narrative of Eden—found in the book of Genesis—in which Adam and Eve disobey God, and as a result, the ground is cursed:[4]

> And to the man [God] said, "Because you have listened to the voice of your wife, and have eaten of the tree about which I commanded you, 'You shall not eat of it,' cursed is the ground because of you; in toil you shall eat of it all the days of your life; thorns and thistles it shall bring forth for you; and you shall eat the plants of the field. By the sweat of your face you shall eat bread until you return to the ground, for out of it you were taken; you are dust, and to dust you shall return." (Gen. 3:17–19)

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Earlier in Romans, Paul says that sin and death entered the world through Adam (Rom. 5:12) before describing how the negative consequences of Adam's transgression are ultimately addressed by the abundant grace of God through Jesus Christ (Rom. 5:15–21). Scholars commonly associate the inception of death through Adam with creation's present subjection to corruption. They explain that Paul imagines bodily death and physical decay to be pervasive phenomena within creation that began with the Edenic curse on the ground and will persist until the end of the age, when the children of God will be glorified (Rom. 8:19; cf. 5:2). The redemption of bodies, which Paul and his audience look forward to (Rom. 8:23), is also typically associated with this grand narrative of the introduction and ultimate removal of the processes of death and decay from God's good creation. In other words, creation in general, and the bodies of believers in particular, will alike be liberated from perishability and disarray at the end of the present age. Some interpreters go so far as to say that the release of creation from bondage to decay involves the reversal of the entropic principle, which was introduced to creation in response to primordial trespass.[5] In short, the standard interpretation of this passage of Romans maintains that the "corruption" to which creation is presently in bondage is a physical phenomenon associated with death, which is alien to God's creation, yet which characterizes present existence.

The typical interpretation of Romans 8 has important implications for discussions about Christian faith and evolution. If humans emerged from an evolutionary process of development that took place over the course of billions of years as countless generations of living organisms reproduced and then died, it follows that death and decay must have been active on the earth long before the first humans could have disobeyed God and thereby introduced such phenomena through their folly. It seems that the common interpretation of Romans 8 and an evolutionary understanding of human origins are mutually exclusive. Thus such an interpretation presents a serious difficulty to Christians who would maintain both the authority of scripture and the validity of evolution.[6]

One curious feature of the widespread, "physical" interpretation of creation's bondage to decay in Romans 8:20–21 is the frequency with which its proponents go out of their way to state how clear and obvious it is that Paul has in mind the primordial curse God places on the ground in Genesis.[7] Under close examination, the evidence in support of this common interpretation is by no means clear or obvious. In the most straightforward reading of Genesis, the curse on the ground relates to its agricultural yield, since the explicit result is that Adam will work the fields in order to cultivate wheat with which to make bread, instead of enjoying the free fruit that is so abundantly present in the Garden of Eden (Gen. 3:17–19). Nothing in the early chapters of Genesis suggests that this agrarian curse has anything to do with the introduction of processes of decay to a creation that previously lacked such phenomena.[8] Adam and Eve are warned that they will surely die if they eat the forbidden fruit (Gen. 2:17; 3:3–5), but this appears to result from their being denied access to the tree of life when they are expelled from the garden (Gen. 3:22–24). The curse on the ground is associated with a change in the amount of toiling Adam will need to do to provide for his family, not with human mortality or any other change to the created order. It is certainly conceivable that Paul does imagine that the Edenic lapse introduced mortality and other aspects of decay to God's creation, but the evidence in favor of finding an allusion to the curse of Eden behind the subjection of creation to corruption in Romans is flimsy at best, and scholars do not normally proffer compelling argumentation in favor of it.[9]

An alternative interpretation of creation's bondage in Romans deserves consideration, namely, that creation's bondage to corruption involves human *moral* corruption, rather than the sort of *physical* corruption that occurs when an organism dies on Earth. Creation presently suffers from the detrimental effects of pervasive moral depravity, and this moral decadence is the fundamental plight from which Paul awaits liberation in the discourse of Romans.

The Mourning of Creation in the Biblical Prophets

In Romans 8:20–22, Paul describes creation groaning and experiencing labor pains in connection with bondage to futility and corruption. Indeed, this image of personified creation's groaning is probably the most captivating element of the present passage of interest. Several scholars have noted a potential connection between the notion of creation's present groaning in Romans and a number of passages among the prophets of the Old Testament in which the earth is said to mourn as a result of human sin (Amos 1:2; Hosea 4:1–3; Jer. 4:23–28; 12:1–4, 7–13;

23:9–12; Isa. 24:1–20; 33:7–9; Joel 1:5–20).[10] For example, the prophet Jeremiah mentions that the land in the region of Judah mourns and suffers because of a drought as well as the impending invasion of foreign rulers who will bring further desolation to the region:

> How long will the land mourn, and the grass of every field wither? For the wickedness of those who live in it the animals and the birds are swept away, and because people said, "He is blind to our ways." … Many shepherds have destroyed my vineyard, they have trampled down my portion, they have made my pleasant portion a desolate wilderness. They have made it a desolation; desolate, it mourns to me. (Jer. 12:4, 10–11a)

Both the drought and the invasion are forms of divine judgment against pervasive ungodliness and hypocrisy among the people of the region (Jer. 12:1–2).[11] The land mourns because God's judgment against the people who occupy the region causes detrimental effects for the land. Similarly, the prophet Isaiah describes the earth mourning due to devastation that is about to come upon it as a divine judgment against Israel's violation of the covenant between God and the people:

> The earth mourned, and the world was ruined; the exalted ones of the earth mourned. And the earth behaved lawlessly because of those who inhabit it, because they transgressed the law and changed the ordinances—an everlasting covenant. Therefore a curse will devour the earth, because those who inhabit it have sinned; therefore those who dwell in the earth will be poor, and few people will be left. The wine will mourn; the vine will mourn; all who rejoice in their soul will groan. (Isa. 24:4–7, NETS)[12]

The exact details in each of the relevant prophetic passages vary, but all of the passages in question personify the land of Israel and describe it mourning over human sin and its problematic implications for the health and well-being of the land itself.

It is noteworthy that none of the passages in which the earth is said to mourn evoke the notion of an Edenic fall, nor are any of these passages concerned with the presence of death or decomposition in the created order. The land's mourning is about the destructive outworking of widespread injustice and moral corruption among the people who inhabit the territory of Israel, or some subset thereof. In essence, the creation suffers with humans as the people receive divine judgment for their iniquity. This notion constitutes a substantial tradition within the Jewish scriptures, particularly the prophetic writings.[13]

In a series of journal articles, Laurie J. Braaten interprets the groaning of creation in Romans as an evocation of the prophetic notion of the mourning of the earth over human sin and the resultant judgment. He rightly argues that the basis for attributing creation's groaning to this tradition of terrestrial lamentation is stronger than the grounds on which scholars more commonly argue that Paul alludes to the divine curse on the ground found in the book of Genesis, since the earth's mourning is a widespread tradition in the Old Testament that bears a clear resemblance to the groaning of creation in Romans, whereas the link between this Pauline material and the Edenic curse is at best vague, speculative, and tenuous.[14]

Braaten draws a further connection between the groaning of the Spirit in Romans and several passages among the prophetic texts he analyzes in which humans are said to mourn, or are encouraged to mourn, together with the land of Israel over the destructive effects of human sin.[15] Paul describes the work of the Spirit within believers to guide intercessory prayer and groaning in anticipation of eschatological deliverance:

> [N]ot only the creation, but we ourselves, who have the first fruits of the Spirit, groan inwardly while we wait for adoption, the redemption of our bodies ... Likewise the Spirit helps us in our weakness; for we do not know how to pray as we ought, but that very Spirit intercedes with sighs too deep for words. (Rom. 8:23, 26)

The indwelling Spirit, the believer, and the whole of creation groan together. This is not unlike certain prophetic passages related to the mourning of the land of Israel, in which humans are said to mourn in unison with the land. For instance, the prophet Joel calls upon priests of Israel to mourn together with the personified land over her desolation:

> The grain offering and the drink offering are cut off from the house of the Lord. The priests mourn, the ministers of the Lord. The fields are devastated, the ground mourns; for the grain is destroyed, the wine dries up, the oil fails. (Joel 1:9–10)

The ancient Greek (i.e., Septuagint) translation of Isaiah also mentions leaders of the people mourning alongside the earth itself: "The earth mourned, and the world was ruined; the exalted ones of the earth mourned" (Isa. 24:4, NETS; cf. Isa. 24:7).[16] Jeremiah

describes the mourning of the earth—including mountains, animals, the sky, and the ground (Jer. 4:23–28)—and then continues on to describe Jerusalem's groaning over the imminent invasion of foreign armies (Jer. 4:29–31), which hints that the people of God who inhabit the region of Judah mourn together with the subhuman creation because of the common plight of desolation that will accompany violent invasion.[17] Given that a number of the prophetic passages about the mourning of the land of Israel attest a theme of human mourning and groaning alongside the mourning of the land itself, Paul's description in Romans of the groaning of the righteous alongside the groaning of creation itself constitutes an additional point of congeniality with this prophetic biblical tradition.

The groaning of creation and the bondage of creation are closely related metaphors in Romans 8:20–23, since creation's present state of bondage is clearly the cause of creation's groaning and suffering. If Paul does indeed evoke the prophetic motif of the mourning of the earth when he describes creation's groaning in Romans, then his description of creation's bondage to futility and corruption in verses 20–21 is most naturally understood to refer to the suffering of nonhuman creation alongside the suffering of humans due to human sin with its destructive effects, including the judgment of God toward sin (see further below).

The elements of interest in Romans 8:20–23 that best support scholarly arguments in favor of finding an allusion to a primordial curse on the ground—namely, the groaning of creation and creation's bondage to futility and corruption—are the same elements that arguably bear an even greater thematic resemblance to passages among the Old Testament prophets about the mourning of the land due to sin. I do not see any reason that it would make sense to suppose that both biblical traditions are evoked by the same elements of Romans. Thus, there remains little reason to insist that the bondage and groaning of creation alludes to an inherent state of physical corruption that resulted from the sin of Adam and Eve.

Moral Corruption in Romans

The notion that creation's bondage to corruption and futility in Romans 8:20–21 has to do with the destructive effects of human moral depravity is supported by a number of instances of the language of slavery that occur in the preceding chapters of Paul's letter (Romans 6–7).[18] Paul characterizes life apart from Christ as a state of slavery to sin. For example, he says,

> [T]hanks be to God that you, having once been slaves of sin, have become obedient from the heart to the form of teaching to which you were entrusted, and that you, having been set free from sin, have become slaves of righteousness. (Rom. 6:17–18)

In this and other similar material (cf. Rom. 6:6, 11–14, 16–22), Paul characterizes life prior to baptism (cf. Rom. 6:3–4) as a state of obedient slavery to sin, whereas life in Christ is characterized by obedience to God and freedom from sin. A bit further on in the letter, Paul adopts the persona of an individual in a state of bondage to sin apart from Christ.[19] It is clear from his portrayal that slavery to sin is not merely a matter of obedient alignment with the cause of sin. Rather, a person in a state of slavery to sin is inextricably bound to sinful behavior and needs to be rescued:

> I am of the flesh, sold into slavery under sin. I do not understand my own actions. For I do not do what I want, but I do the very thing I hate. Now if I do what I do not want, I agree that the law is good. But in fact it is no longer I that do it, but sin that dwells within me. For I know that nothing good dwells within me, that is, in my flesh. I can will what is right, but I cannot do it. For I do not do the good I want, but the evil I do not want is what I do … So I find it to be a law that when I want to do what is good, evil lies close at hand. For I delight in the law of God in my inmost self, but I see in my members another law at war with the law of my mind, making me captive to the law of sin that dwells in my members. Wretched man that I am! Who will rescue me from this body of death? (Rom. 7:14–19, 21–24)

In contrast to the moral slave who is afflicted by sin, and who walks according to the flesh, Paul and his audience walk according to the Spirit and submit to the will of God (see, especially, Rom. 8:4–9). In this sense, they have been liberated from bondage to sin. Nonetheless, the possibility remains that members of Paul's audience could be duped by sin and fall back into a state of slavery as a result. This is evident because Paul exhorts his audience to obey God's will and not to submit to sin (Rom. 6:12–14), and warns that there will be dire consequences if they live in accordance with the flesh rather than the Spirit (Rom. 8:13). Presumably, the possibility of believers once again falling under the control of sin

will be removed once and for all when God's glory is revealed (cf. Rom. 8:18).

The literary context of Paul's references to creation's subjugation under futility and corruption (Rom. 8:21–22) gives us good reason to explore a moral, rather than physical, interpretation of his language. The words "corruption" and "futility" in this passage are sufficiently flexible that they could describe physical decomposition and transitoriness, or moral corruption and depravity.[20] Given that Paul employs the imagery of slavery, domination, and warfare to describe human subjection to sinful desires in the preceding chapters of Romans, it would make sense that creation's bondage also has something to do with moral disorientation.[21] It would be uncharacteristic of Paul to speak of rocks, plants, and animals as morally disoriented, but another interpretive possibility emerges if we consider Paul's description of creation's groaning in this same passage as an evocation of the biblical prophetic tradition of the earth's mourning over the detrimental effects of human sin (see above). When we consider the themes and motifs that characterize the chapters leading up to Paul's reference to creation's bondage to corruption, it should lead us to understand creation's bondage as the suffering of creation that results from pervasive human moral depravity. In other words, human moral disorientation does not have detrimental effects on humans only (cf. Rom. 1:18–32); it is also more broadly destructive to creation as the domain that humans inhabit. For this reason, creation eagerly awaits God's redemption just as Paul and his audience do.

Paul refers to the object of his future hope as "the redemption of our bodies" (Rom. 8:23), where "redemption" signals a release from captivity.[22] Paul probably imagines future bodily liberation to occur when he and his audience will be united with Christ in a resurrection like his (Rom. 6:5), and receive the gift of eternal life (cf. Rom. 2:7; 5:27; 6:22–23). While it is certainly reasonable to expect that redeemed bodies will no longer be subject to death or decomposition, it is not apparent that the elimination of mortality is Paul's chief interest as he refers to bodily redemption at this point in the discourse of Romans. In the preceding chapters (Romans 6–7), Paul constructs moral slavery as a domination by sin that takes place in the members of the body. The person who is enslaved to sin finds that the law of sin is at work in the members of his or her body, waging war against the law of his or her mind, and thereby compelling him or her to carry out immoral actions (Rom. 7:23; cf. 6:12; 7:5, 25), with the result that such a person longs to be rescued from "this body of death" (Rom. 7:24). To live in a manner free from slavery to sin is to present the members of one's body in service to God, rather than in service to sin (Rom. 6:13, 19; cf. 12:1). A person who lives in such a manner puts "the deeds of the body" to death by the power of the Spirit (Rom. 8:13). With these and other comments, Paul shows that the human body is the domain in which one's subjection to sin plays out. Given the ways in which the body factors into the discourse of Romans, Paul's reference to "the redemption of our bodies" is appropriately understood to refer to believers being set free from any further possibility of moral slavery. In other words, Paul's eschatological hope in Romans has primarily to do with total and final freedom from sin, and this moral freedom is quite probably what Paul means when he alludes to bodily redemption.[23]

Human Corruption and the Suffering of Creation

Paul does not explain exactly how creation suffers because of human moral depravity, as his chief focus is on the hope of glory, which is incomparably greater in magnitude than any present sufferings (Rom. 8:18). Nonetheless, it is worth considering exactly what sorts of phenomena Paul's audience might assume he has in mind when he suggests that human moral corruption has detrimental effects on creation. In his commentary on Romans, Robert Jewett intriguingly suggests that

> imperial ambitions, military conflicts, and economic exploitation had led to the erosion of the natural environment throughout the Mediterranean world, leaving ruined cities, depleted fields, deforested mountains, and polluted streams as evidence of … universal human vanity.[24]

This is as good a suggestion as I have found in the literature on this passage. Consistent with this interpretation, J. Donald Hughes extensively documents historical evidence for ecological problems in the ancient Mediterranean world, and shows that human activity, especially imperial activity, clearly contributed to numerous forms of ecological degradation in the Mediterranean world of the Roman era, during which Paul wrote.[25] Simply put, evidence for the detrimental implications of misguided human

actions on human habitation was apparent in Paul's day, much as it should be apparent to most observers of the world in the twenty-first century.

The Introduction of Death through Adam in Romans

One additional exegetical consideration must be addressed for my interpretation of Romans 8 to hold water. As I mentioned above, scholars who find a reference to the Edenic curse on the ground in Romans 8 typically bolster their interpretation by appealing to the introduction of death through Adam, which Paul discusses earlier in the letter (Rom. 5:12–21). Of particular relevance is the assertion that "sin came into the world through one man, and death came through sin, and so death spread to all because all have sinned" (Rom. 5:12), where the "one man" in question is clearly Adam (cf. Rom. 5:14). If Paul has already made reference to death entering the world through Adam earlier in Romans, then he apparently understood that humans are susceptible to death because of the trespass of Eden. Thus it is not much of a stretch to interpret creation's subjection to corruption a few chapters later (Rom. 8:21) as likewise alluding to a physical corruption of creation through the disobedience of Adam and Eve.

Although interpreters of Romans 5:12 commonly understand the inception of death through Adam to indicate that humans became mortal as a result of the sin of Adam and Eve,[26] the passage can alternatively be understood to describe the moral corruption of humanity, rather than the introduction of physical death. Under this understanding, "death" is a moral metaphor. A person is morally "dead" if they live under the sort of moral slavery that Paul attributes to humans apart from Christ (see above).[27]

The moral-metaphorical use of the language of death was fairly common among Jewish and Greco-Roman authors from around the time of Paul. For example, Ben Sira, a Jewish author from the second century BCE, frames foolishness as a death-like state: "a fool's life is worse than death" (Sir. 22:11; cf. Sir. 22:9–15). Seneca the Younger, a Roman Stoic author from the first century CE, says that lazy people who "listen to their bellies" should be considered dead even while they live, since they accomplish no more than a corpse (*Epistulae morales* 60.4). Numerous other authors relevant to the milieu of Paul likewise describe human folly and a lack of self-control using the metaphor of death.[28]

Of particular interest for the interpretation of Romans is Philo of Alexandria, a Jewish interpreter of scripture from the first century CE, who pervasively employs the metaphor of the "death of the soul" to describe people who lack moral self-control and are instead mastered by unvirtuous appetites.[29] Philo is especially interesting because he interprets the Edenic sentence of death placed on Adam and Eve as the "death of the soul" rather than the death of the body, which Philo considers to be natural.[30] Essentially, God subjected Adam and Eve to domination by sinful passions as a punishment for their disobedience, much as Paul describes life apart from Christ as subjection to sinful passions (see, especially, Rom. 7:5–6; cf. above). Although Philo does not indicate that the sentence of moral-metaphorical death placed on Adam and Eve also spread to the rest of humanity, as the Adamic material of Romans would suggest (Rom. 5:12–21), his comments nonetheless attest the plausibility of a moral-metaphorical interpretation of the Edenic narrative within the Judaism of the first century CE.

A moral-metaphorical interpretation of the inception of death through Adam in Romans is further supported by Paul's metaphorical use of the language of death elsewhere in the letter. As Paul takes on the persona of an individual in a state of bondage to sin apart from Christ (Rom. 7:7–25; see above), he describes his domination by sin as a kind of death:

> I was once alive apart from the law, but when the commandment came, sin revived and I died, and the very commandment that promised life proved to be death to me. For sin, seizing an opportunity in the commandment, deceived me and through it killed me. So the law is holy, and the commandment is holy and just and good. Did what is good, then, bring death to me? By no means! It was sin, working death in me through what is good, in order that sin might be shown to be sin, and through the commandment might become sinful beyond measure. (Rom. 7:9–13)

Here, "death" does not pertain to the death of the body, but rather to an increase of covetousness in response to the biblical prohibition against coveting (cf. Exod. 20:17; Deut. 5:21; Rom. 7:5–8; 8:2). Paul goes on to describe the work of sin in the members of the body, which pushes him to long for release from "this body of death" (Rom. 7:23–24). Again, "death" does not appear to have anything to do with mortality or the physical death of the body. Rather, sinful passions exercise control within the body, thereby forcing a person to commit sinful behavior against

his or her will (Rom. 7:14–23), and this state of bondage to sin can be described as "death."[31]

The fact that Paul uses the language of death as a metaphor for a lack of moral self-control in close proximity to his allusion to the inception of death and sin through Adam (Rom. 5:12–21; 7:5–25) suggests the serious possibility that the inception of death through Adam may involve the introduction of moral corruption of the sort Paul describes in the letter (Romans 6–7), rather than the death of the body. At a basic level, this interpretation resembles the suggestions of some authors at the intersection of Christian faith and evolutionary science who propose that the inception of death through Adam should be understood as "spiritual death" rather than physical death.[32]

Based on the aforementioned considerations, the inception of death through Adam in Romans 5 does not necessarily problematize a moral reading of creation's slavery to corruption in Romans 8. In fact, both passages can be read in light of Paul's concern about the moral bondage of humans apart from Jesus Christ, and his confidence that freedom from moral bondage—for humans as well as for creation more broadly—is possible through the redemptive work of Christ.

When Did Creation Become Enslaved to Corruption?

Romans 8 is ambiguous about when creation came to be subjected to futility and corruption. If we accept that the corruption in question has to do with human moral corruption, we could potentially link the beginning of creation's slavery to the entry of sin and (moral) death into the world through Adam, which Paul discusses in Romans 5 (see above), and many interpreters accustomed to reading Romans 8 as an account of an Edenic "fall" will be inclined to take such an approach. This is certainly a possible interpretation, but as I discussed above, the passage does not allude to the narrative of Eden as clearly as interpreters often claim, and other interpretations are possible. For example, David G. Horrell, Cherryl Hunt, and Christopher Southgate note the lack of a clear allusion to Adam in Romans 8. They suggest that the subjection of creation to corruption may refer more generally to the whole of Genesis 3–11, which portrays the primordial (moral) corruption of humanity in a variety of accounts, including Adam and Eve's eviction from Eden, Cain's murder of Abel, the Flood, and the Tower of Babel.[33] If this is what Paul has in mind, then the subjection of creation to the detrimental effects of human moral corruption could be interpreted as a gradual rather than a punctiliar process. For that matter, Paul's letter to the Romans includes an even more general account of the corruption of humanity due to human refusal to give glory to God:

> For the wrath of God is revealed from heaven against all ungodliness and wickedness of those who by their wickedness suppress the truth. For what can be known about God is plain to them, because God has shown it to them. Ever since the creation of the world his eternal power and divine nature, invisible though they are, have been understood and seen through the things he has made. So they are without excuse; for though they knew God, they did not honor him as God or give thanks to him, but they became futile in their thinking, and their senseless minds were darkened. Claiming to be wise, they became fools; and they exchanged the glory of the immortal God for images resembling a mortal human being or birds or four-footed animals or reptiles. Therefore God gave them up in the lusts of their hearts to impurity, to the degrading of their bodies among themselves, because they exchanged the truth about God for a lie and worshiped and served the creature rather than the Creator, who is blessed forever! Amen. (Rom. 1:18–25; cf. 1:26–32)

Paul describes God giving rebellious humans over to their appetites—with detrimental results—because they did not give due glory to their Creator. As a result, humanity became still more corrupt and a laundry list of vices abounded (see, especially, Rom. 1:29–31). Paul is not explicit here about exactly who he is describing, exactly when God's "giving over" of rebellious humans took place, and whether the increase in corrupt behavior described here took place at one point in time, gradually over a longer period, or periodically at various times and in various places. The account is not necessarily a description of the introduction of sin into a world that previously lacked it (cf. Rom. 5:12). Rather, humans who were already morally disoriented became still more corrupt as a result of divine action (cf. Rom. 1:26, 28).

Although the description of human moral decline in Romans 1 does not refer to the corruption of creation per se, it does describe humans "becoming futile" in their thinking (Rom. 1:21), which potentially parallels the "futility" to which creation is said to be subjected later in the letter (Rom. 8:20).[34] Indeed, this and several other parallels have led some scholarly interpreters of Romans to find in Romans 8 the

resolution of the situation introduced in Romans 1.[35] Under such an interpretation, we might say that the creation joins with Paul and his audience in longing eagerly for liberation (Rom. 8:19–23) from the moral corruption that Paul describes abounding as a result of misguided human worship (Rom. 1:18–32).

Ultimately, the etiology of creation's slavery to corruption in Romans is ambiguous. If we understand "corruption" in the moral sense for which I have argued, then we could potentially take Paul to refer to the introduction of moral corruption into the world through Adam (Rom. 5:12–21),[36] or to the increase of sin's pervasiveness in some more general way (Rom. 1:18–32). This ambiguity makes the passage adaptable to multiple possible understandings of the origin of human sin. As David Horrell et al. rightly emphasize, Paul's focus in Romans 8 is not on the plight of creation's corruption, but rather on the solution of redemption in Christ and on believers' hopeful, anticipatory posture toward Christ's redemption.[37]

Conclusion

Although the "physical" interpretation of creation's subjection to corruption and futility in Romans 8 is pervasive among Pauline scholars, the basis for such a reading is less clear and solid than its proponents often claim. The broader themes of Romans 6–8 are more consistent with an interpretation under which "corruption" and "futility" refer to human moral depravity; creation's bondage to human depravity reflects the fact that human disorientation from God is detrimental not only to humans, but also to God's creation as the habitat of humans. Whereas the standard interpretation presents a substantial problem for Christians who accept that humans emerged from an evolutionary process to which death is intrinsic, the moral interpretation for which I have argued can be much more readily harmonized with an evolutionary understanding of human origins. One must still work out how to understand the inception of moral corruption within God's creation,[38] but the problem of conflicting etiologies of physical death is resolved.

My interpretation also has implications for how contemporary Christians might think about environmentalism. Paul's point in Romans 8 is certainly not to call his audience to some form of ecological activism, nor do I suggest that environmental concerns are the only ones contemporary Christians ought to consider when thinking about the suffering of creation due to human moral depravity.[39] Nonetheless, the present, multifaceted ecological crisis is a key issue in our day and age, and my exegetical analysis of Romans lends itself to reflection about the role of human sin in this ecological crisis. In the twenty-first century, it should not be difficult to imagine how human greed, selfishness, and pride lead to increased consumption, waste, pollution, and a lack of sustainability.[40]

I further suggest that my interpretation of creation's slavery to human corruption prompts a more active posture toward creation's present languishing than does the conventional, "physical" interpretation.[41] If the big problem with creation that Romans expresses has to do with a divinely mandated ontological transformation involving entropy, decomposition, and the like, then a believer in Christ can really do little in the face of such challenges other than to pray and wait for deliverance to come. Prayer is obviously important to the life of faith, and Paul does make clear that prayer is an important feature of a believer's engagement with the present age (see, especially, Rom. 8:26–27), but if we understand creation's present mourning as a result of the negative consequesnces of human moral corruption, then followers of Christ can potentially play a more active role in working against the dominating forces of futility and corruption in anticipation of Christ's full eschatological redemption. Paul calls upon his readers to submit the members of their body to God (Rom. 6:13, 16; cf. 12:1) and to put sinful deeds to death by the power of the Spirit (Rom. 8:13). In other words, to live faithfully in Christ is to live out one's liberty from sin through bodily actions that are consistent with the will of God. In the face of the earth's suffering due to various pervasive human vices, this embodied faithfulness should certainly include efforts to avoid and counteract the abuse of creation that is so pervasive in the twenty-first century. ✞

Notes

[1]This translation is my own. English translations of all other biblical passages are taken from the NRSV, except where otherwise specified.

[2]Several elements of Romans suggest that the Roman believers were experiencing some kind of persecution from outside the community of faith, or at least that they were concerned about the possibility of such persecution. Paul reassures his audience that nothing can separate them from the love of God in Christ (Rom. 8:31–39), and his rhetoric along these lines includes a series of questions that fit a context in which the audience is concerned

about opposition from other people: "Who is against us?" (8:31), "Who will bring a charge against God's elect?" (8:33), "Who is to condemn?" (8:34), "Who will separate us from the love of Christ?" (8:35). Paul also insists that persecution, violence, and other forms of hardship pose no serious obstacle to the love of Christ toward himself and the Roman believers (8:35–36). In chapters 12–13, Paul encourages the Roman believers to engage in various behaviors that would facilitate good relations with the broader society in Rome, such as extending mercy and generosity to persecutors (12:14–21), being subject to governing authorities and paying taxes (13:1), loving neighbors (13:9–10), and living in a respectable manner (13:13). Edward Adams argues persuasively that these exhortations suggest the probability of strained relations between the Roman believers and their broader society in this particular city (*Constructing the World: A Study in Paul's Cosmological Language* [Edinburgh: T&T Clark, 2000], 195–220). We do not have much historical evidence from which to reconstruct what the Roman believers were experiencing around the time Paul wrote to them, but any social strain may well have been related to an edict of Emperor Claudius several years earlier (ca. 49 CE) that a number of Jews, including at least some Jewish Christians, must be expelled from Rome (see Suetonius, *Divus Claudius* 25; Acts 18:2; cf. Romans 16:3–5; and Robert Jewett, *Romans: A Commentary* [Minneapolis, MN: Fortress, 2007], 531–54). Romans is normally dated in the mid- or late-50s CE (see, e.g., Jewett, *Romans: A Commentary*, 18–21).

[3]The Greek word, *ktisis*, translated "creation" in this passage, could also potentially indicate an individual "creature," rather than "creation" as a whole. Several exegetes of Romans argue that the word should here be understood to refer to the human body, which is subject to sin and death (cf. Romans 6–7), and which will be redeemed at the revelation of eschatological glory (e.g., W. Fitzhugh Whitehouse, *The Redemption of the Body: Being an Examination of Romans VIII. 18–23* [London, UK: Stock, 1892], 42; J. Ramsey Michaels, "The Redemption of Our Body: The Riddle of Romans 8:19–22," in *Romans and the People of God: Essays in Honor of Gordon D. Fee on the Occasion of His 65th Birthday*, ed. Sven K. Soderlund and N. T. Wright [Grand Rapids, MI: Eerdmans, 1999], 104–14; and Gregory P. Fewster, *Creation Language in Romans 8: A Study in Monosemy* [Leiden, The Netherlands: Brill, 2013]). This reading implies that the liberation of the *ktisis*, to which Paul looks forward (8:21), is equivalent to the redemption of bodies, to which he also refers (8:23). However, several considerations make this reading difficult. First, it would be strange for Paul to refer to the body in its subjection to sin and death using the word *ktisis* in Romans 8:19–23, since he typically uses another word, *sōma*, with roughly the same connotation elsewhere in Romans (4:19; 6:6; 7:24; 8:10, 11, 13; cf. 1:24; 12:1). For that matter, Paul refers to the body in its subjection to sin and death using *sōma* just after his several uses of *ktisis* in my passage of interest (8:23), and it would be quite perplexing if Paul chose to refer to the body with *ktisis* in Romans 8:19–22, and then suddenly switched to the more typical term *sōma* within the same passage. Second, Paul constructs a parallel between the *ktisis* and "we ourselves" (8:23) in our passage. If *ktisis* and "we ourselves" both essentially refer to humans, then the passage seems oddly redundant, whereas if *ktisis* refers to the broader created world, then it makes sense that Paul would wish to highlight solidarity between his audience and the creation they inhabit. Third, as I discuss below, Paul's comments about the *ktisis* resemble a tradition in biblical prophetic writings in which the earth mourns, and this parallel supports understanding Paul's description of the groaning *ktisis* in reference to creation rather than an individual "creature." Scholarship of the last several decades has generally taken the view that *ktisis* in Romans 8:19–23 refers to the created world. (Adams, in *Constructing the World*, pp. 19–21, notes the emerging consensus and discusses the interpretive options at greater length than I have done here.)

[4]E.g., John G. Gibbs, *Creation and Redemption: A Study in Pauline Theology* (Leiden, The Netherlands: Brill, 1971), 40; C. E. B. Cranfield, *A Critical and Exegetical Commentary on the Epistle to the Romans*, 2 vols. (Edinburgh, Scotland: T&T Clark, 1980), 1:413–15; James D. G. Dunn, *Romans 1–8* (Dallas, TX: Word, 1988), 469–75; Joseph A. Fitzmyer, *Romans: A New Translation with Introduction and Commentary* (New York: Doubleday, 1992), 505; Jewett, *Romans: A Commentary*, 512; and Nicholas A. Meyer, *Adam's Dust and Adam's Glory in the Hodayot and the Letters of Paul: Rethinking Anthropogony and Theology* (Leiden, The Netherlands: Brill, 2016), 215–23.

[5]E.g., T. Ryan Jackson, *New Creation in Paul's Letters: A Study of the Historical and Social Setting of a Pauline Concept* (Tübingen, Germany: Mohr Siebeck, 2010), 163.

[6]E.g., in a recent essay, Hans Madueme ("All Truth Is God's Truth: A Defense of Dogmatic Creationism," in *Creation and Doxology: The Beginning and End of God's Good World*, ed. Gerald Hiestand and Todd Wilson [Downers Grove, IL: IVP Academic, 2018], 59–76) rejects evolutionary creationism in favor of young earth creationism (or rather, a nuanced version that he calls "dogmatic creationism") because evolutionary creationism conflicts with "the bond between fall and human death" ("Truth," 65), which Madueme finds in passages such as Romans 8.

Some authors solve the apparent conflict between an evolutionary account of the origin of death and decay with passages like Romans 8:18–23 by distinguishing between what Paul himself thought and what faithful Christians should take to be the core message of scripture. For instance, Denis O. Lamoureux distinguishes between the inerrant, spiritual "message" of the Bible and the incidental, culturally-conditioned elements that the biblical authors included by default. Lamoureux considers the inception of sin and death through a single pair of common, primordial progenitors to be among the standard assumptions of Paul's day, and thus suggests that for the purposes of modern Christians, Adam and Eve can be treated as archetypical of sinful, mortal humanity in general (for Lamoureux's fullest treatment of "the sin-death problem," see *Evolutionary Creation: A Christian Approach to Evolution* [Eugene, OR: Wipf & Stock, 2008], 305–29). My contention in this article is not that this sort of approach is always wrongheaded, but rather that with respect to Romans 8, it is unnecessary.

[7]E.g., John Murray, *The Epistle to the Romans: The English Text with Introduction, Exposition and Notes*, 2 vols. (Grand Rapids, MI: Eerdmans, 1968), 1:303; Gibbs, *Creation*, 40; Douglas J. Moo, *The Epistle to the Romans* (Grand Rapids, MI: Eerdmans, 1996), 515; Brendan Byrne, *Romans* (Collegeville, MN: Liturgical, 2007), 257; Trevor J. Burke, "Adopted as Sons (ΥΙΟΘΕΣΙΑ): The Missing Piece in Pauline Soteriology," in *Paul: Jew, Greek, and Roman*, ed. Stanley E. Porter (Leiden, The Netherlands: Brill, 2008),

285; R. J. (Sam) Berry, "Natural Evil: Genesis, Romans, and Modern Science," *Perspectives on Science and Christian Faith* 68, no. 2 (2016): 87; and Guy Prentiss Waters, "Theistic Evolution Is Incompatible with the Teachings of the New Testament," in *Theistic Evolution: A Scientific, Philosophical, and Theological Critique*, ed. J. P. Moreland, Stephen C. Meyer, Christopher Shaw, Ann K. Gauger, and Wayne Grudem (Wheaton, IL: Crossway, 2017), 897.

[8]Wojciech Szypula, *The Holy Spirit in the Eschatological Tension of Christian Life: An Exegetico-Theological Study of 2 Corinthians 5,1–5 and Romans 8,18–27* (Rome, Italy: Editrice Pontificia Universita Gregoriana, 2007), 260.

[9]I will discuss the relevance of Romans 5:12–21 below.

[10]See esp. Laurie J. Braaten, "The Groaning Creation: The Biblical Background for Romans 8:22," *Biblical Research* 50 (2005): 19–39; and ___, "All Creation Groans: Romans 8:22 in Light of the Biblical Sources," *Horizons in Biblical Theology* 28 (2006): 131–59. Braaten makes the nuanced point that the "groaning" of creation should be identified with the biblical tradition of the earth's mourning, whereas creation's "travail" has to do with the pain of judgment. The conceptual distinction between these verbs is supported by the fact that the creation, Paul's "we," and the Spirit are all said to "groan" (expressed with cognates of the Greek verb *stenazō*, 8:22, 23, 26), whereas only the creation is said to "travail." See especially Braaten, "All Creation Groans," 132–41. For analysis of this group of prophetic passages, see further Katherine M. Hayes, *"The Earth Mourns": Prophetic Metaphor and Oral Aesthetic* (Atlanta, GA: Society of Biblical Literature Press, 2002).

[11]Hayes, *"The Earth Mourns,"* 108–14.

[12]Here and elsewhere, the abbreviation "NETS" indicates that an English translation renders the Greek text of the Septuagint, and is taken from Albert Pietersma and Benjamin G. Wright, eds., *A New English Translation of the Septuagint* (New York: Oxford University Press, 2007). The Septuagint is relevant for interpreting the New Testament because the Septuagint was generally the Bible of the earliest Christians, and the New Testament authors frequently quote from the text of the Septuagint, in particular, in their writings (Joel B. Green and Lee Martin McDonald, "Glossary," in *The World of the New Testament: Cultural, Social, and Historical Contexts*, ed. Joel B. Green and Lee Martin McDonald [Grand Rapids, MI: Baker, 2013], 586). Although the matter is somewhat complicated in the details, it is apparent that Paul's quotations of scripture are often shaped by the Greek textual tradition, including a number of quotations from Isaiah, in particular. For details, see, e.g., Florian Wilk, "The Letters of Paul as Witnesses to and for the Septuagint Text," in *Septuagint Research: Issues and Challenges in the Study of the Greek Jewish Scriptures*, ed. Wolfgang Kraus and R. Glenn Wooden (Atlanta, GA: Society of Biblical Literature, 2006), 253–71; and Tim McLay, *The Use of the Septuagint in New Testament Research* (Grand Rapids, MI: Eerdmans, 2003), 148–53.

The Masoretic (Hebrew) text of Isaiah 24:4, 7, consistent with the Isaiah Scroll found among the Dead Sea Scrolls, includes the verb *ʾbl*, which can potentially be translated with the senses "dry up" or "mourn" (Ludwig Koehler, Walter Baumgartner, and Johann J. Stamm, eds., *The Hebrew and Aramaic Lexicon of the Old Testament*, 4 vols. [Leiden, The Netherlands: Brill, 1994–1999], 1:6–7). The Septuagint (Greek) text translates this verb with *pentheō*, which unambiguously refers to mourning (Frederick W. Danker et al., eds., *A Greek-English Lexicon of the New Testament and Other Early Christian Literature*, 3rd ed. [Chicago, IL: University of Chicago Press, 2000], 795).

[13]See Braaten, "The Groaning Creation," 29–31; and ___, "All Creation Groans," 142–45.

[14]Ibid. Similarly, see Sylvia C. Keesmaat, *Paul and His Story: (Re)Interpreting the Exodus Tradition* (Sheffield, UK: Sheffield Academic Press, 1999), 105–6; and Ulrich Wilckens, *Der Brief an die Römer*, 3 vols. (Zürich, Switzerland: Benziger, 1978–1982), 2:149–51. Jonathan Moo argues for a particularly strong parallel between Romans 8:19–22 and Isaiah 24–27, which includes such an instance of the earth's mourning ("Romans 8.19–22 and Isaiah's Cosmic Covenant," *New Testament Studies* 54, no. 1 [2008]: 74–89).

[15]Braaten, "The Groaning Creation," 28–37; ___, "All Creation Groans," 141–53; and cf. ___, "Earth Community in Joel 1–2: A Call to Identify with the Rest of Creation," *Horizons in Biblical Theology* 28, no. 2 (2006): 113–29.

[16]On the relevance of the Septuagint for the interpretation of the New Testament, see note 12. Instead of "the exalted ones of the earth mourned," the Masoretic text and the Isaiah Scroll of the Dead Sea Scrolls include the more cryptic phrase, "the height of the people of the earth."

[17]In the Greek (Septuagint) text of Jeremiah, the prophet describes the groaning of Jerusalem with the words *stenagmos* and *ōdinō* (Jer. 4:31), which correspond to the two cognate verbs that Paul uses in Romans to describe creation's mourning and groaning in unison, *sustenazō* and *sunōdinō* (Rom. 8:22).

[18]Braaten ("All Creation Groans," 157–58) likewise connects creation's bondage (Rom. 8:20–21) with material earlier in the letter related to human subjection to a lifestyle characterized by sin and death (Romans 6).

[19]The literature surrounding the question of the identity of the speaker of Romans 7:7–25 is too vast and complicated to address thoroughly here. As an example, Werner Georg Kümmel rightly argues that Paul's assertion that "I am of the flesh, sold into slavery under sin" (Rom. 7:14) is incompatible with his later claim that "the law of the Spirit of life in Christ Jesus has set you free from the law of sin and of death" (Rom. 8:2), since Paul would presumably grant that he, in addition to his hearers, has been set free in Christ. Thus, when Paul uses the first person to describe suffering under the dominion of sin (Rom. 7:7–25), he cannot reasonably be understood to be describing his own present experience. Rather, he is adopting and describing a different perspective (Werner Georg Kümmel, *Römer 7 und das Bild des Menschen im Neuen Testament: Zwei Studien* [Munich: Kaiser, 1974], 41–42, 125–26). Stanley Kent Stowers argues persuasively that this passage of Romans should be understood as an example of an ancient Hellenistic literary device called a "speech-in-character" ("Romans 7.7–25 as a Speech-in-Character [προσωποποιία]," in *Paul in His Hellenistic Context*, ed. Troels Engberg-Pedersen [Minneapolis, MN: Fortress, 1995], 180–202), though I think it more likely that Paul portrays a general experience of life in slavery to sin, rather than the specific experience of a gentile proselyte prior to Christian conversion, as Stowers argues. Paul's first-person description of domination by sin (Rom. 7:7–25) is immediately preceded by a contrast between his and his audience's former subjection to sinful passions and their present freedom in the Spirit (Rom. 7:5–6), which suggests that his description of domination by sin (Rom. 7:7–25) is an expansion of his and his audience's former subjection to sinful passions (Rom. 7:5), and that the subsequent

passage of Romans, which describes freedom in the Spirit (Rom. 8:1–13), is an expansion of his brief description of his and his audience's present spiritual freedom (Rom. 7:6). For a thorough exegetical treatment along these lines, see Gordon D. Fee, *God's Empowering Presence: The Holy Spirit in the Letters of Paul* (Peabody, MA: Hendrickson, 1994), 503–21.

[20]"Corruption" (*phthora*, Rom. 8:21) has several potential shades of meaning, including "dissolution, deterioration, corruption" (e.g., 1 Cor. 15:42; Col. 2:22) and "inward depravity" (Danker et al., *Greek-English Lexicon*, 1054–55; and cf. Güntner Harder, "φθείρω, φθορά, κτλ," in *Theological Dictionary of the New Testament*, ed. Gerhard Kittel and Gerhard Friedrich, 10 vols. [Grand Rapids, MI: Eerdmans, 1964–1976], 9:93–106). The moral sense of *phthora* appears multiple times in 2 Peter (1:4; 2:19) and in the Septuagint (Ps. 102:4; Micah 2:10; Wisdom 14:12, 25).

If "corruption" (Rom. 8:21) is understood in reference to physical deterioration and decay, then "futility" (*mataiotēs*, Rom. 8:20) could be understood as the transitoriness that accompanies existence in a creation characterized by such decay (cf. Danker et al., *Greek-English Lexicon*, 621). If "corruption" is understood as a moral metaphor, then "futility" would denote the moral emptiness and error that accompanies moral corruption.

[21]Paul describes death using tyrannical language several times in Romans, as well (Rom. 5:4, 17, 21; 6:9), but this language can also potentially be understood in reference to moral corruption, rather than physical death. See below.

[22]Danker et al., *Greek-English Lexicon*, 117.

[23]It is beyond the scope of this article to engage in a thorough discussion of 2 Corinthians 5, but it is worth noting that this portion of the letter contains a number of parallels to my passage of focus in Romans. Like Romans, 2 Corinthians describes believers groaning in anticipation of ultimate freedom from the present state of bodily existence (2 Cor. 5:1–4), and notes that the Spirit also plays a role in anticipating this future freedom (2 Cor. 5:5; cf. Rom. 8:26–27). Freedom from the present state of bodily existence may also be what Paul means when he says, "If anyone is in Christ, (there is a) new creation: the old things passed away; behold, new things have come!" (2 Cor. 5:17), though the meaning of this sentence is not completely clear, and a broader understanding that includes cosmic transformation is certainly possible (see Douglas J. Moo, "Creation and New Creation," *Bulletin for Biblical Research* 20, no. 1 [2010]: 39–60). The notion of anticipated freedom in 2 Corinthians differs from Romans in that the key plight in 2 Corinthians involves present, bodily suffering at the hands of persecutors (see 2 Cor. 1:4–11; 4:8–18), without a clear sense that this suffering has anything to do with the body's involvement in sin. The notion that the broader creation groans alongside believers is also not apparent in this passage of 2 Corinthians. This sort of diversity among parallel passages of Paul's letters is typical, and probably has much to do with the differing occasions of the letters (see esp. 2 Cor. 1:4–11).

[24]Jewett, *Romans: A Commentary*, 513. See further Sheralee N. Thomas, "κτίσις in Romans 8:18–23 in Light of Ancient Greek and Roman Environmental Concerns: A Suggestion," *Journal of Asia Adventist Seminary* 10 (2007): 135–52.

[25]J. Donald Hughes, *Environmental Problems of the Greeks and Romans: Ecology in the Ancient Mediterranean*, 2nd ed. (Baltimore, MD: Johns Hopkins University Press, 2014). Along similar lines, see Micah D. Kiel, *Apocalyptic Ecology: The Book of Revelation, the Earth, and the Future* (Collegeville, MN: Liturgical Press, 2017), 63–68.

[26]E.g., Anders Nygren, *Commentary on Romans* (Philadelphia, PA: Muhlenberg, 1949), 327; Murray, *The Epistle to the Romans*, 1:290; Cranfield, *A Critical and Exegetical Commentary on the Epistle to the Romans*, 1:389; and Dunn, *Romans 1–8*, 273–74.

[27]For a detailed argument in favor of such an interpretation, see William Horst, "Morality, Not Mortality: The Inception of Death in the Book of Romans," *Perspectives on Science and Christian Faith* 71, no. 1 (2019): 24–36. Martinus C. de Boer reaches a similar conclusion in passing ("Paul's Mythologizing Program in Romans 5–8," in *Apocalyptic Paul: Cosmos and Anthropos in Romans 5–8*, ed. Beverly Roberts Gaventa [Waco, TX: Baylor University Press, 2013], 11). On the relevance of 1 Corinthians 15 for understanding Romans 5, see Horst, "Morality, Not Mortality," 31–33.

[28]E.g., Sallust, *Bellum catilinae* 2.8; *Letter of Aristeas* 212; Dio Chrysostom, *To the People of Alexandria* 16; Musonius, *Fragment* 20; Plutarch, *Moralia* 1128d; and Josephus, *War* 7.344; cf. Plato, *Gorgias* 493a; ___, *Cratylus* 400c; and ___, *Phaedrus* 250c. For additional examples, see Dieter Zeller, "The Life and Death of the Soul in Philo of Alexandria: The Use and Origin of a Metaphor," *Studia Philonica Annual* 7 (1995): 40–54; and Craig S. Keener, *The Mind of the Spirit: Paul's Approach to Transformed Thinking* (Grand Rapids, MI: Baker, 2016), 34.

[29]E.g., Philo, *Allegorical Interpretation* 2.77–78, 82; 3:52; ___, *On Agriculture* 67–77; ___, *On the Posterity of Cain* 73–74; ___, *That the Worse Attacks the Better* 70; ___, *On Planting* 37; ___, *On Flight and Finding* 55; ___, *On the Special Laws* 1.345; and ___, *Questions and Answers on Genesis* 2.45. For discussion, see esp. Zeller, "The Life and Death of the Soul in Philo of Alexandria," 19–40; and Karina Martin Hogan, "The Exegetical Background of the 'Ambiguity of Death' in the Wisdom of Solomon," *Journal for the Study of Judaism* 30, no. 1 (1999): 1–24.

[30]Philo, *Allegorical Interpretation* 1.105–8; cf. ___, *Allegorical Interpretation* 3.52; ___, *Who is the Heir?* 52–53; and ___, *Questions and Answers on Genesis* 1.16, 45, 51.

[31]Emma Wasserman, in *The Death of the Soul in Romans 7: Sin, Death, and the Law in Light of Hellenistic Moral Psychology* (Tübingen, Germany: Mohr Siebeck, 2008), convincingly argues that "death" in Romans 7 should be understood against the backdrop of the metaphorical language of death in Hellenistic moral discourse, especially the "death of the soul" found in the writings of Philo.

[32]See, e.g., Deborah B. Haarsma and Loren D. Haarsma, *Origins: Christian Perspectives on Creation, Evolution, and Intelligent Design*, rev. ed. (Grand Rapids, MI: Faith Alive, 2011), 210–12, 226; Denis R. Alexander, *Creation or Evolution: Do We Have to Choose*? (Oxford, UK: Monarch, 2008), 245, 253, 260–67; Daniel M. Harrell, *Nature's Witness: How Evolution Can Inspire Faith* (Nashville, TN: Abingdon, 2008), 111–26; Daniel C. Harlow, "After Adam: Reading Genesis in an Age of Evolutionary Science," *Perspectives on Science and Christian Faith* 62, no. 3 (2010): 190; George L. Murphy, *Models of Atonement: Speaking about Salvation in a Scientific World* (Minneapolis, MN: Lutheran University Press, 2013), 69–70; and Berry, "Natural Evil," 92, 97.

[33]David G. Horrell, Cherryl Hunt, and Christopher Southgate, *Greening Paul: Rereading the Apostle in a Time of Ecological Crisis* (Waco, TX: Baylor University Press, 2010), 75, 81–82, 135.

[34]The first passage includes the verb *mataioō* ("became futile," Rom. 1:21), whereas the second passage uses the cognate noun *mataiotēs* ("futility," Rom. 8:20), but an attentive reader cannot help but notice the parallel. It is worth noting that this cognate group occurs in Romans only in these two passages, and is relatively infrequent in the New Testament in general (see Matt. 15:9; Mark 7:7; Acts 14:15; 1 Cor. 3:20; 15:17; Eph. 4:17; 1 Tim. 1:6; Titus 1:10; 3:9; James 1:26; 1 Pet. 1:18; and 2 Pet. 2:18).

[35]E.g., Steve Kraftchick, "Paul's Use of Creation Themes: A Test of Romans 1–8," *Ex Auditu* 3 (1987): 83–84; Braaten, "All Creation Groans," 158; and T. Ryan Jackson, *New Creation in Paul's Letters: A Study of the Historical and Social Setting of a Pauline Concept* (Tübingen, Germany: Mohr Siebeck, 2010), 151.

[36]Although Paul might understand creation to have become enslaved to corruption initially through Adam, I do not think the phrase, "because of the one who subjected it" (Rom. 8:20) refers to Adam, as some have proposed (e.g., Brendan Byrne, "Creation Groaning: An Earth Bible Reading of Romans 8.18–22," in *Readings from the Perspective of Earth,* ed. Norman C. Habel [Sheffield, UK: Sheffield Academic Press, 2000], 199; and Albert M. Wolters, *Creation Regained: Biblical Basics for a Reformational Worldview,* 2nd ed. [Grand Rapids, MI: Eerdmans, 2005], 56). Instead, I agree with the majority interpretation that God is the one who subjected creation to futility, since I am aware of no good reason to think that Adam would have subjected creation to futility "*in the hope* that the creation itself will be set free from slavery to corruption, resulting in the freedom of the glory of the children of God" (Rom. 8:21), whereas it makes perfectly good sense that God would do something like this with such a hope in mind (see, e.g., Cranfield, *A Critical and Exegetical Commentary on the Epistle to the Romans*, 1:414; Fitzmyer, *Romans: A New Translation with Introduction and Commentary*, 508; Jewett, *Romans: A Commentary*, 514; and Scott W. Hahn, *Romans* [Grand Rapids, MI: Baker Academic, 2017], 139).

[37]Esp. Horrell, Hunt, and Southgate, *Greening Paul*, 77, 81–82.

[38]Various relevant essays dealing with an evolutionary understanding of the inception of sin can be found in William T. Cavanaugh and James K. A. Smith, eds., *Evolution and the Fall* (Grand Rapids, MI: Eerdmans, 2017).

[39]Horrell, Hunt, and Southgate caution against ecologically focused interpretations of Romans 8 that attribute to Paul too nuanced an understanding of the causes of environmental degradation (*Greening Paul*, 65–71).

[40]Likewise, Kathryn D. Blanchard and Kevin J. O'Brien, in *An Introduction to Christian Environmentalism* (Waco, TX: Baylor University Press, 2014), reflect in detail on the ecological relevance of virtue.

[41]Interestingly, Luzia Sutter Rehman, in "To Turn the Groaning into Labor: Romans 8.22–23," in *A Feminist Companion to Paul*, ed. Amy-Jill Levine and Marianne Blickenstaff (Cleveland, OH: Pilgrim, 2004), 74–84, argues that the imagery of labor and groaning in Romans should be understood as active rather than passive anticipation of the end of the age, based especially on the fact that much hard work goes into giving birth.

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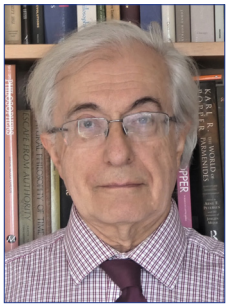

Peter J. Bussey

How Might God Have Guided Evolution? Scientific and Theological Viewpoints

Peter J. Bussey

Recent contributions to this journal by J. B. Stump, Chris Barrigar, and Randy Isaac discuss two related questions: that of God's intention to use an evolutionary process to create human beings, and whether God may have actively guided this process. I offer a more detailed analysis of the concepts of quantum complementarity and cognitive dualism used by Stump to differentiate the scientific narrative from the theistic. Both of these concepts need to be qualified, and I conclude that the theistic and scientific pictures can be kept together. The theistic account is well articulated within a creation framework. In the evolutionary account, the presence of mentality in higher animals is an important but neglected element, which will affect the scientific description. If the process of evolution was guided by God, an influence on animals' behavior through their mental nature is an attractive option. However, the matter remains open as to whether this actually happened.

The subject of human evolution continues to provide much debate among Christian thinkers. In a recent paper in this journal entitled "Did God Guide Our Evolution?," J. B. Stump discussed a number of ideas in connection with how we came to be here.[1] Correspondence followed from Randy Isaac and Chris Barrigar,[2] to which Stump responded.[3] My aim in what follows is to examine in more depth some of the issues that were raised, and to suggest a further proposal which, as far as I know, has not been in wide circulation.

The first chapters of the book of Genesis contain the traditional scriptural account of God's creation of the world and of human beings. Genesis 1 presents the process in the form of a historical narrative, with a series of creation events taking place in time under God's direction. These culminated with the human race, and each stage nominally took one day. The literary style of Genesis 2–3, focusing on the first human beings, is more that of a legend with spiritual content. The challenge for Christians and other believers is to combine a reasonable interpretation of these texts with the modern science-based account of the evolution of living species on this planet, a process that took many millions of years.

A viewpoint framed entirely in terms of science will exclude the biblical narratives and might imply, some would say, that there is nothing special or significant about our own species that requires explanation. But few of us are really willing to dismiss human significance so totally, and the biblical texts provide a perspective in which the world, that is to say the universe, was created with our appearance as a major primary goal.[4] The relevant questions are then whether we are indeed here by God's intention, how this may be related to the scientific description, and whether the standard evolutionary biological processes were

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sufficient to accomplish our appearance without additional assistance.

Stump examines several approaches to these issues, with a discussion that fluctuates between the question contained in his article's title and that of God's purposes in creating the world. These are separate questions: one can believe as a matter of faith that our human presence on Earth is part of a divine plan, but with or without divine guidance of evolution. His basic statement is that there are two relevant narratives: one concerning the scientific account of evolution, and one concerning God's intentional creation of human beings. He is content to maintain both these narratives as different portrayals of the same subject-matter, both containing truth and neither complete in itself—but not to be combined into a single discourse. The question of whether God guided the evolutionary process is not clearly answered.

To consider that the evolutionary process may have been guided by God in some way might seem to involve introducing a "God of the gaps," something that Christian believers have learned to be very cautious about. Historically, there was a tendency to use gaps in the current scientific understanding to indicate that a nonscientific agency must be acting, namely God. However, whenever a "gap" was later filled by improved scientific knowledge, the associated argument for God's action and existence became discredited. This situation can be defused by seeing God as the author of the laws and regular processes of nature, which in themselves show the divine glory. The question then becomes whether God acted exclusively by means of these laws and processes, including Darwinian evolution, or in special ways as well.

I will not attempt to discuss reasons for or against believing that we are here with a purpose. The processes of evolution do seem to have given rise to our existence, and I assume with Stump that we are indeed here by God's purposeful intention.

Arguments from Complementarity and Dualism

The two statements we will consider first are that the evolutionary process occurred historically, and that at the same time God intentionally created human beings in the divine image. They express two different ways of thinking; can we actually hold them both? To assist this, Stump made recourse to the idea of "complementarity," an approach that was supported with some reservations by Isaac in the subsequent exchanges.[5] It is a concept that finds a certain kind of scientific plausibility by reason of its centrality in quantum physics. Can it properly be transferred into a different context, though?

When a quantum object, such as an electron or a photon, is said to have wave-like or particle-like properties, this usually means that it can be in a "wave-like" state, covering an extended region of space and possessing a well-defined wavelength, or else it can be in a "particle-like" state, occupying only a small region of space and without a definite wavelength.[6] These two types of quantum states have different mathematical descriptions and may be called "complementary." What state the electron, say, is in depends on its physical history. We can carry out a measurement on the electron and are free to choose what type of measurement to make. If we take an electron in a wave-like state and measure its wavelength, all is plain and clear. If, instead, we insist on measuring a definite position of this wave-like electron, the measurement will indeed return a well-defined position value, but it will be random.[7] Now, this is nothing at all like the kind of coexisting descriptions that Stump seeks to apply to our human story. A quantum object cannot be in two complementary states at the same time. This follows from the mathematics of the quantum wave function, and not just from the practical impossibility of two simultaneous but different measurements.

In contrast, Stump's two discourses of human history are to be taken as simultaneously true, even though they are conceptually different. He describes this position, following the philosopher Roger Scruton, as "cognitive dualism," which in plain words means that "there are two different ways of looking at the matter."[8] Note that once this is expressed in Anglo-Saxon vocabulary rather than Latin, it becomes evident that there is nothing very special about the number "two," and there might well be three or more ways of looking at something! In the present case, just two ways are of interest, but we should be generally wary of assuming a dualistic constraint. (Sets of more than two mutually complementary quantum-mechanical states exist.) Let us be really clear here: quantum mechanics does *not* say that the

electron can actually possess both a localized "particle-like" property and an extended "wave-like" property at the same time, but they are not simultaneously observable. The electron *cannot* possess the two attributes at the same time. In other words, we must say that with regard to complementarity, a quantum object has to be assigned "ontological dualism," rather than a mere "cognitive dualism."[9] It is the latter term that Stump wishes to apply to the two views of our human historical condition.

Stump rightly stresses that biological evolution and divine creation must both be considered as factual realities. In this respect, I do not think he has convincingly distanced himself from Stephen Jay Gould's NOMA,[10] even though an unbeliever or agnostic might claim that religion is about questions of meaning and value and is essentially subjective. Does this really shortchange the religious position? A Christian believer can validly assert that these human perceptions relate very much to factual realities,[11] and so I do not see that there is necessarily a disagreement here between Stump and Gould. If Stump's position is effectively that of Gould, theologically repackaged and strengthened, it may not be any the worse for that.

However, if there are two different ways of looking at a given matter, it may or may not be possible to hold them both in mind simultaneously. For example, it may be humanly impossible to view a pointillist painting simultaneously as a picture of something and also as a large assemblage of small dots of paint, even if we know intellectually that both descriptions are true. But, in the case of human evolution, and in disagreement with Stump (it would seem), I see no clear reason why we should not view the subject in both the stated ways at the same time. That is, we may consider the evolutionary process as a scientifically described sequence of events, and also consider it with wonder as something divinely intended. To view with both eyes, as it were, rather than just with either the one or the other, may give a more complete three-dimensional picture. Is there really such an incongruity between the scientific and the God-based view of evolution that we need to follow Stump and invoke exclusive cognitive dualism? I would question this.

In short, we need to distinguish between "inclusive" and "exclusive" dualism. In the inclusive cognitive case, which I suggest applies here, both viewpoints can be considered simultaneously, that is to say, in parallel. This is not so in an exclusive case in which the two viewpoints are logically disparate or categorically incompatible, although they are both considered to be true. Quantum complementarity is a case of exclusive ontological dualism.

Niels Bohr and Complementarity

A certain looseness in the use of the concept of complementarity is often found in various writers, but this may perhaps be forgivable. The physicist Niels Bohr can be credited with introducing this term into the popular vocabulary. He played an important role in the middle decades of the twentieth century in educating the world about the new theory of quantum mechanics, in which the concept of complementarity was central. In talks and essays, he also endeavored to extend the idea to other areas of life, but not always with complete clarity. A thorough survey of Bohr's thinking was given some time ago in this journal by Jack Haas,[12] and was cited by Isaac; here I summarize a few key points that indicate the range of Bohr's ideas on this subject.

In a 1938 essay, "Natural Philosophy and Human Cultures," Bohr wrote:

> Using the word much as it is used, in atomic physics, to characterize the relationship between experiences obtained by different experimental arrangements and visualizable only by mutually exclusive ideas, we may truly say that different human cultures are complementary to each other.[13]

But this is quite an extrapolation! In quantum physics, we are measuring a single physical object in alternative ways, whereas different human cultures are different objects of study.

Bohr also saw complementarity between the description of the physical-chemical processes in a living creature, and that of the living creature's behavior as a whole.[14] Another proposed application was in human societies, in the exercise of justice but also of charity.[15] This might lead Christians to wonder whether God's justice and love are also "complementary"; another question might be whether the term may be applied to God as both acting within time and possessing a timeless, eternal existence. A further suggestion from Bohr concerned determinism and free will in humans, but when invoking

complementarity in connection with mental processes he was a little more circumspect.

> The indispensability of … apparently contrasting means of expression to the description of the richness of [human] conscious life strikingly reminds us of the way in which elementary physical concepts are used in atomic physics. [However,] psychical experience cannot be subjected to physical measurements.[16]

Even so, he considered that in this area, "thoughts" and "feelings" are in a complementary relationship.[17]

Some of Bohr's extensions of complementarity beyond physics may be appropriate, but they often seem to lack precision,[18] and reactions to his ideas have tended to be cautious. As Isaac and Stump remind us, the use of "complementarity" to assert the validity of two different descriptions of something does not in itself mean that we have understood anything about the relation between them. The language of both accounts can be legitimate, and the reference to complementarity offers reassurance that apparently contradictory statements may be acceptable, but it does not resolve any questions. Despite Bohr's aspirations toward "unity of knowledge," a reference to complementarity does not actually unify anything. The unavoidable conclusion is that parallels between quantum physics and other areas should be made only with great care. There is usually no need to invoke quantum complementarity in order to assert the truth of different points of view on a topic. Even as an analogy, it may mislead, since every area presents its own particular issues to be addressed. Above all, as a physicist, I would urge that scientific language should not be used metaphorically.

Interestingly, in one of the topics used by Bohr to illustrate "complementarity," a more appropriate quantum comparison was available, namely, in the relation between whole and parts. These two levels of description of a system, for example, in living creatures as Bohr said, are very different. A compound quantum object has its own existence as a physical whole, in addition to that of its constituent parts; for example, a hydrogen atom behaves as a quantum object in its own right, while also being composed of a proton and an electron. This is not properly a complementarity relationship, and the quantum physics here can usefully remind us that a purely analytical approach to a topic may be erroneous. So, perhaps a holistic view of the evolutionary process may carry information that is not perceivable in the analytical details—something that Stump seems to suggest, although it needs further argument. It also means that traditional materialistic physicalism, with its analytical insistence on identifying everything with its elementary constituents, can no longer be claimed as a standard template for rational thinking. The fact that holistic and constituent aspects of a system can both be present seems to be a good example of inclusive ontological dualism.

In evaluating Bohr's examples, it would be instructive to assign each to an ontological or cognitive category, exclusive or inclusive. This is not the subject of the present paper, but I hope that the above discussion has convincingly shown that a simple invocation of "complementarity" is not always helpful in describing a dualistic situation; it may well just impart a superficial note of scientific respectability while explaining nothing. Where, then, does this leave us in examining human evolution? Stump stressed in his reply to Isaac that he was making no attempt to relate the evolutionary process to God's purposes, but simply to assert the presence of both, in language aimed at supporting the *absence* of an explanation. This avoids any suggestion as to whether God guided evolution. But is it really best to leave matters so completely indeterminate? It seems to me that such a position is too easy an option, and it will not help Christians in conversation with skeptics. Inclusive cognitive dualism is more helpful, as we shall now see.

Creation and Its Completeness

Having argued that a scientific picture and theological insights can be viewed in parallel, we now turn to consider the scientific account in a more theological light by looking at the subject of creation. Genesis 1 suggests that the creation of the world was completed in a series of day-long stages, six in all, starting with basics and culminating with human beings. Modern science rewrites the order and detailed content of these stages and reassigns the timescales, but the general conceptual framework still seems valid. In fact, although the Hebrew word *yom* used in Genesis 1 is naturally rendered as "day," it can have a much more flexible connotation. Creation's "days" can be interpreted symbolically, and the Hebrew tradition has placed much emphasis on honoring the Sabbath on the seventh day of the human week, but

as representing a cosmic period of rest, marking the completion of God's work of creation.[19] There is thus no real theological problem with the scientific view of evolution, however long it took, provided that we can view it as the work of God.

The Genesis 1 account therefore provides a theological basis for stating that God set the universe up in a definite and particular way, starting with physical matter and a given set of physical laws and constants of nature—a "nomological" approach, in Stump's terminology.[20] This completed the physical creation. The laws had to be sufficiently substantive to provide governance of the ensuing natural processes; "laws" that are purely descriptions of nature can have no effect on anything. Stump and Chris Barrigar reached an agreement that such a viewpoint should not be rejected as "deistic." Deism, as commonly interpreted, refers to the idea that God created the universe but became a passive onlooker as to how it all played out. A passive deity is incompatible with Christian teaching, in which God interacts with human beings. The latter can clearly still be affirmed.

Even biology can be implicit in the initial Big Bang, if the assumption is made that it reduces to physics. God set it all up to go right: the physical constants and laws were sufficiently well chosen or "fine-tuned" to carry within them the processes of life. A central probabilistic aspect affects how biological evolution unfolds, but the law-guided random processes eventually worked out to produce advanced living creatures. This orthodox position is effectively that of Barrigar,[21] and also of Charles Darwin, Aldous Huxley, Richard Dawkins, Stephen Jay Gould, and a host of others, apart from the theological perspective. We humans are intelligent and have other good qualities, such as a capability for love; the assumption is made that the evolutionary processes will generate all this, at least on one planet in the universe. It might be initially undetermined as to whether the most advanced creatures would turn out as bipedal mammals, or whether some other biological form might emerge; however, this is a matter of debate.[22]

But the process of divine creation was not finished with the initial physical set-up! Only with the emergence of a race with spiritual qualities could human creation be considered as fully complete. At the biological level, detailed studies of human anatomy and DNA leave no room for doubt that we have a lineage connecting us to earlier animal species. This is confidently stated despite an incomplete understanding of how the most advanced known prehuman primates, the australopithecines, gave rise relatively quickly to the first human-like species, *Homo erectus*. This apparent "evolutionary jump" occurred around two million years ago. From *Homo erectus,* further human-like species developed, such as the Neanderthals and Denisovans, and finally our own race, *Homo sapiens*. Our biological history was now complete, but this does not include our spiritual nature, implying personhood and relationship with God. Something more was required in this respect.

This leads to questions as to how to interpret the Genesis figures of Adam and Eve as denoting the first true humans: if and when such archetypal figures historically existed, and whether as individuals or collectively. Some Christians believe that Adam and Eve are to be envisaged as the first members of *Homo erectus,* while others propose a later identification or nothing specific at all. This topic has been the subject of extensive discussion, including in the present journal, and will not be pursued further here,[23] but it is an important part of our creation story.

The Relevance of a Mental Factor

There is a further factor. Advanced living creatures have conscious minds, and this is not something physical: the laws and principles of physics have nothing to say about such a phenomenon. I diverge here from those who claim that mentality can "emerge" from physical nature; it is something qualitatively different, a new element that enters into living creatures by some means when they become able to accommodate it.[24] The full emergence of human beings on Earth is now seen to require the physical universe, the relevant evolutionary biology, a possession of mental qualities, and finally their establishment as spiritually endowed beings.[25]

Three distinct stages of development are therefore apparent: large numbers of evolved animal species with no mentality, a reduced number with mentality, and, finally, the human race with spirituality, in concordance with the biblical concept of "body, mind, and spirit." It seems likely that many animals have conscious minds, albeit not so advanced as our own. Taking this as completely evident, the philosopher Thomas Nagel famously wondered, "What

is it like to be a bat?" Some of the most conclusive evidence for animal minds comes from strong indications that some species possess self-awareness, which is investigated by observing animals' behavior in front of mirrors. Most species do not seem to have self-awareness; I have observed a small bird engaged in a ferocious battle against its own image in a shiny car hub-cap! But even without self-awareness, it is highly reasonable to suppose that mentality occurs fairly frequently in the most developed animal species on our planet.

The philosopher William James pointed out that consciousness must have a functional role in the processes of life or else it would not have evolved.[26] James was primarily concerned to demonstrate that the conscious mind cannot be just an epiphenomenal feature but must actually *do* something that is useful. At the same time, his argument makes it equally clear that a full understanding of the processes of evolution requires the purely physical and chemical considerations to be augmented by mental considerations as well. We might imagine, for example, that the presence of conscious mentality would enhance an evolutionary selection for intelligence, since this quality may be employed more effectively with a conscious mind. This means that an analysis that considers only the role of physics, chemistry, and biology should not be expected to describe accurately the rates of evolution of conscious animal species.

It hardly needs saying that we do not know with any certainty where the boundary between consciousness and nonconsciousness lies in the chain of animal life, nor do we know how to evaluate its evolutionary functionality with any accuracy. We do not even know how mentality and the physical processes in the brain interact, but a substantial paradigm shift from a purely physical model is needed. Therefore, it is hardly surprising that most discussion of this area turns out to be very imprecise, if it takes consideration of mentality at all. I cannot add precision here, unfortunately, but it is important to be aware of the issue.

The process of creation could thus have been *physically* completed with the Big Bang and the laws of physics. The evolution of nonconscious life could then be an outcome and extension of the process of physical creation, on the assumption that this was sufficient. But creation would not yet have been complete with regard to advanced animal life, which would require the provision of mentality at a later period. Finally, the human race had to be spiritually endowed. The picture now becomes decreasingly "deistic," because the later aspects may be supposed as requiring active divine involvement after the physical start of the universe.

The Possibility of Physical Guidance to Evolution

We are now better equipped to consider the original questions of this article. Our biological understandings have advanced substantially over recent decades, and this can be expected to continue. The basic question would be whether these understandings provide a good basis for believing that processes of a traditional Darwinian kind were sufficient to generate our species over the measured time-spans. If a detailed examination were to lead to this conclusion, then no additional kind of process would be indicated, in particular, divine intervention or "guidance." The answer to the question "Did God Guide Our Evolution?" would be simply "No."

A definite conclusion of this kind could be hard to reach in view of our limited scientific knowledge. It is taken as the default scientific position, however; a present failure to understand some points is hoped to be rectified by later science. But if only physical and chemical processes are taken into account, the evolution of the most advanced animal species is presumably *not* likely to have occurred on the observed timescale, since contributions from animal mentality will also be relevant. This additional factor is again probably beyond our current ability to estimate.

What if it were possible to decide that the natural resources were insufficient, taking everything into account? As the titles of Stump's article and the present article imply, there have been proposals that God might have acted to get the evolutionary processes to work as desired. Stump calls this a "causal joint strategy," and gives particular consideration to the proposal that, since quantum processes are to a large extent random, God could have imposed definite outcomes on some of them in order to achieve particular genetic mutations. The desirable random mutations are always physically available at some level of probability, and this kind of divine action would give perfectly possible results to the quantum processes, although they might be unlikely, with nothing in contradiction to the laws of physics.

It amounts to an imposition of additional form on the randomness. Perhaps there is nothing to object to here; probabilistic laws do not govern nature rigidly, and an addition to nature is not a contravention of nature. But as Stump correctly says, it is still an "intervention," albeit a rather subtle one.

Detailed proposals along these lines were made by Robert J. Russell.[27] In fact, "quantum mutations" are not so easy: mutations are more complex events than just making an electron do this or that. A mutation involves modification, removal, addition, or reconfiguration of molecular groups (base nucleotides) within the DNA structure in a cell, and can arise from processes that are somewhat distant from a pure quantum event. One could simply assert that quantum or no quantum, God just does it! But it should be remembered that if God were to cause a mutation, by any means at all, this would be a constraining act on nature and thus a further creative act on top of the already created physical processes, which we might have supposed were complete.[28]

Rather than comparing divine guidance to the ideas of René Descartes about the pineal gland, I think a better comparison is with Isaac Newton's suggestion that a divine hand was needed to keep the outer planets stable in their orbits around the sun. Later, with improved mathematical techniques, Pierre-Simon Laplace showed that this was not necessary, and he had "no need of that hypothesis." An imposed physical force on the planets, as Newton proposed, might seem very much an artifice, implying that the original laws of nature did not quite serve their purpose. Newton could perhaps have argued that laws of nature are absolutely splendid things, but they are crude instruments for something so delicate as a solar system, and there would be nothing wrong with a requirement for fine extra adjustments.[29] In the evolutionary process, if God wished to direct special creative mutations from time to time in this manner, there are likewise no logical grounds for objecting. But such suggestions do seem to imply that the work of physical creation was not as complete in its initial formative stages as might have been supposed. This might seem unsatisfactory.

A Better Proposal?

A means for divine guidance that could fit more seamlessly and even implicitly with the created natural order might seem more attractive. I am not arguing that it necessarily occurred, but if it did, we might think along the following lines. How does God normally communicate with us as human beings? Christians would first reply that there are special types of communication and miraculous intervention, as recounted in the scriptures, which have occurred from time to time over the centuries. Perhaps they are even fairly frequent. But on a daily basis, many of us would assert that God guides by means of mental impulses of various kinds—feelings of rightness or wrongness, alerts to various possibilities, and so on. In particular, the operation of our moral consciences may be considered as indicative of a permanent contact with God; it is a factor that has been degraded by conditions of general human fallenness but which is still normally present in us. All this, then, from common human experience, is perfectly "natural." Human beings can even exercise elements of creativity, since we are in the "image and likeness of God," and maybe God is also willing to lend a hand with this!

If God can contact human minds, there may be no clear objection to a contact with the minds of other animal species. How might this affect the evolutionary process? The evolution of more primitive species, lacking minds, would most likely proceed with no special divine influence at all, operating on physical and chemical principles precisely according to Darwinian and post-Darwinian understandings of natural selection. But the evolution of higher species might be influenced positively through mental contact, if God found it advantageous to incline individuals or groups to particular types of behavior. For example, it might be beneficial if particular pairs of animals could be induced to breed together to produce offspring with certain enhanced characteristics. These would presumably not be detrimental to the animals' survival or reproductive capability, but might assist these features or be helpful for the longer-term development of the species, according to a divine plan. Another possibility might be to incline groups of animals to migrate into more challenging environments such as would induce the development of more advanced biological adaptations, again with positive longer-term effects.

Mentality, presumably, normally operates according to created laws and principles. But it is also something specific to individuals, and it may be that divine contact with individuals is not a disturbance to

whatever natural principles are operating. Animals can receive communication from other animals, and so why not also from God?

This type of divine guidance, if it occurred, could have had an effect of accelerating evolutionary tendencies that might have been otherwise too unlikely or too slow to be useful, or maybe an effect such as to induce new possibilities of evolutionary direction. Although physical creation was complete, evolution involving mental processes was still ongoing, and a special divine input could also have been present. Perhaps this was how *Homo erectus* developed in a rather short geological time out of the australopithecines? These are speculations, of course, but they do seem to bridge the gap between a purely physical-chemical evolutionary narrative and the proposals of many creationists, a gap that often gives rise to a destructive perceived antagonism between science and Christian belief.[30]

Summary

To see a divine hand behind the process of creation as a whole is perfectly compatible with forming a scientific picture at the same time. It is a matter of *inclusive* cognitive dualism, I have argued. Creation took place in three stages: physical with the Big Bang, mental, and spiritual. As far as the biological side of human evolution is concerned, we do not fully know whether the physical and chemical processes of evolution were capable of doing the job on their own, but it is a reasonable assumption, up to the point when mentality became relevant. The Big Bang, then, contained the seeds of life, but they took myriads of years to come to fruition.

Theologically, it is possible to argue that life is so special as to represent a new stage of creation, and that God might well have guided the physical process of evolution, although this viewpoint is not one that I am advocating here. But the gift of mentality in animals is a further significant factor in the evolution process, one that is definitely new, marking a new stage in which God might have exercised creative power. The imparting of spiritual identity to the human race, so that we are in God's image, was the final step in human creation.

The possibility that God may have guided evolution in some way is not just a philosophical or theological question, but one whose answer may require precise and quantitative scientific evaluation of the evolutionary workings. It is surely wrong to suppose that God's activities have to be undetectable in principle, and therefore a pure matter of faith and belief.[31] Whatever the answer here may be, none of this detracts from the overall presence of a divine purpose in the universe. I am unable to propose a clear answer to Jim Stump's original question, but if God *did* guide evolution, the possibility that it occurred through mental communications with the more advanced animals could be a relatively "natural" means by which it might have been achieved. ✞

Acknowledgments

I should like to thank the two anonymous referees of this paper for their constructive and very helpful suggestions.

Notes

[1]J. B. Stump, "Did God Guide Our Evolution?," *Perspectives on Science and Christian Faith* 72, no. 1 (2020): 15–24. Hereafter *PSCF*.

[2]Randy Isaac, "Does Complementarity Explain Anything?," *PSCF* 72, no. 2 (2020): 126; and Chris Barrigar, "The *Agape*/Probability Proposal Is Not Deist," *PSCF* 72, no. 2 (2020): 126.

[3]J. B. Stump, "Response to Randy Isaac and Chris Barrigar," *PSCF* 72, no. 2 (2020): 127–28.

[4]There might be God-breathed races on other planets, but we do not discuss this here.

[5]Complementarity was also used by William G. Pollard, *Chance and Providence: God's Action in a World Governed by Scientific Law* (London, UK: Faber & Faber, 1958). Pollard's approach has some similarities to that of Stump, in that he sees the providential and scientific view of the world as complementary in approximate analogy with quantum mechanics.

[6]"State" here refers to the particle's quantum mechanical wave-function.

[7]Following this measurement, the electron will be in the resulting localized "particle-like" state, which now forms the starting point for its subsequent behavior. The original wave-like state is lost.

[8]George Orwell's "double-think" may be seen as an extreme example of cognitive dualism! George Orwell (né Eric Arthur Blair) pointed out strongly how a choice of language can affect our way of thinking and that clear honesty is essential.

[9]There are intermediate states in which the electron has some degree of both types of property, wave-like and particle-like. An uncertainty principle holds. This is well described by the relevant mathematics but is not relevant to our present argument.

[10]"Non-overlapping magisteria." That is, science and religion talk about two different aspects of reality, and both (if you are a believer) may be considered to be true.

[11]For some fuller discussion of this all-important subject, one might start with the 1914 Gifford lectures by Arthur Balfour, *Theism and Humanism* (Seattle, WA: Inkling

Books, 2000), whose ideas were taken up by others, notably C. S. Lewis.

[12]John W. Haas Jr., "Complementarity and Christian Thought," *Journal of the American Scientific Affiliation* 35, no. 3 (1983): 145–51.

[13]Niels Bohr, "Natural Philosophy and Human Cultures" (1938), in *Atomic Physics and Human Knowledge* (Mineola, NY: Dover Publications, 2010), 30–31.

[14]Niels Bohr, "Unity of Knowledge" (1954), in *Atomic Physics and Human Knowledge,* 76. One could go beyond Bohr's conceptually formulated statements and assert that sometimes it may be necessary to kill the living creature in order to understand its biochemical processes! This would clearly resemble the quantum physics where one type of experimental observation excludes another. Fortunately, biological investigations do not always need to go so far.

[15]Ibid., 80–82.

[16]Niels Bohr, "Atoms and Human Knowledge" (1955), in *Atomic Physics and Human Knowledge*, 92.

[17]Bohr, "Natural Philosophy and Human Cultures," 27.

[18]For example, Bohr's imaginative assertion that "… the impossibility of providing an unambiguous content to the idea of subconsciousness corresponds to the impossibility of pictorial interpretation of the quantum-mechanical formalism" ("Unity of Knowledge," 77).

[19]While God remains active continuously (John 5:17), the Epistle to the Hebrews emphasizes that the actual work of creation was "finished from the foundation of the world" (Heb. 4:3).

[20]On at least one planet in the universe, one might add.

[21]Chris Barrigar, "God's *Agape*/Probability Design for the Universe," *PSCF* 70, no. 3 (2018): 161–75. Barrigar calls this "front-loading" the universe. His stress is on an evolutionary universe that will generate creatures capable of love.

[22]Simon Conway Morris, in his *Life's Solution: Inevitable Humans in a Lonely Universe* (New York: Cambridge University Press, 2004), proposes a theory of *convergent evolution* in which certain standard forms and patterns often evolve in different groups of species. This may happen in different environments of a given type, and it is as if evolution tends to operate according to a number of overall rules and tendencies. The formation of human-like creatures might then be expected, if one knows what these rules are. This would remove some of the unpredictability in the evolutionary process and would make the operation of a plan appear less contradictory to the randomness that is often assumed to be fundamental in evolution.

[23]I discussed this in a recent article, "Natural Law— 'God's Law in our Hearts,'" *Science and Christian Belief* 32, no. 1 (2020): 5–28.

[24]For an introductory discussion of this topic, see Christof Koch, "Is Consciousness Universal?," *Scientific American Mind* 25, no. 1 (2014): 26–29. I do not necessarily agree with all of this author's views, but he raises some relevant issues. A version of the philosophy of panpsychism is sometimes put forward in which everything is said to be "enminded"; this goes beyond anything that is proposed by Koch or by myself and seems to be hard to define and harder to verify. The atheist philosopher Galen Strawson is an advocate of panpsychism; see "Realistic Monism: Why Physicalism Entails Panpsychism," in Galen Strawson, *Real Materialism and Other Essays* (New York: Oxford University Press, 2008), 53–74.

[25]Body, mind and spirit, to use the scriptural picture.

[26]William James, "Are We Automata?," *Mind* 4, no. 13 (1879): 1–22.

[27]Robert John Russell, "Special Providence and Genetic Mutation: A New Defense of Theistic Evolution," in *Perspectives on an Evolving Creation*, ed. Keith B. Miller (Grand Rapids, MI: Wm. B. Eerdmans, 2003), 335–69.

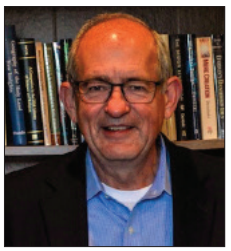
[28]Russell and others believe that an intervention is allowable only if undetectable, because then the mutation *could* have occurred naturally. I find this a little strange. Is God really in the business of hiding his activities? Very possibly, an intervention could have a certain high level of Bayesian probability assigned to it compared to that of the "natural" event.

[29]Indeed, we may still wonder at the fact that our planetary system has been sufficiently stable over so many millions of years—this is a highly technical question, however, involving a chaotic element to planets' behavior, and no astronomer would advocate Newton's solution to it nowadays.

[30]This proposal appears to be almost a mirror image of that of Russell, "Special Providence and Genetic Mutation," 366. He suggests that God acts in various ways in quantum genetic events, but when animal consciousness appears, in this respect the animals are left to run their own affairs. He then raises the issue of animal suffering over the aeons. If quantum mutations were God's way of guiding evolution, one might have hoped for more interventions to ameliorate this. It is a serious problem.

[31]Certainly, the writer to the Hebrews did say that it is by faith that we believe that God created the universe (Heb. 11:2). Since then we are living in God's "Sabbath rest" (Hebrews 4). But once this has been accepted, there is no logical need to propose that God's activity in the world is always invisible.

Emily Boring



Randy Isaac

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Article

Rethinking Abiogenesis: Part II, Life as a Simplification of the Nonliving Universe

Emily Boring, Randy Isaac, and Stephen Freeland

In Part I, we argued that it may be useful, even important, to perceive the origin of life as a seamlessly continuous (and arguably incomplete) process, rather than any specific point in time or evolutionary history.[1] Here we challenge another widespread assumption: that abiogenesis involves some sort of increase in complexity. Instead, we argue that in at least some useful ways, natural selection can be viewed as a process that simplifies *the nonliving universe, yielding organisms that are increasingly efficient in processing energy and genomes that capture only a fraction of the information available in the broader environmental context. We show how this view of "life as simplification" connects with our previous argument for abiogenesis as a seamlessly continuous process in time: anything we consider alive makes sense only in the context of, and in relationship to, neighboring points in time and space. Overlooking this context tempts unproductive questions, such as how could something nonliving move toward the complexity of life? Seen in context, life's complexity merely reflects the greater complexity of the surrounding universe. This shift in perspective opens productive scientific and theological reflections that include conceptions of "order out of chaos."*

Living things, we are often taught to perceive, are more complex than their nonliving environment. This view can be traced back at least as far as Aristotle, who argued explicitly that all living things are something more than inanimate matter precisely because they also possess a soul.[2] Subsequent to Aristotle, the idea that biology is more than matter alone travelled through centuries of western civilization, gathering considerable nuance along the way, to become the "Great Chain of Being"[3] which describes the exact hierarchy, or ladder of all creation, stretching from God at the top, down through animals, to plants, onwards to minerals and rocks. This system firmly locates inanimate matter as less than anything living.

Universal acceptance of this state of affairs led, for example, to all pre-Darwinian evolutionary theories of Western science seeking an answer to the question, "What causes matter to ascend this ladder, to become more over time?" Thus, the word "evolution" originally entered biology in theories which extended biological development (from fertilized egg to embryo to adult) onwards to include equally deterministic development of simpler, "lower" species into "higher" forms of life.[4] It was in this sense that Darwin's grandfather used the word "evolution" in a poem to describe the unfolding of a plan for the

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ascent of matter into ever more complex forms of life.[5]

Although concepts of the soul are rarely recognized by contemporary science, and mainstream evolutionary biology tends to reject explicit notions of teleology[6] and progress,[7] Aristotle's idea continues to exert a profound influence on how we think today. The very word *inanimate*, for example, means "without soul" or "without breath": life possesses something which nonlife lacks. More pragmatically, students of a traditional undergraduate science curriculum in the USA will typically meet organic chemistry before biochemistry, as if the latter builds upon the simpler knowledge of the former. But where, in fact, does chemistry become "complex" enough that it attains the special attention we give to living things? Science offers little objectivity with which to distinguish clear lines of separation (box 1). The terminology of "organic chemistry" and "biochemistry" is better understood through a lens of science history as successive attempts to define an

Box 1: "Organic" Chemistry and "Bio"chemistry Are Cultural Constructs

Does the molecule carbon dioxide belong to organic chemistry or inorganic chemistry? Here is how the American Chemical Society explains the situation:

> *Organic chemistry is defined as the study of carbon-containing compounds and inorganic chemistry is the study of the remaining subset of compounds other than organic compounds; there is overlap between the two fields …*[8]

Taken at face value, much depends upon whether one approaches the molecule as an oxidized state of carbon or a reduced state of oxygen. Move onwards to biochemistry, and the relevance of carbon dioxide is indisputable. It is crucial to understanding carbon fixation (photosynthesis) and its chemical inverse, respiration: the former harnesses energy to convert carbon dioxide and water into sugar; the latter converts sugar into carbon dioxide and water, releasing energy. Phenomena more central to life's chemistry are not easy to think of. We could travel onwards (and "upwards" in the fictional hierarchy of complexity) to scientific disciplines of plant biology, animal physiology, ecology, and evolutionary biology only to find equally valid reasons for considering carbon dioxide part of their legitimate domains of inquiry. Net flux in carbon dioxide is, for example, a major determinant of average, global temperature, experienced by all life. It seems that the domain of chemistry to which carbon dioxide belongs is not inherent to the molecule, but rather a subjective property of the questions being asked about the molecule: it is about the perspective from which this molecule is approached.

Perhaps the simplicity of carbon dioxide, with its single molecule of carbon, causes this overlap of multiple domains, and things become clearer when multiple carbon atoms join together. In a deeply influential book about life's origins, chemist Robert Shapiro describes the situation thus:

> *Carbon atoms have a marvelous ability to join with one another and … such long chains are characteristic of many molecules important to life … Up to the early nineteenth century it was thought that the division between organic and inorganic chemistry was the basis that separated living and nonliving matter. Now we know better. Certain meteorites, for example, contain a complex mixture of organic compounds, with chains of various length. Yet they do not contain life, nor is there any indication that they were ever in contact with life before they fell to Earth … The essence of the difference between life and nonlife at the molecular level lies not in the presence of … long chains of atoms but rather in the organization, as well as the identity, of the molecules …*[9]

This final phrase refers to sequences of nucleotides that form genetic material and sequences of amino acids that form proteins. In the main text of our article, we discuss how these sequences comprise a subset of the building blocks produced by nonbiological chemistry, and then how the organization of these sequences results from the process of natural selection forming simplified "reflections" of the nonliving environment. Biochemistry is not a subset of the universe; it is a vantage point from which to view that universe.

assumed difference between the chemistry of life and nonlife. This difference has proven surprisingly elusive, and at least some aspects of life's chemistry that are different seem distilled from greater chemical diversity: a purification or reduction of abiotic chemistry rather than an increase in complexity. We will argue that this is exactly what we should expect from evolution by natural selection, and yet here, as much as anywhere, echoes of Aristotle's teleological thinking persist.

Take, for example, Richard Dawkins, who opened an otherwise excellent exposition of late-twentieth-century evolutionary theory by suggesting that, unlike biology, "*physics is the study of simple things that do not tempt us to invoke design … even large physical objects like stars consist of a rather limited array of parts, more or less haphazardly arranged.*"[10] The truth of this statement hinges upon what perspective one assumes as a basis for investigation: how one chooses to define "simple," "more or less haphazard," and "parts."[11]

Dawkins's description of evolutionary theory cares and notices little about atoms as parts. A nuclear physicist or astronomer, on the other hand, would perceive and describe the chemical composition and physical structure of a star as anything but haphazard. Atomic reactions at high pressure/temperature convert hydrogen into concentric shells of helium, carbon, oxygen, sulfur, and so on through subtle, sophisticated equations by which science has come to describe matter and energy. It is not clear to us that any of these research areas involve something "simpler" than evolutionary biology: certainly, the processes involved continue to occupy sharp minds in full-time exploration on multiple fronts.[12] Thus, the statement that the structure of a star seems haphazard and simple relies on a subjective choice of definition.

If living things are more prone than nonliving things to invoke design in the mind of an intelligent nonexpert, then perhaps this thinking occurs because the patterns of cause and effect that explain the physical manifestation of organisms—morphology to behavior—resonate with our own personal experience. Many insects resemble leaves or sticks because the resemblance influences their chances of being eaten by predators. This is something we understand readily in the food webs around us. In contrast, ordered patterns in the anatomy and behavior of a late stage, main sequence star involve "the equations of stellar structure including those for energy conservation, momentum transfer, mass conservation, and energy transport."[13] In other words, the perspective by which an evolutionary biologist perceives the "purpose" (cause) of living things is one with which we empathize more intuitively.

How could we probe further the objective validity of the idea that life is somehow more than nonlife? One approach is to ask whether we can construct a logical argument for the opposite view: What are useful ways in which life can be defined as simpler than abiotic chemistry?

A Case Study: The Chemical Simplicity of Life

Consider the small, organic molecules used as building blocks by all life on Earth for the past 3.5 billion years. Students of biology learn early the "Central Dogma" of molecular biology: life encodes genetic messages in sequences of nucleobases; these genes are translated into a different chemical language of protein enzymes so as to form metabolism. Genetic information is "written" using an "alphabet" of just four types of nucleobase, which specify a corresponding protein sequence "written" in an "alphabet" of just twenty different types of amino acid.

It has become clear in recent years that nonbiological processes (and therefore prebiological processes) produce a far greater diversity of both amino acids[14] and nucleobases[15] than are used by life. This insight derives from the unlooked-for convergence of results of laboratory chemistry experiments to simulate prebiological conditions, and analysis of meteorites, which represent the natural counterpart of such simulations. Even within life's reduced "alphabets," nonliving chemistry tends to produce two mirror-image versions (enantiomers) of amino acids and ribose in equal amounts, whereas biochemical polymers (proteins and nucleic acids) use only one. From the perspective of life's origins (and astrobiology), the logical inference is that early evolution sifted the molecular diversity of abiotic chemistry into streamlined components of life's Central Dogma with which it has been working ever since. Our emphasis on simplicity may be unusual, but many prior authors have suggested that the whole system of carbon-based, polymer-based life emerged, via evolution, from a far more heterogeneous and messy prior state.[16]

Zooming in from molecular building blocks to consider the types of atom from which they are

constructed reveals something similar. The periodic table comprises more than 100 different chemical elements. Of these, just six are responsible for fundamental biochemistry, such as amino acids and nucleotides: carbon (C), hydrogen (H), nitrogen (N), oxygen (O), phosphorus (P), and sulphur (S).[17] Certainly these six are used to coordinate a network of chemical reactions that involve a handful of other chemical elements in trace amounts (copper, magnesium, iron, and so forth), but the framework of protein enzymes, nucleic acid genes, cell membranes, and energy storage responsible for this coordination comprises only "CHNOPS." Six is, objectively, smaller than one hundred! Six is smaller even than the tens of elements that might be present within, say, the sun[18] or those meteorites in which amino acids are found.[19] In this sense of atomic composition, then, the "design" of living organisms is again "simpler" than the analogous design of the nonliving universe.

Of course, counting the molecular building blocks (or types of atom) used by life versus those produced by abiotic chemistry is just one, very limited definition of "simplicity."[20] Can we extend this thinking usefully by asking why life's chemical basis is simpler than that of the nonliving universe?

A clue comes from observing that a standardization of components has repeatedly proved advantageous during human history by providing increased efficiency. For example, the metric system emerged to provide advantage over prior, heterogeneous units of measurement, and the standardization of nuts and bolts provided a noticeable contribution to the industrial revolution.[21] A constant drive for efficiency is a well-described theme for biological evolution in times more recent than life's origins.[22] For example, Eric Chaisson suggests the metric of energy rate flux to express the greater efficiency of living organisms in utilizing energy.[23] Certainly, this perspective aligns well with scattered evidence that life's "choices" of amino acids,[24] nucleotides,[25] and even the sugar ribose[26] look a lot like the optimized products of natural selection.[27] The biochemical substance of life is simpler than its abiotic context because the general process of natural selection by which life emerges is one of filtering and reduction.

But the clearest potential counterargument to our notion of "life as simplification" is that, within living systems, atoms and the molecular building blocks of the Central Dogma made with them become linked together into improbably[28] nonrandom sequences (genes and proteins) that do not find any counterparts in the nonliving world. How could we possibly think of these sequences as simpler than the nonliving universe?

The answer is that natural selection continually filters environments into genetic encodings that "summarize" and reflect back just a few key aspects. Since the Central Dogma became established, we encounter these summaries in the language of gene sequences and the protein enzyme sequences that they encode. This idea of natural selection sifting, summarizing, and reflecting back a few key aspects of the environment is the crux of our argument, and carries important implications for the way we think about life's emergence through both scientific and theological lenses. To get there, let us first explain exactly what we mean by the assertion that evolution by natural selection sifts, summarizes, and reflects back the environment.

Evolution by Natural Selection Reflects Environments into Genetic Language

Within biology, form tends to fit function. This orthodox, textbook knowledge arises directly from Darwinian theories of adaptation. An introduction to evolution might begin, for example, by comparing dramatically different life forms: cacti and water lilies. Cactus leaves have evolved into spikes, which reduce the plant's loss of water through transpiration while defending against predators. These are appropriate traits for life in a desert, where water retention (including the defense of hard-won resources) is key to reproductive success. Meanwhile, the lily is buoyant and flat, with a large surface area that transpires water quickly—traits that reflect the abundance of freshwater in lakes and ponds, where staying afloat brings reproductive success through exposure to sunlight and atmospheric carbon dioxide.

The "form fits function" principle guides many of the questions that evolutionary biologists ask about life's diversity, and helpfully so. We might wonder at the difference in teeth between carnivores and herbivores, the curved beaks of hummingbirds that match specific flowers, or the streamlined shape of fish. A classic "adaptationist" approach—asking, "How is this trait (form) beneficial to the organism's survival or reproduction (function)?"—usually provides a useful way in which to understand whatever we are looking at, from the number of seconds that

a male dung fly[29] spends mating to the size of mussel shells preferred by shore crabs.[30] In some famous words from Dobzhansky, "Nothing in biology makes sense except in the light of evolution."[31] As a thought experiment, consider the challenge faced by visiting aliens trying to make sense of lilies and cacti (or stick insects, or any other plant or animal) if they were to transport the organism into their spaceship before starting their examination. At best, they might infer key features of the environment in which the organism functions. At worst, morphology and behavior would be bewildering, misleading. As pointed out to us during peer review, "This explains why astrobiologists who develop life detection approaches spend time in the field. We know that context is everything."

The causal mechanism that accounts for these tight links between environments and traits is, of course, natural selection: the process by which genetic variants that confer greater fitness within a population, increase in frequency over time through differential reproductive success. Through this mechanism, the genome becomes programmed by the differential survival of traits (phenotypes) that are beneficial in a given environment. The definition of "beneficial" in this context means traits which lead most effectively to reproduction, often through enhanced survival. The genes (usually complex interacting suites of them) that persist and proliferate through natural selection are those that encode phenotypes through which energy flows more efficiently into reproduction.

Our advocacy for a perspective of evolution as a process of simplification is that differential reproduction usually results in the loss of genetic variation over time as natural selection eliminates less favorable sequences from a larger pool of options. The most direct route to reduced genetic diversity is *fixation* in a population of a single variation that confers greatest reproductive success and, by inference, elimination from the gene pool of all alternatives.

The straightforward fact that selection (and, for that matter, genetic drift) acts to reduce genetic variation in a population seems paradoxical when we think of evolution resulting in "*endless forms most beautiful and most wonderful*" (the closing sentence of Darwin's *Origin of Species*). The resolution to this paradox is that, while natural selection sifts and simplifies from the available genetic variation, mutation[32] is constantly feeding new variation into the system, providing the raw ingredients on which natural selection continues. From the perspective we advocate, each mutation is a temporary influx of complexity from the universe into evolution's grinding gears of simplification. Mutation increases the diversity of genomic sequences, while natural selection reduces and simplifies this variation through differential reproduction, according to which variants best reflect the environment. In accord with the second law of thermodynamics, the environment tends to increase chaos while natural selection is a simplification leading to greater order out of chaos.

It is worth pausing here to forestall a potential misunderstanding. The assertion that evolution by natural selection causes genomes to "capture" partial information about an environment does not violate the Central Dogma of molecular biology, which states that information flows from genes to proteins to phenotypes rather than the other way around. No violation is implied, because the environment does not encode information directly into the genome via some mechanism of reverse translation (as Lamarck and many pre-Darwinian theorists, in effect, proposed). Instead, the environment exerts a pressure which, often gradually and through the mechanism of differential reproductive success, changes the distribution of alleles in a population. Natural selection filters random mutations according to how efficiently they convert resources into offspring. That is a statement about life's relationship to the environment. Variations in traits which exert greater, positive impact on reproductive success will come to dominate and be built upon by future generations. In this way, genomes are shaped by environments in full accord with the foundational ideas of evolutionary theory.[33]

But the portion of the environment that "appears" in the genome is, as we will argue, only a fraction of the total environment at hand.

What Constitutes an Environment?

If natural selection molds evolving lineages to fit their environment, then what exactly comprises this environment? At first glance, we might notice key physical conditions: the intensity of sunlight, availability of water, ambient temperature, oxygen levels, and so forth. Natural selection, we presume, is tracking such things; that was where our description of lilies and cacti began. But a cactus morphology that

protects hard-won resources from herbivory hints at something important beyond physical features of the environment. To natural selection, biological interactions are equally, if not more important, than abiotic factors in defining an organism's environment. Avoiding predators while successfully finding food, fending off parasites, infections, and competitors while entering into mutually beneficial relationships with individuals from within and beyond the organism's population—these factors all influence reproductive success. What could be more important, after all, than choosing a good mate? Thus, an evolutionary concept of "environment" must extend beyond abiotic factors to consider other species such as predators, prey, and parasites, as well as other members of the same species such as potential mates and competitors.[34] The morphology and behavior of any given lineage will make greater scientific sense if considered in the context of these other interacting biological entities. An interesting logical consequence is that the environment is never the same for two lineages, or even two individuals occupying the same physical locality, because the environment of each is defined in part by the presence of the other. The environment is the whole; the organism is a constituent and fractional part.

Adaptations Are Simplified Reflections of Their Environments

Our argument for evolution as simplification proceeds by focusing on the difference between those aspects of the environment that become reflected in a genome and those that do not. Setting aside, for a moment, the phenomenon of genetic drift, we can state that adaptive natural selection is driven only by those aspects of an environment that influence the differential replication of genes. Therefore, the record of an environment that makes its way into a genome represents only some features of that environment.

To see why, consider again the cactus. Natural selection might "see" the scarcity of water and the threat of herbivory when it comes to desert cacti, because these exert the most pressure on survival and reproduction. More accurately, we might say that within the lineage which led to a contemporary cactus, somewhere in the recent past, plants with spinier leaves gave rise, on average, to more successful offspring than counterparts with less spiny leaves. Sustain that environment long enough, and we arrive at the cacti we see today. Compared to the price of water loss in this environment (whether through transpiration or herbivory), minor local variations in soil chemistry, altitude, or a host of other aspects of that same environment are less important beneath the resolving power of natural selection, and thus adaptations related to these conditions will not necessarily be preserved in genes. Put another way, the cactus's genome has evolved to reflect an incomplete picture of the environment in which its predecessors competed to reproduce. An independent observer could never reproduce all aspects of an environment from even the most thorough study of the organism. Natural selection has filtered (simplified) a complicated environment in the process of producing genetically coded "reflections." This is the sense in which we state that all genetic programming may be viewed as a partial "image" of a far more multifaceted environment, much as a photograph captures only some of the information of the object it depicts.

Simplified Reflections Blur the Line between Organisms and Their Environment

Another way to approach these same ideas is to say that all fundamental properties we associate with life, such as homeostasis, movement, growth, and development, exist only in relation to a richer biotic and abiotic context. The aliens who took a well-adapted organism into space would not only be guessing at the significance of adaptations—they would be studying a dead organism, unless they took an appropriate slice of the right environment along for the trip. That is what we expect from natural selection. Your body has evolved to breathe in a gaseous mixture that is relatively rich in oxygen, and to breathe out a different mixture richer in carbon dioxide. This is the result of natural selection which has shaped your physiology to use the oxygen in breaking down carbohydrates (hydrated carbon) into carbon dioxide and water, releasing energy along the way. Any actual instance of homeostasis, movement, growth, or development dissolves, under scrutiny, into one or more adaptations, each specific to the environment. The oxygen on which your physiology relies originated, of course, in photosynthesis. In the absence of oxygen-producing photosynthesis, our physiology would no longer be an adaptation as our homeostasis, movement, growth, and development would cease. What might pass superficially for properties inherent to life are all genetically encoded, partial reflections of a specific environment, and

their ongoing manifestation requires the presence of the same (or very similar) environmental conditions which they are programmed to reflect.

Life and its environment are unmistakably intertwined, particularly when we notice that genes are often selected for their influence quite beyond the bodies in which they occur. As Dawkins pointed out, a beaver's dam may be usefully considered as part of its "Extended Phenotype."[35] This extension of adaptations may also encompass the biotic component of any given organism's environment. A fungal secretion which manipulates the behavior of an ant which it parasitizes,[36] or characteristics that provide advantage in securing a mate, illustrate this extended interconnection of organisms. Even the carbon dioxide you breathe out contributes to the atmosphere that other organisms experience—just as the oxygen you breathed in reflects the output of photosynthesis. At this point, it has become difficult to distinguish clear boundaries between interacting organisms and the nonliving environment they inhabit.[37]

From Continuity with the Environment to Continuity through Time

We have argued thus far that evolution by natural selection causes the genetic material of each lineage to form a simplified reflection of its environment. The resulting adaptations intertwine organisms inextricably with their environment, including one another, through physiology and ecology. Distinctions blur between different organisms and between life and nonlife.

In a previous paper, "Rethinking Abiogenesis: Part I," we argued that abiogenesis, like the rest of biological evolution, is usefully perceived as a seamlessly continuous (and arguably incomplete) process, rather than an event occurring at any specific point in time or evolutionary history.[38] Not every step by which life has emerged is equally relevant to understanding every other step, but no step can be understood without relationship to neighboring points, which can only be understood in relation to others, and so on. We now argue that a similar continuity holds at any one point in time for organisms' relationships to their surroundings (the environment, abiotic and living). Whereas Part I stretched a unique point in time called "abiogenesis" into a continuous line of life's ongoing unfolding,[39] here in Part II, we stretch that timeline into a second continuous dimension: space. Life at any one point in physical space can be understood only in relationship to neighboring points (points within the "environment"), which can only be understood in relation to others, and so on.

But these two dimensions are not truly distinct. Life's connection to the environment through physiology and ecology is merely the local stage on which evolution plays out its current round of evaluating adaptations and their variations. Environments inevitably change over time, and each organism that contributes to another's environment (potential mates and their preferences, predators, parasites) is, of course, itself an evolving lineage that changes over time in response to its biotic and abiotic environments.

All the while, natural selection is encoding a few salient features of these interactions into the genetic programming of each evolving lineage as genes, and their variations are measured relative to current conditions. Today's adaptations build on those which brought success to prior generations in the environment of yesterday. Ghostly reflections of past environments persist within a genome until natural selection overwrites them (often incompletely) by new, more relevant instructions (or until they "decay" through the accumulating noise of unchecked mutation and genetic drift).

And so the genetic programming of any individual organism can be understood as the accumulated, partial reflections of the chain of environment(s) through which its ancestors passed. That cacti have evolved spine-like leaves reflects the water-scarce environments in which their ancestors lived. That these spines are clearly identifiable as modified leaves reveals an overlay on earlier anatomical features, which helped more distant ancestors thrive on dry land rather than in a watery environment of even more distant (earlier) ancestors … and so on. An example of this same point from closer to home is to consider the array of medical problems, from diabetes[40] to allergies, which afflict affluent, twenty-first-century humans living in environments that have changed radically and quickly away from those to which their bodies adapted over millennia.

In sum, through a lens of evolution, no sharp lines distinguish life as something distinct from nonlife in either time or space. We arrived at this perspective by questioning the assumption that life, in terms of the chemical evolution of biomolecules, is more

complex than nonlife; and by perceiving this as an outcome typical of natural selection "filtering" information from the surrounding environment into partial genetic reflections.

The ideas we present here are novel in emphasis, not in content. No evolutionary biologist would deny that natural selection "notices" and "reflects" only a few key features of an evolving lineage's environment, although they might find our language, with its focus on simplification rather than on generation of diversity, unusual. This unusual emphasis emulates the rhetorical device employed by Richard Dawkins in his introduction to *The Extended Phenotype*: the Necker Cube is an optical illusion comprising

> a line drawing which the brain interprets as a three-dimensional cube. But there are two possible orientations of the perceived cube, and both are equally compatible with the two-dimensional image on the paper … if we look for several seconds the cube "flips over" in the mind.[41]

The evidence remains unchanged; the lines of the drawing are constant and, in Dawkins's words, "*neither of the two perceptions of the cube is the correct or 'true' one*."[42]

But Dawkins argues, as do we, that a deliberate shift allows us to return to long-accepted, orthodox evidence with fresh perspective, generating new and constructive questions. In our case, we do not deny that the process of natural selection, at the level of organisms or chemical materials, contains elements that may reasonably support a view of "life as greater complexity" or "life as simplification." But we also believe that given the overwhelming emphasis among present researchers on "life as complexity," the latter possibility—"life as simplification"—may hold considerable untapped potential for advances in both scientific research and theological thought. In the remaining two sections here, we demonstrate the common roadblocks that our perspective of "life as simplification" may help to alleviate, and we gesture to the new horizons of origin-of-life questions that our perspective shift invites.

Scientific Reflections

Traditional academic disciplines are responsible for developing most of the ideas we present above.[43] The interconnectedness of organisms with each other and their environment is literally the definition of ecology,[44] and a subcommunity of twenty-first-century evolutionary biologists has developed significant early concepts of niche construction[45] by which organisms influence their environments rather than the other way around. Another subcommunity of evolutionary biologists has, over a similar period, pioneered a clearer perspective of life's continuity over time,[46] the subject of our prior Part I. Scientific implications for the future of these ideas therefore lie not in their novelty, but in their further development through integration of separate disciplines and subdisciplines. While such integration can help research anywhere along the trajectory of life's history, it becomes increasingly necessary as the subject of our focus becomes increasingly distant in time and space from the world we experience.

The community of researchers who study our planet's history more than about one billion years ago, for example, find that their questions and insights defy neat, academic boundaries of knowledge. It is not that the process of evolution, including the local stage of evolutionary ecology, was any different: the argument for life's continuity over time and space argues quite the opposite. Rather, life's interconnectedness with itself and the nonliving universe is absolutely required to explain major events leading to the planet and biosphere we encounter today. Such events include the evolutionary tightening of interconnectedness between some single-celled organisms that we know today as multicellularity, an innovation from which both plants and animals later emerged.[47] Multicellularity built, in turn, from the prior evolutionary debut of a new type of cell, eukaryotes, which partition the contents of their cell membrane into specialized membrane-bound subcompartments (organelles): genetic material within the cell nucleus, respiration within mitochondria, and photosynthesis within chloroplasts.[48] The evidence is now overwhelming that eukaryotes represent an evolutionary tightening of an ecological connection between multiple, unrelated cell types: "endosymbiosis," whereby prokaryotes from different lineages evolved into a single, codependent community.[49] In looking at a eukaryotic cell, we are seeing the distant offspring of independent cells whose survival and reproduction depended on living as a community.

In recent years, evidence has been mounting that both the advent of eukaryotes and the multicellular organisms which emerged among them reflect prior niche construction on a planetary scale. Around 2.5 bya, our planet underwent a one-way transformation,

from an atmosphere dominated by carbon dioxide to one with a significant presence of free oxygen (O_2). This planet-changing event was caused by the evolutionary emergence and spread of oxygen-producing photosynthesis by a lineage we know today as cyanobacteria. The new physiology introduced into ancient ecosystems a highly reactive (and therefore toxic) gas to most other lineages, which had, of course, evolved in its prior absence. At least one such lineage, the proteoalphabacteria, "counter-evolved" to harness this oxygen in a controlled burn of sugars—aerobic respiration—which produces far more energy than the previously universal anaerobic respiration (and still found conserved throughout fundamental biochemistry of most living organisms).[50] Somewhere within *this* lineage a further population evolved into the mitochondria of eukaryotes,[51] a sublineage of which later evolved to absorb the photosynthetic cyanobacteria as well, leading to what we know today as plants.[52] Despite these evolutionary success stories, changing an entire planet's atmosphere so dramatically led to global ecological upheaval and a resulting mass extinction, dwarfing that (much later) of the dinosaurs.[53] Upheaval came not only from the direct challenge of dealing with oxygen, but also from drastic climate change, because climate reflects the gaseous composition of a planet's atmosphere.[54]

It is difficult to read this account of Earth's early history without perceiving a continuous chain of cause and effect, reflections back and forth, between biology and the nonliving environment over both space and time. What has been discovered thus far required a fluid exchange of knowledge between geoscience and biology. This merging of different areas of academic expertise, we argue, is our best guide to where future insights await. Indeed, geoscience (and through it biology) is finding an ever-increasing role for comparison with neighboring planets in our solar system, such as Mars and Venus, that are (as far as we know) devoid of life. As the features that distinguish Earth from other planets reveal themselves more and more as consequences of life, not causes (prerequisites) for life, the traditional disciplines of planetary astronomy and geoscience are melding into a new composite known as planetary science:[55] something greater than the sum of its parts as each side informs the other.

Not only do biology and geoscience of our planet's early history advance through input from those who can describe Mars, but Martian exploration learns from geoscience and biology what to consider in evaluating the past or present existence of life there.[56] It is no coincidence that the Mars Curiosity mission is exploring Gale crater, where rocks date back through (and therefore reveal important information about) the planetary changes that we just described for Earth. Indeed, the rover vehicle is approaching rocks thought to be 4 bya—matching current estimates for the earliest presence for biological activity that we recognize on Earth.[57] Findings at this interface go onwards to inform other astronomers interested in biosignatures that could indicate the presence of life on distant exoplanets[58]—while their observations of younger star systems guide our understanding of the solar system formation[59] which laid the foundations for life's emergence.

Previously, we described astrobiology as an open network between scientists of different disciplines (rather than a subject mastered by any individual) that widens and improves the study of abiogenesis. But astrobiology is more accurately defined as "the study of the origin, evolution, distribution, and future of life in the universe"[60] because these topics are so interdependent. It would therefore have been more accurate to describe the study of abiogenesis as dissolving into a bigger picture of astrobiology, to the benefit of all concerned. And so our title's promise about "Rethinking Abiogenesis" speaks here, as in Part 1, of a shift in research patterns toward interdisciplinary networks that connect scientists from different backgrounds into a shared, intellectual community. It expands the sort of fluid exchange of knowledge by which nuclear physicists who study the evolution of stars share their understanding of why hydrogen, carbon, oxygen, and nitrogen are the most abundant chemicals in the universe with biologists who notice that they represent the bulk of life's chemistry. It is only from a distinctly older and narrower disciplinary perspective that an evolutionary biologist could describe stars as "more or less haphazardly arranged"! For what it is worth, stars tend to become more chemically complex both as they age and as successive generations of stars "die" and "give birth" to one another,[61] although the relationship is not as simple as once believed.[62]

This observation brings us to the one major idea we have presented here but not yet discussed for scientific implications: biological evolution as a process of simplification. Again, we want to emphasize here that it is not the content, but the emphasis, of

our argument that is new. Current understanding of stellar ("abiotic") evolution implies that in selecting just a handful of lower-mass chemical elements, biological evolution was working in the opposite direction from abiotic processes of increasing chemical complexity—aligning with similar observations we made above for nucleobases and amino acids. But like Dawkins's Necker Cube, we argue that a subtle shift in perception from life-as-complexity to life-as-simplification helps us approach ongoing questions of origins research in new and productive ways.

For example, one of the biggest remaining challenges in understanding life's earliest evolutionary steps is the following: how did the molecules which form a foundation for all life find one another within a diverse chemical "soup"? In more formal language, how did life's chemistry simplify into homopolymers (such as DNA and protein) from a mixture containing nucleobases, amino acids, and thousands of other "organics"? And how did it do so when unguided chemical reactions tend to produce messy, complicated heteropolymers, tar and/or cross-reactions? The answer we offer above is natural selection, in this case applied to chemical entities. But if, by natural selection, we think only of the differential survival of different organisms, then our proposed answer comes dangerously close to begging the question: life comes into being by the process of life. The escape from this apparent circularity, we argue, comes not from erecting a hard line between "chemical evolution" and "biological evolution," but from noting that if living organisms are inseparable from the nonliving universe, then so is the process of natural selection. As we wrote in Part 1,

> The process of natural selection is not limited to acting only on what we take to be alive. [It] applies to anything that leaves behind copies of itself which vary in ways that are inherited from one generation to the next. The necessary outcome is, of course, that those variations, which for any reason leave behind more copies than their counterparts, are likely to form the basis for further variation as time flows forward. This process applies to chemicals ... chemical evolution seems increasingly important to investigate how life-as-we-know-it came into existence.[63]

From the perspective of life as simplification, we can observe that many corners of the universe exist where a throughput of energy leads to material, chemical simplification. Energy from sunlight can distill fresh water from salty oceans, and energy from Brownian motion can cause a crystal comprising one type of molecule to accrete layers of itself from a complex aqueous solution. In each case, a careful observer could frame the process as one of simplification within an environment of greater complexity. In both cases, it is clear that the components and processes are all part of a seamless whole. Crystallization and evaporation are each processes that reflect the complex, whole environment in which they occur, in the sense that a few key aspects of that complex environment produce the phenomena. From this perspective, life clearly aligns itself with nonlife.

Do not let us underrepresent the enormity of the questions that remain. But for future progress, we might join those who look further into minerals and other examples of naturally occurring "simplifications" of messier chemistry, looking to find replication and selection processes that result in our kind of organics. Interestingly, there probably were not very many different kinds of minerals on the early Earth. According to some accounts, most of mineral diversity seems to be a product or byproduct of life.[64] If these accounts are correct, then you might say that there is *one* area of chemistry where life has increased the complexity of its surrounding environment over time, diversifying the repertoire of minerals occurring on our planet. Or you might say that the regular, repeating arrays of atoms which constitute a mineral are simpler and more ordered than the universe from which they are drawn—that life enlarges and speeds up other ways in which pockets of the universe distill simplicity from complexity.

Rather than speculate further, let us close an advocacy for life's continuity with the nonliving universe by pointing out that the beauty of this sort of interdisciplinary science is how it ends up speaking to *all* of life (and all of the nonliving universe!). Much of what we think we know about our own atmospheric changes under rapidly increasing levels of carbon dioxide involves the same science that explains, and is fed by, studies of both Earth's early history and that of Mars and Venus—our neighbor planets. And that, in turn, has provoked some fascinating ideas about the way(s) in which life may, in fact, stabilize geochemical, atmospheric, and even temperature variations that would occur on a nonliving planet.[65]

Theological Reflection

The scientific narrative we have presented may seem to be devoid of reference to God and therefore equivalent to an atheistic perspective of the origin of life.

However, it is our perspective that the continuum of evolutionary development in space and time from the abiotic to biotic realms is a trademark of God's handiwork and an invitation to describe and appreciate the nature of such handiwork with greater precision and creativity.[66] God's work is revealed to us through its consistency as well as its awesome grandeur. Observations of how our universe developed are usually influenced by the observer's metaphysical presupposition. Only when consensus is obtained among scientists of different faiths is there confidence in the result.[67] Here, we argue that regardless of a reader's personal religious perspective or beliefs about the content of the Creation narrative, our emphasis on abiogenesis as a continuously unfolding, relational process of simplification helps to circumvent common theological arguments and to generate new linguistic and thematic possibilities with which to speak of God's presence in the created world.

One theological implication of our perspective on abiogenesis lies in the area of apologetics. It is not uncommon for Christians to declare that there must be a God since there is no other explanation for the origin of life. On the other hand, it is also not uncommon for skeptics or atheists to declare that since abiogenesis appears to be plausible, then there is no need for God. To both sides of such arguments, it would appear that a plausible scenario for abiogenesis is a setback for apologists and support for atheists. Let us be clear that such sentiments reflect common fallacies. The claim that "there is no scientific explanation, therefore there is a God" is the fallacy known as "God of the Gaps." It is a fallacy due to the incompleteness of scientific knowledge. Future scientific investigation might discover such an explanation and it is difficult to confidently show that no such explanation is possible.

The claim that "there is a scientific explanation, therefore there is no God," is, in turn, the fallacy of univocity.[68] The thirteenth-century concept of God's single essence of being has been distorted in our modern era as requiring a sole level of explanation. Scientific and theological explanations are thought to be mutually exclusive. This is a fallacy since God might be the creator of all things, whether or not we have attained a scientific understanding.[69] Responses to atheistic claims of this type should therefore not deny the premise (that there is a scientific explanation) but rather the logic (that such explanation endangers the power of God). Finally, a robust tradition of Christian scholarship illustrates the way in which our description of creation as a continuous, seamless, unfolding process is quite compatible with modern textual interpretation of Genesis and other biblical accounts.[70] On these grounds and more, our interpretation of abiogenesis should conjure little concern for apologetics. Rather, a clearer understanding of how God may have created life from nonlife through evolutionary mechanisms can enhance our awe and wonder at the glory of God's creative power.

Finally, our account of natural selection as a continuous process of simplification is consistent with accounts of creation as "order out of chaos" found in Genesis 1 and 2. See, for example, Welker's compelling argument that the text of Genesis leads to a view of creation not as "an ultimate process of being produced by a transcendent reality and absolute dependence on that reality,"[71] but as "the construction and maintenance of associations of different, interdependent creaturely realms."[72] Multiple times in Genesis, God engages in acts of "evaluative perception" ("And God saw that what had been created was good"—Gen. 1:4a, 10b, 12b, 18b, 21b, 25b, 31a), in which observation of one level of creation influences God's following actions.[73] Additionally, God allows humans to collaborate in the "naming of all cattle, the birds of heaven and all animals of the field" (Gen. 2:19–20),[74] suggesting that God's creative process includes an intention for creatures to "order" their world into cultural categories and meanings.[75] In other words, a close reading of Genesis reveals that elements of reactivity, iteration, and stepwise increase in organization (decrease in chaos) are embedded in the biblical narrative of creation. The simplification of life through natural selection, then, could reasonably be viewed as one mechanism through which God continually brings nature, and the relationships within it, into greater "order." ✞

Notes

[1]Emily Boring, J. B. Stump, and Stephen Freeland, "Rethinking Abiogenesis: Part 1, Continuity of Life through Time," *Perspectives on Science and Christian Faith* 72, no. 1 (2020): 25–35, https://www.asa3.org/ASA/PSCF/2020/PSCF3-20BoringStumpFreeland.pdf.

[2]Britannica, s.v. "Aristotle: Philosophy of Mind," accessed August 28, 2020, https://www.britannica.com/biography/Aristotle/Philosophy-of-mind.

[3]Arthur Lovejoy, *The Great Chain of Being: A Study of the History of an Idea* (Cambridge, MA: Harvard University Press, 1936).

[4]Charles Bonnet, *La palingénésie philosophique : ou Idées sur l'état passé et sur l'état futur des êtres vivans : ouvrage destiné à servir de supplément aux derniers écrits de l'auteur et qui contient principalement le précis de ses recherches sur le christianisme* (Geneva, Switzerland: Claude Philibert, 1769), https://archive.org/details/lapalingnsiephil02bonn; First English translation: ____, *Philosophical and Critical Inquiries concerning Christianity*, trans. John L. Boissier (Philadelphia, PA: W.W. Woodward, 1803), http://archive.org/details/philosophicalan00bonngoog.

[5]Stephen J. Gould, "Darwin's Dilemma: the Odyssey of Evolution," in *Ever Since Darwin: Reflection on Natural History* (New York: W.W. Norton and Company, 1979).

[6]David Hanke, "Teleology: The Explanation That Bedevils Biology," in *Explanations: Styles of Explanation in Science*, ed. John Cornwell (Oxford, UK: Oxford University Press, 2004), 143–55; Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe without Design* (New York: W. W. Norton, 1996), 1–2; and Daniel C. Dennett, *Darwin's Dangerous Ideas: Evolution and the Meanings of Life* (New York: Touchstone, 1995).

[7]Stephen J. Gould, *Wonderful Life: The Burgess Shale and the Nature of History* (New York: W. W. Norton, 1990); and T. Ryan Gregory, "Understanding Natural Selection: Essential Concepts and Common Misconceptions," *Evolution: Education and Outreach* 2, no. 2 (2009): 156–75, https://doi.org/10.1007/s12052-009-0128-1.

[8]American Chemical Society, "What Is Inorganic Chemistry?," accessed August 27, 2020, https://www.acs.org/content/acs/en/careers/college-to-career/areas-of-chemistry/inorganic-chemistry.html.

[9]Robert Shapiro, *Origins: A Skeptic's Guide to the Creation of Life on Earth* (Manitou Springs, CO: Summit Books, 1986), 63.

[10]Dawkins, *The Blind Watchmaker,* 1–2.

[11]Dawkins himself would agree that a "subjective choice of definition" influences our perception of whether a process is simple or complex. In *The Extended Phenotype,* he describes how different types of scientists (geneticists, embryologists, ethologists) focus on different levels of phenotypic expression as the "end link in a chain of causation" (Richard Dawkins, *The Extended Phenotype: The Long Reach of the Gene* [Oxford, UK: Oxford University Press, 1989], 230–31). This arbitrary choice in turn guides the hypotheses the scientist makes and the level of complexity which we feel compelled to "explain" in order to account for a phenotypic expression.

[12]Jakob R. Mosumgaard et al., "Coupling 1D Stellar Evolution with 3D-Hydrodynamical Simulations On-the-Fly II: Stellar Evolution and Asteroseismic Applications," *Monthly Notices of the Royal Astronomical Society* 491, no. 1 (2020): 1160–73, https://doi.org/10.1093/mnras/stz2979; Garrett Somers, Lyra Cao, and Marc H. Pinsonneault, "The SPOTS Models: A Grid of Theoretical Stellar Evolution Tracks and Isochrones for Testing the Effects of Starspots on Structure and Colors," *The Astrophysical Journal* 891, no. 1 (2020), https://iopscience.iop.org/article/10.3847/1538-4357/ab722e; and V. Silva Aguirre et al., "The Aarhus Red Giants Challenge I: Stellar Structures in the Red Giant Branch Phase," *Astronomy and Astrophysics* 635 (2020), https://doi.org/10.1051/0004-6361/201935843.

[13]Geraldine J. Peters and Raphael Hirschi, "The Evolution of High-Mass Stars," in *Planets, Stars and Stellar Systems*, ed. Terry D. Oswalt and William C. Keel (Dordrecht, The Netherlands: Springer, 2013), 447–84, https://doi.org/10.1007/978-94-007-5615-1_9.

[14]Jamie Elsila et al., "Meteoritic Amino Acids: Diversity in Compositions Reflects Parent Body Histories," *ACS Central Science* 2, no. 6 (2016): 370–9, https://doi.org/10.1021/acscentsci.6b00074.

[15]Michael P. Callahan et al., "Carbonaceous Meteorites Contain a Wide Range of Extraterrestrial Nucleobases," *Proceedings of the National Academy of Sciences* 108, no. 34 (2011): 13995–98, https://doi.org/10.1073/pnas.1106493108.

[16]Robert Shapiro, "A Simpler Origin for Life," *Scientific American* 296, no. 6 (2007): 46–53, https://doi.org/10.1038/scientificamerican0607-46; and A. G. Cairns-Smith, *Seven Clues to the Origin of Life* (Cambridge, UK: Cambridge University Press, 1985).

[17]When it comes to amino acids and nucleotides, only the former use sulfur and only the latter use phosphorus: this distinction was the basis of Hershey and Chase's 1969 Nobel Prize for demonstrating that genes (not proteins) carry genetic inheritance.

[18]Martin Asplund et al., "The Chemical Composition of the Sun," *Annual Review of Astronomy and Astrophysics* 47, no. 1 (2009): 481–522, https://doi.org/10.1146/annurev.astro.46.060407.145222.

[19]Ninja Braukmüller et al., "The Chemical Composition of Carbonaceous Chondrites: Implications for Volatile Element Depletion, Complementarity and Alteration," *Geochimica et Cosmochimica Acta* 239 (2018): 17–48, https://doi.org/10.1016/j.gca.2018.07.023.

[20]The word "simplicity" and its intuitive inverse "complexity" carry meanings that shift as we move from everyday speech into the specialized academic discipline of information theory, where, for example, two strings of characters of equal length may be defined as carrying identical information but different complexity, depending on how easily they compress into shorter representations. A string of 10 "A"s could be compressed into "10xA" whereas a string of random letters might be incapable of compression at all: both carry 10 bits of information but the latter comprises higher complexity. In this disciplinary parlance, genetic sequences produced by natural selection hover around a mid-point between the two extremes: too simple and they could not convey the informational content necessary to build metabolism; too complex and they could not contain the patterns by which molecular machinery decodes these instructions into metabolism. This specialized meaning of complexity bears directly upon the arguments we present and their relationship to faith through deep themes that link life, differential persistence over time, and concepts of "meaning" that science might recognize; however, we leave that for future, careful exploration in order to focus here on the least nuanced (simplest?) meaning of the term "simplicity" that enables us to develop our argument.

[21]C. Dresser and J. O. Cooke, "Industrial Standardization in the Mechanical Engineering Industry," *Proceedings of the Institution of Mechanical Engineers* 124, no. 1 (1933): 737–42, https://doi.org/10.1243/PIME_PROC_1933_124_022_02.

[22]Richard Dawkins, "God's Utility Function," *Scientific American* (1995): 80–85, https://richarddawkins.net/1995/11/gods-utility-function/.

[23]Eric J Chaisson, "The Natural Science underlying Big History," *The Scientific World Journal* (2014): Article ID 384912, http://dx.doi.org/10.1155/2014/384912.

[24]Matthias Granold et al., "Modern Diversification of the Amino Acid Repertoire Driven by Oxygen," *Proceedings of the National Academy of Sciences* 115, no. 1 (2018): 41–46; Melissa Ilardo et al., "Extraordinarily Adaptive Properties of the Genetically Encoded Amino Acids," *Scientific Reports* 5, no. 1 (2015): Article number 9414, https://doi.org/10.1038/srep09414; Melissa Ilardo and Stephen Freeland, "Testing for Adaptive Signatures of Amino Acid Alphabet Evolution Using Chemistry Space," *Journal of Systems Chemistry* 5, no. 1 (2014): Article number 1, https://doi.org/10.1186/1759-2208-5-1; and Gayle K. Philip and Stephen J. Freeland, "Did Evolution Select a Nonrandom 'Alphabet' of Amino Acids?," *Astrobiology* 11, no. 3 (2011): 235–40, https://doi.org/10.1089/ast.2010.0567.

[25]Eors Szathmáry, "What Is the Optimum Size for the Genetic Alphabet?," *Proceedings of the National Academy of Sciences* 89, no. 7 (1992): 2614–18, https://doi.org/10.1073/pnas.89.7.2614; and Dónall A. Mac Dónaill, "Why Nature Chose A, C, G and U/T: An Error-Coding Perspective of Nucleotide Alphabet Composition," *Origins of Life and Evolution of the Biosphere* 33, no. 4–5 (2003): 433–55, https://doi.org/10.1023/a:1025715209867.

[26]Albert Eschenmoser, "Chemical Etiology of Nucleic Acid Structure," *Science* 284, no. 5423 (1999): 2118–24, https://doi.org/10.1126/science.284.5423.2118.

[27]Traditionally, the term "natural selection" is used exclusively within the biological realm. Our extension of the term to the abiotic (and therefore prebiotic) realm reflects our suggestion that there exists a continuum of the core principles underlying natural selection into a larger set of related phenomena. In biology, natural selection is based on reproduction with genetic variation, and subsequent differential reproductive success. Beyond biology, we see other, somewhat similar processes of imperfect replication with consequent differential persistence. For example, a mineralogist and planetary scientist peer reviewer for this manuscript noted "the reason why arkose sandstone is found only in dry environments [is] in a sense ... natural selection ... some materials are less robust in wet environments, so they only persist over time in arid conditions."

[28]For example, a single, small protein enzyme sequence of just 100 amino acids, each drawn from an "alphabet" of size 20 permits 20^{100} (larger than 10^{130}) possibilities; for an equivalent length gene sequence built from an alphabet of four nucleobases, the number of possible configurations is larger than 10^{60}. By way of comparison, there are estimated to exist approximately 10^{20} stars in the universe. It is virtually impossible that any one specific gene or protein sequence could form by monomers bumping into one another at random.

[29]Geoff A. Parker and Leigh W. Simmons, "Evolution of Phenotypic Optima and Copula Duration in Dungflies," *Nature* 370, no. 6484 (1994): 53–56, https://doi.org/10.1038/370053a0.

[30]R. W. Elner and Roger N. Hughes, "Energy Maximization in the Diet of the Shore Crab, *Carcinus maenas*," *Journal of Animal Ecology* 47, no. 1 (1978): 103–16, https://doi.org/10.2307/3925.

[31]Theodosius Dobzhansky, "Nothing in Biology Makes Sense except in the Light of Evolution," *American Biology Teacher* 35, no. 3 (1973): 125–29, https://doi.org/10.2307/4444260.

[32]Those who study larger organisms, such as animals, often think more in terms of meiotic recombination, but this evolutionary innovation can only mix and match variations that were, ultimately, generated by mutation: indeed, the mechanism of recombination itself introduces new possibilities for types of mutation. See, for example, Miguel Arenas et al., "Mutation and Recombination in Pathogen Evolution: Relevance, Methods and Controversies," *Infection, Genetics and Evolution* 63 (2018): 295–306, https://doi.org/10.1016/j.meegid.2017.09.029.

[33]For further discussion of how environmental information is injected into the system, see Randy Isaac, "Review of *Introduction to Evolutionary Informatics* by Robert J. Marks II, William A. Dembski, and Winston Ewert," *Perspectives on Science and Christian Faith* 69, no. 2 (2017): 99–104, https://www.asa3.org/ASA/PSCF/2017/PSCF6-17Isaac.pdf.

[34]Dawkins, *The Extended Phenotype*.

[35]Ibid.

[36]Charissa de Bekker et al., "Species-Specific Ant Brain Manipulation by a Specialized Fungal Parasite," *BMC Evolutionary Biology* 14, no. 1 (2014): Article number 166, https://doi.org/10.1186/s12862-014-0166-3.

[37]It might seem that the analogy of genomes shaped by natural selection resembling photographs breaks down at this point or, more importantly, that the idea that organisms simplify their nonliving environments breaks down. Far from it. The reader need take only a moment to think about some of the ways in which photographs do, in fact, go on to influence the "real world"—from mass media images that influence a national mood and its manifestations, to personal, idiosyncratic vacation photos that trigger a conversation. The analogy and the point it represents hold up and nothing stops the photograph from being a simplified reflection of the objects it depicts.

[38]Boring, Stump, and Freeland, "Rethinking Abiogenesis: Part 1."

[39]For a more detailed discussion of "seamless," including the possibility for important feedback loops, see the exchange between Sy Garte, "A Greater Degree of Discontinuity," *Perspectives on Science and Christian Faith* 72, no. 3 (2020): 188–89, https://www.asa3.org/ASA/PSCF/2020/PSCF9-20Garte.pdf; and our authors, "'Rethinking Abiogenesis' Authors Respond," *Perspectives on Science and Christian Faith* 72, no. 3 (2020): 190–91, https://www.asa3.org/ASA/PSCF/2020/PSCF9-20Boring.pdf.

[40]L. Ségurel et al., "Positive Selection of Protective Variants for Type 2 Diabetes from the Neolithic Onward: A Case Study in Central Asia," *European Journal of Human Genetics* 21, no. 10 (2013): 1146–51, https://doi.org/10.1038/ejhg.2012.295.

[41]Dawkins, *The Extended Phenotype*, 1.

[42]Ibid.

[43]While the disciplines addressed in this section are necessarily secular in nature, our perspective is that the entire universe is God's creation. By his Word, all things were created through a seamless continuum of processes in space and time. The observation and description of these processes are the same for atheists and theists, though the former discount the underlying source that theists affirm.

[44]*Merriam-Webster Dictionary*, s.v. "ecology," accessed August 29, 2020, https://www.merriam-webster.com/dictionary/ecology.

[45]John Odling-Smee, Kevin Laland, and Marcus Feldman, *Niche Construction: The Neglected Process in Evolution* (Princeton, NJ: Princeton University Press, 2003).

[46]Kevin De Queiroz, "Species Concepts and Species Delimitation," *Systematic Biology* 56, no. 6 (2007): 879–86, https://doi.org/10.1080/10635150701701083.

[47]Philip C. J. Donoghue and Jonathan B. Antcliffe, "Origins of Multicellularity," *Nature* 466, no. 7302 (2010): 41–42, https://doi.org/10.1038/466041a.
[48]Richard K. Grosberg and Richard R. Strathmann, "The Evolution of Multicellularity: A Minor Major Transition?," *Annual Review of Ecology, Evolution, and Systematics* 38 (2007): 621–54, https://doi.org/10.1146/annurev.ecolsys.36.102403.114735.
[49]William F. Martin, Sriram Garg, and Verena Zimorski, "Endosymbiotic Theories for Eukaryote Origin," *Philosophical Transactions of the Royal Society B* 370, no. 1678 (2015), https://doi.org/10.1098/rstb.2014.0330.
[50]Mauro Degli Esposti, "Bioenergetic Evolution in Proteobacteria and Mitochondria," *Genome Biology and Evolution* 6, no. 12 (2014): 3238–51, https://doi.org/10.1093/gbe/evu257.
[51]Matteo P. Ferla et al., "New rRNA Gene-Based Phylogenies of the *Alphaproteobacteria* Provide Perspective on Major Groups, Mitochondrial Ancestry and Phylogenetic Instability," *PLoS ONE* 8, no. 12 (2013): e83383, https://doi.org/10.1371/journal.pone.0083383.
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[53]Malcolm S. W. Hodgskiss et al., "A Productivity Collapse to End Earth's Great Oxidation," *Proceedings of the National Academy of Sciences* 116, no. 35 (2019): 17207–12, https://doi.org/10.1073/pnas.1900325116.
[54]Robert E. Kopp et al., "The Paleoproterozoic Snowball Earth: A Climate Disaster Triggered by the Evolution of Oxygenic Photosynthesis," *Proceedings of the National Academy of Sciences* 102, no. 32 (2005): 11131–36, https://doi.org/10.1073/pnas.0504878102.
[55]Wikipedia, s.v. "Planetary Science," https://en.wikipedia.org/wiki/Planetary_science.
[56]NASA, "Mars 2020 Mission Overview," accessed August 28, 2020, https://mars.nasa.gov/mars2020/mission/overview/; and Pamela Conrad, "A Tale of Two (Cities) Planets: What Earth and Mars Are Teaching Us about the Evolution of Habitable Worlds," January 21, 2016, accessed August 27, 2020, https://carnegiescience.edu/events/lectures/dr-pan-conrad-tale-two-cities-planets-what-earth-and-mars-are-teaching-us-about.
[57]Emmanuelle J. Javaux, "Challenges in Evidencing the Earliest Traces of Life," *Nature* 572, no. 7770 (2019): 451–60, https://doi.org/10.1038/s41586-019-1436-4.
[58]Edward W. Schwieterman et al., "Exoplanet Biosignatures: A Review of Remotely Detectable Signs of Life," *Astrobiology* 18, no. 6 (2018): 663–708, https://www.liebertpub.com/doi/full/10.1089/ast.2017.1729.
[59]For example, Joshua N. Winn and Daniel C. Fabrycky, "The Occurrence and Architecture of Exoplanetary Systems," *Annual Review of Astronomy and Astrophysics* 53, no. 1 (2015): 409–47, https://doi.org/10.1146/annurev-astro-082214-122246.
[60]G. Scott Hubbard, "What is Astrobiology?," October 1, 2008, accessed August 29, 2020, https://www.nasa.gov/feature/what-is-astrobiology.
[61]Nikolay Kacharov et al., "Stellar Populations and Star Formation Histories of the Nuclear Star Clusters in Six Nearby Galaxies," *Monthly Notices of the Royal Astronomical Society* 480, no. 2 (2018): 1973–98, https://doi.org/10.1093/mnras/sty1985.
[62]J. Sánchez Almeida and C. Dalla Vecchia, "The Origin of the Relation between Metallicity and Size in Star-Forming Galaxies," *The Astrophysical Journal* 859, no. 2 (2018): 109–26, https://iopscience.iop.org/article/10.3847/1538-4357/aac086/pdf.
[63]Boring, Stump, and Freeland, "Rethinking Abiogenesis: Part 1," 30.
[64]Robert M. Hazen et al., "Mineral Evolution," *American Mineralogist* 93 (2008): 1693–720, http://www.geo.umass.edu/petrology/PetSem/Hazen_p1693-1720_08_LR.pdf.
[65]Aditya Chopra and Charles H. Lineweaver, "The Case for a Gaian Bottleneck: The Biology of Habitability," *Astrobiology* 16, no. 1 (2016): 7–22, https://doi.org/10.1089/ast.2015.1387.
[66]George L. Murphy, *The Trademark of God* (Wilton, CT: Morehouse-Barlow, 1986).
[67]Jitse van der Meer, "Background Beliefs, Ideology, and Science," in *Perspectives on Science and Christian Faith* 65, no. 2 (2013): 87–103, https://www.asa3.org/ASA/PSCF/2013/PSCF6-13vanderMeer.pdf.
[68]Mark A. Noll, "Evangelicals, Creation, and Scripture: Legacies from a Long History," *Perspectives on Science and Christian Faith* 63, no. 3 (2011): 147–58, https://www.asa3.org/ASA/PSCF/2011/PSCF9-11Noll.pdf.
[69]See, for example, Kathryn Tanner's robust argument for a radically transcendent "God beyond kinds," who is responsible for all aspects of creation—causes, effects, and intervening processes at once—while leaving the mechanisms of such processes open for scientific explanation. Kathryn Tanner, "Is God in Charge?," in *Essentials of Christian Theology*, ed. William C. Placher (Louisville, KY: Westminster John Knox Press, 2003), 120.
[70]Deborah Haarsma and Loren Haarsma, *Origins: Christian Perspectives on Creation, Evolution, and Intelligent Design* (Grand Rapids, MI: Faith Alive Christian Resources, 2011).
[71]Michael Welker, *Creation and Reality* (Minneapolis, MN: Fortress Press, 2000) 8.
[72]Ibid., 11.
[73]Ibid.
[74]Ibid., 12.
[75]Importantly, the granting of some power over the naming and maintenance of creation to human beings need not come at the cost of God's own total omnipotence. For a thorough defense, see Tanner, "Is God in Charge?," 118–29.

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Environment

STEWARDS OF EDEN: What Scripture Says about the Environment and Why It Matters by Sandra L. Richter. Downers Grove, IL: IVP Academic, 2020. 168 pages. Paperback; $22.00. ISBN: 9780830849260.

As an ecologist, I have read many articles and books about creation care over the last few decades. Some of these were written by scientists, some by theologians, and some by philosophers. As a result, I wondered what new perspectives Sandra Richter, a noted Hebrew Bible scholar, might offer in her recent, and highly praised, book, *Stewards of Eden*.

Creation care is a topic near and dear to my heart. However, teaching at a Christian liberal arts college in the Midwest, it is often challenging to encourage evangelical students to transcend their preconceived notions about environmental stewardship. They often think that it's not something that Christians should worry about. Many believe that it's strictly an area of concern for secular liberals. Would Richter's book be helpful? Could her words connect with some of the students that I struggle to reach?

A quick glance at some of the chapter topics, such as "The Domestic Creatures Entrusted to *'ādām*," "The Wild Creatures Entrusted to *'ādām,*" and "Environmental Terrorism," piqued my interest. These aren't topics typically addressed as entire chapters in similar books. There was an absence of chapters specifically detailing different forms of environmental degradation, the history of the environmental movement, and Christian motivations for creation care. Richter does touch upon these topics, but her organization and focus is distinctly different from other texts.

The lion's share of *Stewards of Eden* is a deep dive into the Hebrew Bible, specifically the Torah, shining light on our Creator's covenant with and expectations of his people. Richter begins at the beginning, with Genesis as a "blueprint for creation," establishing identities, relationships, and responsibilities. She describes how the rebellion of "God's chosen stewards has consigned all under their authority to frustration and death." This sets the stage for the establishment of Yahweh's law, which gives life to those who obey.

As we, predominantly nonagrarian people, live out our lives, it is tempting to skim over the aspects of the law recorded in the Torah that are devoted to care for the land and animals, and often even care for the poor. However, Richter brings these subjects into sharp focus in the several chapters of her book. In particular, Deuteronomy and Leviticus are used to show the reader that proper care for creation was an important aspect of the law given to the Israelites. Neglect or misuse of the land and its human and nonhuman inhabitants brought judgment and hardship.

Using modern case studies, Richter shows that, by extension, the same principles are in operation today. For example, she contrasts modern factory farming of animals with care of domestic beasts prescribed by Yahweh's law. The Old Testament laws specified "a Sabbath's rest, a share of the harvest, humane treatment," and "slaughter with dignity and compassion" for domestic animals. Failure to follow a modern-day equivalency of these laws results in not only dreadful "living" conditions for the animals, but concentrations of animal wastes that pollute our water, antibiotic resistant microbes, and the inability for small family farms to remain economically viable.

As a scholar of the ancient Near East, Richter also brings interesting historical perspectives into the narrative. During times of warfare, invading armies often killed wildlife, razed vineyards, and cut down fruit trees. These tactics terrorized and demoralized the local population, as they negatively impacted the land's ability to support its inhabitants for generations. The Israelites were specifically instructed not to employ these strategies, even if it would bring short-term gain. Again, using modern examples, she makes a case that Yahweh's life-giving laws against wanton environmental destruction, even for national security, still have relevance.

Although her strengths are most apparent in chapters focused on the Old Testament, Richter rounds out her book with a discussion of the hope realized in the redeeming work of Christ, work that extends to all of creation. This good news comforts us as we groan in anticipation for the day of the Lord. I appreciate the amount of space she dedicates to the discussion of nature in apocalyptic literature, as a counterpoint to the belief that the good creation will be reduced to a pile of ash by its Creator. Continued care of creation while we yearn for restoration is part of our calling. This good news should inspire us to action.

In *Stewards of Eden*, Richter aptly uses her expertise to support the thesis that "scripture speaks to this topic [environmental stewardship] repeatedly and systematically" and that it is "*not* alien or peripheral to the message of the gospel." There is a lot in this slim volume. Richter is specific and carefully references her statements, but she leaves enough narrative "space" that the lay reader will remain engaged. Her appendix and notes are helpful for those wanting to take action and/or learn more.

As a person already interested in this topic, I found her ability to link modern environmental concerns to ancient Hebrew law fascinating, and I am inspired to explore further. Those interested in the intersection of scripture and creation care should consider adding *Stewards of Eden* to their libraries. For those unfamiliar

with or resistant to considering creation care as part of our Christian calling, it may be most fruitful to explore this book, with its end-of-chapter questions, in discussion groups.

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History of Science

RETHINKING HISTORY, SCIENCE, AND RELIGION: An Exploration of Conflict and the Complexity Principle by Bernard Lightman, ed. Pittsburgh, PA: University of Pittsburgh Press, 2019. ix–307 pages, with notes, selected bibliography, and index. Hardcover; $50.00. ISBN: 9780822945741.

First some background to the making of *Rethinking History, Science, and Religion*. This edited collection by Bernard Lightman, Professor of Humanities at York University, Toronto, Canada, and past president of the History of Science Society, is the product of a two-day symposium on "Science and Religion: Exploring the Complexity Thesis," during the International Congress of History of Science and Technology in Rio de Janeiro in 2017. One can consider this to be a companion volume to *The Warfare between Science and Religion: The Idea That Wouldn't Die,* edited by Jeff Hardin, Ronald L. Numbers, and Ronald A. Binzley (Johns Hopkins University Press, 2018).[1]

In one way, *Rethinking History, Science, and Religion* is a focused and daring work. It asks a fundamental question directed at much of contemporary historiography in the field of science-religion relations: if science and religion are not perpetually in conflict, as ever so many historians have claimed over the past fifty years, is complexity a better, if not the best, way to recount the relationship between science and religion? Complexity is the solution first proposed by John H. Brooke in his now classic 1991 text, *Science and Religion: Some Historical Perspectives* (Cambridge University Press).[2] In fact, Lightman dedicates his edited book to John H. Brooke, the leading proponent of complexity.

But what does the "complexity thesis" add to our discussion? Is it really a thesis? Is it a principle? Does it explain or does it rather describe the situatedness and contingency of the science-religion relationship, its cartography, as David Livingstone might say? Is its sole positive feature to discourage us from making facile assumptions about the relationship between science and religion? Or does it simply add another c-word to our vocabulary: complexity instead of contrast, concordance, compatibility, conflict, conversion, complementarity (or harmony)? Brooke has famously said, "There is no such thing as *the* relationship between science and religion. It is what different individuals and communities have made of it in a plethora of different contexts" (p. 321, italics original, *Science and Religion*). That statement certainly invites one to consider a complexity thesis.

Although the role of complexity has been a conversation topic for several years,[3] Lightman wants to gauge the current "pulse of the field." He wishes contributors to test the "complexity principle" in scholarly contexts other than the usual Christian West (often seen as Europe and the USA/Canada), as well as in public spaces. This move invites an additional question: will the complexity thesis be able to provide a coherent narrative, or will it merely give us one contextualized example after another with no perceptible trend to bind them together? If there are many complex stories to tell, then it seems that a master-narrative or pattern would be a pipedream at best.

After an introduction by Bernard Lightman, the book is divided into three sections: Part I: The Local and the Global; Part II: The Media and the Public; and Part III: Historiographies and Theories. The book concludes with "Afterword: The Instantiation of Historical Complexity," written by John Hedley Brooke.

Part I contains four chapters ranging from a local context (chap. 1, "The Stigmata of Ancestry: Reinvigorating the Conflict Thesis in the American 1970s," by Erika Lorraine Milam), to more global ones (chap. 2, "Three Centuries of Scientific Culture and Catholicism in Argentina: A Case Study of Long-Term Trends," by Miguel de Asúa; chap. 3, "Reexamining Complexity: Sayyid Ahmad Khan's Interpretation of 'Science' in Islam," by Sarah A. Qidwai; and chap. 4, "Christian Missionaries, Science, and the Complexity Thesis in the Nineteenth-Century World," by John Stenhouse).

Each of these chapters addresses the complexity thesis with a different focus. Erika Milam argues that the supposed conflicts between science and religion "gained rhetorical traction" by both scientific creationists and die-hard evolutionists because they both denied the complexity of their own origins. Irven DeVore's studies of primate behavior is used as a template to test that thesis. Miguel de Asúa identifies three trends in Argentinean scientific culture: (1) colonial period harmony, (2) nineteenth-century conflict, and (3) twentieth-century indifference. Sarah A. Qidwai calls us to carefully consider the interpretation of science in Islam rather than by Islam in the 1865 self-published commentary by Sayyid Ahmad Khan (1817–1898). John Stenhouse examines whether Ronald Numbers's suggestion that we introduce some mid-scale patterns (or generalizations) such as "naturalization, privatization, secularization, globalization and radicalization," aids us in understanding the complexity of science/religion relationships in the nineteenth century. Stenhouse concludes that a study of missionary science outside the West complicates Numbers's attempt to "simplify

complexity," and does not do justice to missionary practices well into the twentieth century.

Part II contains five chapters examining the role of the media and public response to science/religion discussions and events: chap. 5, "Creating a New Space for Debate: The Monthlies, Science, and Religion," by Bernard Lightman; chap. 6, "Darwin's Publisher: John Murray III at the Intersection of Science and Religion," by Sylvia Nickerson; chap. 7, "The 'Harmony Thesis' in the Turkish Media, 1950–1970," by M. Alper Yalçinkaya; chap. 8, "A Humanist Blockbuster: Jacob Bronowski and the Ascent of Man," by Alexander Hall; and chap. 9, "Teaching Warfare: Conflict and Complexity in Contemporary University Textbooks," by Thomas H. Aechtner.

In summary, these chapters illustrate how insights from the study of print culture, communications studies, and visual studies have broadened our more "familiar grooves" of explanation and deepened our understanding of science and religion.

Part III is to my mind the most stimulating section, one in which some of the leading historians of science and religion present (their) historiographies and theories. It contains four chapters: chap. 10, "Revisiting the Battlefields of Science and Religion: The Warfare Thesis Today," by Ronald Numbers; chap. 11, "From Copernicus to Darwin to You: History and the Meaning(s) of Evolution," by Ian Hesketh; chap. 12, "Scale, Territory, and Complexity: Historical Geographies of Science and Religion," by Diarmid A. Finnegan; and chap. 13, "Conflict, Complexity, and Secularization in the History of Science and Religion," by Peter Harrison.[4]

Focusing on two of the chapters: In a relatively short chapter (a "brisk survey" of eight pages), Numbers explores the factors that contribute to the continued support of the warfare thesis and the "growth of the opposing neo-harmonist point of view" (p. 183). Contemporaries such as Carl Sagan, Francis Crick, Stephen Hawking, William Provine, the New Atheists, and Christian and Muslim fundamentalists such as Ken Ham and Adnan Oktar are considered. Numbers chides scholars who legitimately question the warfare thesis but often do not address popular audiences.

Peter Harrison argues that we need to make complexity intelligible. Although historians are often averse to meta-narratives, he considers them to be both "unavoidable and indispensable." Harrison defends the utility of a master-narrative, at least something that rises above mid-scale patterns (such as those suggested by Ronald Numbers). He appeals to Charles Taylor's view of secularization as one way to begin to address the relation between science and religion. Taylor, for instance, distinguishes between science as cause of religious disbelief and science as a retrospective justification for it. Secularization involves a change in the conditions of belief which Taylor contributes to transformations within Western Christianity.[5]

In "Afterword: The Instantiations of Historical Complexity," John Hedley Brooke reflects on each of the contributed chapters. He provides a concise judgement about complexity:

> Understood neither as a thesis competing with other theses nor as a prescription to seek out complexity for its own sake, but as a heuristic guiding principle for a critical research methodology, it ceases to be trivial and has proven fertile. (pp. 239–40)

Brooke once again restates his earlier view on complexity: it is a "corrective to essentialist and reductionist narratives of conflict," and complexity's primary function is to critique conflict narratives as well as facile harmonizing ones.

For anyone interested in exploring the latest in the historiography of science and religion, read this stimulating and informative book. You will be challenged. Whether the contributors do justice to the central role and character of religion one will have to judge. I for one have my doubts. If we consider our lives as lived to be religion, then religion is not irrelevant to, or in conflict with, or an influential factor on, but rather the very ground for scientific practice.

Notes

[1]See my review in *PSCF* 71, no. 3 (2019): 183–84.
[2]See my essay review, "Telling the Story of Science and Religion: A Nuanced Account," *British Journal for the History of Science* 29, no. 3 (1996): 357–59.
[3]See Part 2, "Complexity and the History of Science and Religion," in *Recent Themes in the History of Science and Religion*, ed. Donald A. Yerxa (Columbia, SC: University of South Carolina Press, 2009).
[4]Peter Harrison's book *The Territories of Science and Religion* (Chicago, IL: University of Chicago Press, 2015) has been described by Ronald L. Numbers as "the most significant contribution to the history of science and religion since the appearance of John Hedley Brooke's landmark study, *Science and Religion: Some Historical Perspectives*." [See Matthew Walhout's review in *PSCF* 67, no. 4 (2015): 281–84.]
[5]For a more extensive discussion of "science causes secularization," see Peter Harrison's article "Science and Secularization," *Intellectual History Review* 27, no. 1 (2017): 47–70.

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Origins

ORIGINAL SIN AND THE FALL: Five Views by J. B. Stump and Chad Meister, eds. Downers Grove, IL: IVP Academic, 2020. 200 pages. Paperback; $24.00. ISBN: 9780830852871.

The doctrine of original sin has been controversial since its earliest articulation by Augustine of Hippo in the fourth century, and it remains a provocative

source of debate for Christian theologians in our time. Controversy surrounding the doctrine has only intensified as a scientific and evolutionary framework has come to characterize modern thinking. *Original Sin and the Fall: Five Views* provides a forum in which representatives from different Christian traditions are able not only to articulate their own perspectives on original sin and the Fall, but also to respond to the views presented by others in the volume.

Hans Madueme articulates one approach to the doctrine of original sin and the Fall from within the Reformed tradition, an "Augustinian-Reformed" perspective. While he states in the beginning of the essay that he developed his approach "with an eye to recent scientific challenges," he does not engage in a sustained way with information from scientific discourses (p. 12). Instead, he points out some of the shortcomings he perceives in theological accounts of original sin that attempt a synthesis with evolutionary accounts of the world, and he argues that theology should not be too quick to conform to deliverances from the sciences since "scientific consensus is a moving target" (p. 33). Madueme asserts the priority of biblical exegesis and theological evidence, which he views as affirming a historical, cosmic Fall, imputing moral corruption and guilt. Madueme is compelling in this essay in his identification of the many potential pitfalls inherent to the task of reconciling a theological approach to original sin with the current scientific consensus. However, the essay leaves one desiring more work from Madueme to reconcile his rejection of contemporary science with his belief in the unity of scientific and theological truths, since, as he affirms, all truth comes from God.

Continuing in the Reformed vein, Oliver Crisp presents a "moderate" approach to original sin and the Fall that he describes in terms of "dogmatic minimalism" (p. 37). This means that Crisp affirms "as 'thin' an account [of original sin] as is doctrinally possible" (p. 37) while still being consonant with his broader theological commitments. For Crisp, being afflicted by original sin means that every human (except for Christ) has a "morally vitiated condition," and yet does not bear the burden of inherited guilt. Crisp argues that the notion of inherited guilt is "monumentally unjust," and that humans should be held culpable only for actions that "they themselves perform or to which they are party" (p. 47). Crisp argues that one benefit of his approach is that one can hold it in tandem with a variety of different beliefs about human origins and the historicity of the Genesis account. The rejection of inherited guilt is perhaps the least persuasive aspect of Crisp's essay. Though he affirms that all of humanity is metaphysically united, he rejects the notion that this requires a belief in shared guilt. To defend this point, he uses the example of a child born into a family of slaves and argues that the child born into this plight "is not responsible for being born a slave" (p. 41). However, it is odd that Crisp used this example instead of the example of the child born into a family of enslavers. Does not the child born into an enslaving family, who benefits from the system of slavery, bear some culpability for it, even if only passively?

Joel Green's contribution draws from his expertise in biblical studies and is written from a Wesleyan perspective. He argues that Wesley viewed the doctrine of original sin as "essential to the theological grammar of Scripture and life" (p. 56). While Wesley emphasized the impairment of human nature, he did not embrace the notion of total depravity, arguing instead that God's work of healing has begun within the human race. Green shifts next to reflect on the significance of Adam and Eve's sin from the perspective of Second Temple Jewish texts. He argues that evidence of belief in original sin cannot be found in these texts, and suggests that this is significant in terms of understanding the mindset of New Testament writers who may have been influenced by them. Green then turns to the New Testament. He argues that in Romans 5, Paul is not interested in developing a doctrine of original sin. Instead, Paul seeks to establish the equal status of Jews and Gentiles before God (p. 70). Finally, Green assesses Genesis 1–3, arguing that these chapters also do not provide a foundation for the doctrine of original sin, although they do reveal a belief in the pervasiveness and heritability of sin, "not in the sense of passing sin down biologically but in the sense of pattern and influence" (p. 73). In his conclusion, Green argues that Wesley refused to choose between Scripture and the "book of nature," that is, the natural sciences. He uses this as inspiration to briefly suggest a way of maintaining belief in the Fall while also acknowledging the evolutionary history of *Homo sapiens*. Green's essay is helpful in that its reflection on original sin is explicitly in dialogue with insights from evolutionary biology, making this a needed contribution, given the popular perception that evolution has disproven the doctrine.

Andrew Louth provides a nuanced account of an Eastern Orthodox approach to thinking about inherited sin. He first clarifies that part of the dissonance between Western and Eastern thinking about inherited sin can be explained in terms of problems of translation. He notes, "The term original sin (*peccatum originale*) belongs to a particular Western context; nor is it easy to translate into Greek" (p. 79). A central insight of Louth's essay is his thesis that Western theology begins from the point of view of the Fall and becomes narrowly focused on the notion of redemption. In contrast, he argues, Eastern theology begins from creation and culminates in deification. Eastern Christians view sin through a cosmic lens, and fallen humanity not in terms of inherited guilt but in terms of suffering the effects of the inheritance of death. To illustrate his arguments about the differences between Western and Eastern approaches to sin, Louth juxtaposes the writings of Athanasius and Anselm.

He then examines the works of Sergii Bulgakov and Dumitru Stăniloae and argues that they continue the trend of viewing sin in the context of creation and deification. The final section of Louth's essay addresses the sinlessness of Mary via Bulgakov's approach to the issue. This aspect of his essay is particularly welcome since only one other essay (Oliver Crisp's) in the volume mentions Mary in relation to the doctrine of original sin. While Louth's argument that the West focuses narrowly on the Fall-redemption arc could perhaps be challenged, his essay nevertheless illuminates important differences in emphasis between Eastern and Western Christian thinking about sin and makes a crucial contribution to the conversation.

Tatha Wiley, in the so-called reconceived view, draws from the theology of Bernard Lonergan, S.J., to develop an exorcising approach to the doctrine of original sin. Wiley takes seriously the ways in which the traditional articulation of the doctrine has lost credibility in the contemporary age. She suggests that this is a result of its dissonance with modern biblical scholarship and evolutionary biology, and its history of being used to deny the goodness of humanity and sexuality. Wiley emphasizes the time-bound nature of all human understanding, and the fact that theological doctrines will inevitably reflect the historical frameworks in which they are articulated. In the current age, Wiley argues, this requires us to take seriously the scientific context in which we live, as well as our "authentic values" (p. 106). In her recasting of the doctrine, Wiley suggests via Lonergan that the "root sin" of humanity is "sustained unauthenticity" (p. 124). Wiley's contribution is compelling in its boldness. Rather than suggesting a few minor tweaks to the doctrine, she presents a rigorous rethinking of it. Wiley's essay is also valuable in that it addresses the gendered effects of the doctrine's history, and is the only essay in the volume to do so.

Original Sin and the Fall: Five Views is a thought-provoking treatment of one of the most debated aspects of Christian theology. On the whole, the book will likely be useful for professional theologians, students of theology at the graduate and undergraduate levels, pastoral ministers, and interested lay people. The "Responses" portion of the book was especially engaging, as the authors were quite candid in terms of assessing the lines of divergence in the group. The book provides thoughtful approaches to a difficult theological puzzle in which clear positions are established, not only from diverse points of view without apology, but also with genuine efforts to understand and accurately represent the positions of the others. Given the brevity of the volume, there were inevitably many unanswered questions evoked. Those familiar with theological discussions surrounding original sin will likely wish for more-thorough engagement with the challenges raised by evolutionary biology, as well as more reflection on recent shifts in thinking about evolution expressed in the extended evolutionary synthesis. These developments are friendlier to theological intuitions about inherited sin.

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EMBRACING EVOLUTION: How Understanding Science Can Strengthen Your Christian Life by Matthew Nelson Hill. Downers Grove, IL: IVP Academic, 2020. 152 pages. Paperback; $20.00. ISBN: 9780830852833.

This is a short and very readable book whose main purpose is to connect the average churchgoing Christian with a modern and theologically sympathetic understanding of evolution. The general perspective taken by the book is that human understanding of anything (science, art, theology, politics, and so forth) is significantly contextual. The author takes care in the first chapter to explain his perspective on science/faith issues in general, and organizes the book into three parts.

The first part is that of understanding our "biblical lens," namely, exploring the ways in which we are shaped to read scripture, and how this, in turn, influences our beliefs. Do we read the Bible for formation or for information? The two are not mutually incompatible, but neither are they equivalent, and how we balance the two is pertinent to our theological understanding of evolution. This section of the book addresses what are perhaps the two main questions emerging from the early chapters of Genesis: our understanding of Adam and Eve in the garden of Eden, and the place of predation and death in God's creation. The latter troubles the author much more than the former, and the response presented is not wholly satisfying, even to the author himself. Overall, this section is a good presentation of hermeneutics that focuses on Genesis without bogging down the reader with too much theological weight.

The second part of the book addresses how we understand our "scientific lens." A full chapter is devoted to the basic theory of evolution (its "nuts and bolts") and a subsequent chapter to what is meant by scientific truth and its integration (or not) with faith. The author does a good job of distilling the philosophy of science for the intelligent lay reader without "dumbing it down"—not an easy task. Sometimes, however, the treatment is lacking, particularly concerning the *imago Dei* in light of evolution. Are we (as appears to be the inference on page 69) special simply because we were evolutionarily lucky to have large brains?

The remainder of the book—its third part—is devoted to how we might integrate an evolutionary understanding of biology with Christian faith. Many books have been written on this subject, and it is difficult for anyone these days to say what has not already been said. The theme running through this section of the book is

that an evolutionary perspective can be empowering, primarily because knowledge of fact and truth allows a Christian to better carry out the ministry of Jesus in his/her life and in the world. Knowledge of the roots of our negative genetic urges (for example, the tendency to overeat) can empower us to overcome these urges through a combination of human choice and the grace of God. The final chapter discusses how the Christian church, girded with an appropriate integration of evolutionary knowledge and scriptural foundation, is best positioned to foster the virtues of the kingdom of God through community.

I liked this book, and I think it is definitely one for discussion and use in an adult Sunday school class. It does, however, avoid a number of awkward questions and issues. For example, why does it matter if our negative/positive tendencies are evolutionarily based? Wouldn't we, as Christians, act the same if they had some other origin? There is also an assumption by the author of a transcendent morality—but where does this come from? Are our morals likewise a product of evolution? If so, how does this square with biblical (and other) forms of revelation? And as far as the problem of death is concerned, isn't this a problem of sin in the world? Doesn't it mean that sin is present at the outset of creation?

That said, this is very much a positive contribution to the ongoing evolution/creation issue. Without denying our evolutionary origins, it calls us to transcend them as followers of Jesus. I am sure it will foster interesting discussions in many a church and Sunday school class.

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Personhood

ARE WE SLAVES TO OUR GENES? by Denis R. Alexander. New York: Cambridge University Press, 2020. 275 pages. Hardcover; $99.99. ISBN: 9781108426336. Paperback; $29.99. ISBN: 9781108445054. Ebook; $24.00. ISBN: 1108426336.

A few weeks ago, news broke that the genetic testing giant 23andMe was going to become a publically traded company.[1] With an annual revenue of $305 million in 2020 and a database of nearly 10 million human genomes, the company has become not only a consumer favorite for inexpensive at-home genetic testing, but its wealth of genetic knowledge has become a valued commodity for drug development companies. As a part of its marketing approach, 23andMe suggests the knowledge gained from their genetic analysis will help individuals to "know what makes you, you." While not explicitly stated, this slogan and the company's quick rise to success follow a narrative that has become central in modern society—genes completely determine who we are.

Concerned that genetic determinism has taken an unwarranted place in western culture, Denis Alexander offers *Are We Slaves to Our Genes?* as a critique of this rising epistemology. Using an enormous compilation of modern genetic research, Alexander argues that the development of most human traits and behaviors is far more complex than what genetics can account for alone. Rather, current genetic research suggests that the development of a majority of human traits and behaviors is the result of a complex interaction between genes, the environment, and developmental timing; this includes the interaction between interrelated biological systems.

Alexander begins by making a case for the prevalence of genetic determinism in the modern cultural narrative. Using multiple current examples, he highlights how genetic determinism is both implicitly and explicitly woven into the presentation of scientific research, especially in pop culture. He then spends the next three chapters acquainting the reader with basic genetic principles. Along with a basic introduction, he provides current information on how genes and the environment interact during human development. He also offers a thoughtful analysis of current research and techniques for connecting human behavior with genetics. In these chapters, Alexander is careful to be both artful and delicate as he tries to strike a balance between making the information palatable for nonscientists, while still engaging for experts in the field. For either reader, the information presented in these chapters is foundational to understanding the genetic research and analysis presented in later sections of the book. The focus then shifts to providing detailed summaries and analyses of current genetic research on a number of culturally relevant topics.

In chapters 5, 6, and 7, he explores the relationship between genes and mental health, genetics and intelligence, and genes and personality, respectively. The analysis in chapter 7 also includes a look at a few well-known personality disorders. The correlations highlighted and the analyses provided are grounded in current psychological and genetic-based research. The examples used are relevant and interesting for scientists and nonscientists alike. In chapter 9, Alexander moves his attention to the genetics of food desire, weight, and the propensity for exercise. Again, he makes a strong case to show that genetic research does not support the narrative around genetic determinism for development of these traits and behaviors.

Alexander then decides to tackle the correlation between genes and three of the most controversial issues in current American society: religion, politics, and sexual orientation. On each of these contentious issues, he provides an extremely well-researched, thoughtful, and even-handed analysis that is grounded in scientific research, not opinion. The penultimate chapter provides an exquisite summary of the previous chapters

that include additional rationale for his thesis. He then closes the work with a nod to some of the philosophical and religious discussions on genetic determinism. In this chapter, he also provides an interesting contrast between two current worldviews (Christianity and Transhumanism) as they relate to genetic determinism, free-will, morality, and human purpose. The chapter is logically constructed and provides additional compelling rationale against genetic determinism, especially for a non-Christian reader.

Anyone who dives in to *Are We Slaves to Our Genes?* will find it an engaging and thought-provoking read. Alexander summarizes and synthesizes an immense amount of current scientific research into a clear, concise, and palatable narrative. His chapter on genes and sexual orientation is one of the best and well-balanced compilations of current genetic research on the topic around. The chapter includes some current psychological research as well. For those with interest in this topic, the book is worth picking up just for that chapter. Whether the reader is a scientific novice with an interest in pop culture and genetic determinism or an expert in the field, Alexander does a masterful job walking the reader through the current genetic arguments to show that we are more complex than nature versus nurture.

Note

[1]Alex Carchidi, "23andMe Is Going Public via a SPAC. Here's What You Need to Know," The Motley Fool, February 9, 2021, https://www.fool.com/investing/2021/02/09/23andme-is-going-public-via-a-spac-heres-what-you/.

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IN SEARCH OF THE SOUL: A Philosophical Essay by John Cottingham. Princeton, NJ: Princeton University Press, 2020. 174 pages. Hardcover; $22.95. ISBN: 9780691174426.

There is a longing in the human soul for meaning, fullness, God. That is what philosopher John Cottingham claims in his marvelous philosophical essay, *In Search of the Soul*. The book historically traces speculation on the soul and its nature from Plato to Descartes to Daniel Dennett, but it is also an impassioned summons to heed the soul's native orientation to the transcendent. It is noteworthy for its philosophical acumen, accessibility, and appreciation of literature's contribution to the conversation. In the opening chapter alone, he alludes to Philip Pullman, Shakespeare, Wordsworth, and T.S. Eliot. For the purposes of this brief review, I shall concentrate on the philosophical heart of the book, chapter three, and end with a summary overview of the last two chapters.

In chapter three, Cottingham confronts two tendencies in contemporary discussion about the soul and its nature. Today, discussion of the soul centers on the nature of consciousness. Consciousness poses a challenge to the impersonal, mechanistic, materialist consensus of science. So, while neurobiology may be adept at telling us what parts of the brain "light up" in experimental settings, there is an enormous explanatory gap between the registration of stimuli in hemispheres of the brain by an fMRI and the first-person experience of *qualia* such as the taste of cinnamon, the feel of corduroy, or the deep satisfaction in knowing that you are known. How do we integrate the elusive nature of consciousness within the impersonal, mechanistic picture of reality of the sciences? For some, such as Daniel Dennett, we don't, and so we must belittle and discount it. Consciousness is, to use Dennett's analogy, a "user-illusion" like the "click and drag icons" on our computers which bear no relation to its complicated micro-circuitry. The illusion (replete with audio accompaniment) is there only to "humor" our perceptual and cognitive apparatus and pertains to nothing real in the computer. Our "subjective qualitative awareness" is our user-illusion, the click and drag icon that is consciousness.

Cottingham's response to Dennett is an ancient one. Socrates, in the *Phaedo*, once employed something like it when discussing the moral reasons for which he died. First, Dennett ontologically privileges the micro properties of the computer's circuitry over the macro properties. That is, the printed circuit board is real, the icon is not. But, says Cottingham, this is utterly arbitrary and unjustified. Why not say that both micro and macro properties are equally real? The icon may be dependent upon the micro properties of the computer (like the soul in relation to the body), but that doesn't mean it is ontologically dubious. The rich, meaning-laden world to which the icon appeals is just as real, though it can be accessed and understood only within the realm of the conceptual (p. 79). For Cottingham, Dennett's materialist bias is showing: it is only real if it's caught in my net. Therefore, he rejects the attempt to eliminate consciousness from the status of the real by reducing it to an illusory side-effect of the workings of the brain.

In addition to Dennett's materialist reduction, there is another take on consciousness that Cottingham finds unsatisfactory: panpsychism. Panpsychism is, philosophically, at the opposite pole of the Darwinian account of consciousness in which it comes at the end of the process of evolutionary development (p. 80). Instead, panpsychism claims that consciousness is present, inchoately, from the very beginning in the simplest parts/particles. Following the insights of William James, Cottingham holds that panpsychism is "a kind of category mistake" in which properties more plausibly attributed to wholes (like persons) are implausibly ascribed to parts. In addition, though he may agree with panpsychism that consciousness is, somehow, intrinsic to matter—though a latecomer in evolutionary

history—he takes issue with the contention that consciousness is ultimately unintelligible, "a brute fact we cannot deny, but which we cannot ever hope to incorporate into any wider picture of reality" (p. 83).

In a manner similar to consciousness, many philosophers and scientists also regard moral truths as anomalous, out of step with the neutral, quantitative take on the world of the sciences. In his brief survey, moral truths/values are viewed as human projections or groundless "irreducible normative truths" (p. 86). Both of these positions, for Cottingham, fail to do justice to the nature of our experience of the good.

Cottingham maintains that theism is the most congenial framework for consciousness. For not only is it perfectly compatible with the "models and mechanisms of the modern physical sciences" (p. 90), but in this setting consciousness need no longer be dismissed as illusion or anomalous outlier. Theism is congenial to the first-person, qualitative character of consciousness because God is a person and if, as the great theistic traditions affirm, a human being is made in the "image and likeness of God," then it makes sense that matter has the potential to evolve into awareness and self-awareness. Life's evolutionary orientation could be seen as God's way of seeking to be in relation to God's creation. In a Trinitarian context, God is not only a person but a communion of persons rooted in love. So, not only is our personhood grounded, but our social nature is affirmed as an echo of God's interpersonal communion. In addition, our ineradicable sense of normative value loses its anomalous character by finding its natural source and ground in a God of infinite goodness. Finally, theism helps us correct for a tendency in nontheistic conceptions of consciousness to hold that we are the creators of the consciousness we find so captivating, the good we find so compelling. But this, Cottingham maintains, fails to do justice to the profundity of our experience of marveling at the "magical mystery show" of consciousness (p. 92) or the experience of being confronted by what the good demands. So ends my review of chapter three.

In chapter four, Cottingham defends the compatibility of modern psychoanalysis with theism. Here, the depths and opacity of personhood are acknowledged and explored. The dynamics of psychoanalysis are seen to mirror the struggles toward self-knowledge and self-donation found in spiritual direction. The winding corridors and duplicities attendant upon our search for authentic selfhood in psychoanalysis may be a condition of our sinfulness. Finally, chapter five recapitulates the theme adumbrated in chapter one, the natural longing of the human person for God. It is an old theme, but Cottingham has made it new: we were made for God and our hearts are restless until they rest in God.

This is an engaging and inspiring work. Cottingham does not pretend to have all the answers or to have proved what is beyond proof. This is one of the great strengths of his book. He is alert to the questions and to the native orientation of our souls.

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Technology

NIETZSCHEAN MEDITATIONS: Untimely Thoughts at the Dawn of the Transhuman Era by Steve Fuller. Posthuman Studies 1, ed. Stefan Lorenz Sorgner. Basel, Switzerland: Schwabe Verlagsgruppe, 2019. 240 pages. Hardcover; $146.00. ISBN: 9783796539466. Paperback; $41.00. ISBN: 9783796540608.

Christians turning to Nietzsche for support may be counterintuitive, but that can be the case with regard to radical human enhancement technology. As addressed in the June 2020 theme issue of *Perspectives on Science and Christian Faith*, transhumanism presents a treacherous landscape that calls for a thoughtful response from theologians and faith communities. The therapies and technologies already impacting the structure—physical, cognitive, affective, and other aspects—of our lives are growing in precision and potency. And, as indicated in the name of this series, "Posthuman Studies," discussions are underway about the replacement of *Homo sapiens* with *techno sapiens*. Whether our technological future is heavenly or hellish depends on the values embedded in the technology and how that technology is used, so we who are alive now have a moral imperative to do our part to ensure that technologies of human enhancement unfold responsibly.

All the religions are far behind where they need to be in understanding and making critical assessment of radical human enhancement technology and its champion, a movement called transhumanism. Judaism and Christianity are ahead of other religions in this regard, but even they have much work to do and quickly, given the fast pace of the developing technologies in areas such as genetic engineering, tissue engineering, robotics, and artificial intelligence.

Steve Fuller is well qualified to critique the transhumanist agenda. Auguste Comte Professor of Social Epistemology at the University of Warwick, UK, and co-editor of the relatively new series, *Palgrave Studies in the Future of Humanity and Its Successors*, he has written twenty-five books about many subjects, including intelligent design, philosophy of science, and social epistemology, an interdisciplinary field he helped develop.

The three sections of *Nietzschean Meditations* address the philosophical and theological history of transhumanism, the politics of transhumanism, and the role of death in transhumanism. There is a lot about transhumanism in

this volume. This review addresses just a few slices relevant for Christian readers.

The *Übermensch*, the future superman (also translated "Superior Man" and "Higher Man") Nietzsche made famous, was denigrated following World War II due to its association with the Nazis. Fuller travels back to Nietzsche's early reception when the superior man was not a racially tinged idea. This makes it possible for Fuller to "remain interested in the early twentieth-century image of Nietzsche as someone who took literally the prospect of transcending the human condition—a futurist who was unafraid to confront the puzzlement and even suffering that it would entail" (p. 10).

As with the transhumanist agenda, a happy outcome for Nietzsche's superman project was not guaranteed. Nietzsche's tightrope walker, which may be understood as a metaphor for the human condition, falls to his death. For Fuller, this does not mean that Christians, committed to transformation, should not make use of these technologies or see them as a means of God's grace. "As Nietzsche might put it—and transhumanists would recognize—we are not superior animals but failed gods" (p. 17). However, Fuller says we cannot regain our standing on our own; it is a grace-gift from God. Along the way, Fuller adeptly maps varieties of transhumanism onto theological (but not necessarily orthodox) positions, for example, Aubrey de Grey's Pelagian-like biological superlongevity program and Ray Kurzweil's Arian-like vision of "divine" consciousness escaping the confines of the body. For Fuller, the Arian "supposes that humans 'always already' possess divine capacities which may have yet to be discovered" (p. 47). And, importantly, short of making choices for transformation, "humans may freely fall into a further degraded state, which may include regarding their degradation as satisfactory if not superior to the time when they were close to God" (p. 18).

Christians can find Nietzsche a thoughtful guide for a proactionary (as opposed to a precautionary) approach to technological possibilities for human enhancement. Being proactive does not mean underestimating the risks these programs entail. While the tightrope walker can reach the other side, humility asks us to recognize that it is a "risky project of self-improvement" (p. 20). But we can face the danger and push through the fear. "However much day-to-day empirical realities remind us of our earthbound nature, we are nevertheless more than just that" (p. 34). And then, rhetorically, Fuller asks: "The question then becomes how to give that 'transcendental' aspect of our being its proper due: Is it just something that we release on special occasions, such as a church service, or is it integral to our ordinary being in the world, propelling us to realize our godlike potential?" (p. 34). In this context, Fuller asserts that faith can be understood as a "creative response to radical uncertainty" and a belief in providence, that is, "that God will always provide what we need to know to improve our position—but the trick is for us to figure what that is" (p. 34).

This book, then, is not so much about Nietzsche as it is a meditation inspired by Nietzsche that provides a sober critique of transhumanism and its possibilities. The Christian religion will do well to provide a theological response to radical human enhancement, and Nietzsche, via Fuller, can provide guidance, albeit from an unlikely source.

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THE CHARISMA MACHINE: The Life, Death, and Legacy of One Laptop per Child by Morgan G. Ames. Cambridge, MA: The MIT Press, 2019. 309 pages including appendices, notes, bibliography, and index. Paperback; $35.00. ISBN: 9780262537445.

> As with many who lead development projects, Negroponte and OLPC's other leaders and contributors wanted to transform the world—not only for what they believed would be for the better but, as we will see, in their own image. (p. 4)

Morgan G. Ames's book, *The Charisma Machine*, is a deeply incisive analysis of the One Laptop per Child (OLPC) project. The OLPC project, led primarily by Nicholas Negroponte, sought to provide millions of simple, robust, inexpensive laptops to children in developing countries, to allow the children to rise above societal and educational limitations. The author analyzes not only the hardware and software of the OLPC XO laptop, but also delves into the leaders' experiences as "technically precocious boys" and "hackers" at MIT's Media Lab, their educational philosophy of constructionism, and both their personal charisma and that of the XO laptop.

The book appears to be a reworking of the author's PhD dissertation from Stanford University in 2013, and as such, is not an easy read. Understanding the book requires understanding a few oft-used terms, defined in the introduction. Ames repeatedly uses the term "social imaginary" defined as

> a set of coherent visions by a group of people to collectively "imagine their social existence," as philosopher Charles Taylor puts it—the ways that people imagine themselves as part of a group and the identities that this group takes on in their minds. (p. 6)

The book also emphasizes the leaders' common life experiences as technically precocious boys—boys who grew up taking apart devices to understand them and then rebuilding them to make them better. Their experiences continued in the group at MIT's Media Lab, where members would play with computers to learn how they worked and then would challenge each other to reprogram them and extend their capabilities. These

individuals generally had been unhappy being educated at "factory schools," and thus they believed that all children could better educate themselves by being given unsupervised access to laptops. They believed in extreme educational constructionism: children learned best by unrestricted and unguided play, and if given the opportunity by being given a laptop, they would learn to program, would learn English, and would learn how to diagnose and fix hardware problems, all without supervision.

Finally, the term "charisma" is crucial. "Charisma is not legitimized through bureaucratic or rational means but by followers' belief that a leader has extraordinary, even divine, powers that are not available to ordinary people" (p. 8). Negroponte and others were charismatic individuals, making claims about OLPC (and education and society) that others, then, simply accepted as true.

The XO laptop itself, Ames claims, was a charismatic machine. It was a small, inexpensive, colorful laptop, running open-source software, and touted as tough and reliable. In reality, the hardware suffered from many problems: poor battery performance, insufficient memory, fragile wireless antennae, a flaky keyboard and trackpad, and a screen that cracked easily. The software provided by the operating system was supposedly easy to learn and use, and included educational tools (Scratch, Tux Paint, etc.) and an internet browser. Most programs used English in their instructions; the assumption was that children in non-English-speaking regions needed to and would learn English by using the programs, and thus they would become fluent in the "universal language" of technology and industry.

Chapter 1, "OLPC's Charismatic Roots," seeks to answer the question, "Why did so many so enthusiastically accept OLPC's charismatic promises?" The chapter provides a foundation for the rest of the book, going over the histories of Negroponte, and more importantly, Seymour Papert, who first conceived of the XO laptop. Papert was a technological utopian, believing that technology had the power to lift people out of poverty, fix education (by disrupting the status quo), overthrow corrupt governments, and so on. Papert's life experiences and writings (*Mindstorms: Children, Computers, and Powerful Ideas*) provided the foundation for OLPC.

Chapter 2, "Making the Charisma Machine," describes the OLPC hardware and software, and the five principles of OLPC: child ownership, low ages (targeted toward children ages 6–12), saturation ("where every child will own a laptop"), connection (to the Internet), and free and open software. Of these five, saturation and connection ended up proving to be the most difficult. Saturation was never achieved because the laptop hardware was so fragile that many children who were given a laptop, broke it, and they were then never able to use it again. Connection proved to be difficult. Initially the laptop was going to implement a new networking technology which would allow laptops to seamlessly find and connect to one another, forming an ad hoc network across a town. This technology was never fully realized, and so connectivity was possible only if the government or a nongovernmental organization (NGO) installed wireless hotspots at schools.

In chapters 3 and 4, Ames recounts what she observed in Paraguay over a seven-month period. OLPC deployed the XO laptop in Paraguay, especially in one city, Caacupé, with the help of an NGO called Paraguay Educa. Ames recalls seeing hundreds of broken laptops stacked in a backroom at Paraguay Educa, notes how children used the still-working laptops (primarily to download games and music), and how already overworked teachers had little time to incorporate this new disruptive technology into their lesson plans. Success was achieved only in a few schools where Paraguay Educa hired technology *formadores*, or trainers, to be placed to help maintain and promote the laptops. Money for paying these *formadores* quickly ran out, however. She found and interviewed a few children who had taught themselves to program using Scratch or Turtle Art. In all cases, these children had guardians who closely monitored the children's use of the laptops, and encouraged them to create content instead of just consuming it. In other words, these children did not, without supervision and outside encouragement, learn programming, learn English, and learn how to repair their own laptops.

Chapter 6 is a fascinating chapter that examines the role of performance in the success of NGOs and nonprofits. Most organizations sponsored by outside funding sources must periodically demonstrate the effectiveness of their work to their sponsors. Paraguay Educa was no exception, having to demonstrate to visiting leaders of OLPC how well their vision was being realized. These dog-and-pony shows made the OLPC leadership believe that everything in Paraguay was going well. These demonstrations were necessary for the employees of Paraguay Educa to keep their jobs. The OLPC leadership were also not interested in digging too deeply to discover any problems, as they also had to report back to their donors. Ames analyzes this system of accountability based on performances, noting its advantages and disadvantages.

The final concluding chapter summarizes the five main takeaways of the book:

1. Big cookie-cutter solutions to problems without thorough research and sustained honest analysis "in the field" are probably doomed to fail.
2. When developing a project, don't underestimate the hard realities of the culture where the project is to be deployed.
3. Be cognizant of the privilege of those proposing a solution, and how others may not have this privilege.

4. Don't be fooled by performances.
5. Inspect the undergirdings of your philosophies. Are they legitimate?

OLPC failed on all of these points. Millions of dollars were spent, and there is little evidence of any lasting impact.

Although it is not an easy read, this book is recommended for those who are interested in thinking about how computing can be effectively used to make a difference in this world. If you are a Christian, and desire to be an active agent of change for good, you also should spend time considering your privilege, the culture of where your project will be deployed, and why you are optimistic about the success and impact of your project. Will you be making the same mistakes that OLPC made?

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MY TECH-WISE LIFE: Growing Up and Making Choices in a World of Devices by Amy Crouch and Andy Crouch. Grand Rapids, MI: Baker Books, 2020. 208 pages. Hardcover; $15.99. ISBN: 9780801018671.

My Tech-Wise Life is a book about life before it is a book about technology. Through a discussion of her own experience growing up in a "tech-wise family," Amy Crouch shares her struggles and successes as a young adult navigating a world that is obsessed with technology. She honestly shares how she doesn't have it all figured out, while describing the ways that she keeps technology in its place as a tool in her life, rather than as a controlling force.

Technology causes us problems that aren't rooted in technology. It changes the problems that we face, but it doesn't create fundamentally new problems. Sometimes it exacerbates problems that we have always faced, such as distraction. Other times, it covers up problems—this sounds good, until you realize that it also covers up the solutions. We experienced distraction and loneliness long before the distractions from phone notifications, and the loneliness from seeing Instagram posts of parties we weren't invited to. This book is about how to live—with and without technology.

In each chapter, Amy tackles a different facet of technology, exploring how we can be free of the demands of technology in a way that helps us to be more engaged in our own lives. Some chapters address specific technologies: for example, social media, and how "we don't have to compare ourselves" (chapter 1). Other chapters cover how we can use all of our technology better so that "we don't have to be exhausted" (chapter 7).

Each chapter is paired with a letter from her dad, Andy Crouch, the popular Christian author of *The Tech-Wise Family*. Each chapter also ends with "What to Do Next," beginning with questions of reflection, then moving toward the challenges of how to start conversations with your family and friends about how you want to be using technology, and ending with suggestions for how to change your habits surrounding technology.

My Tech-Wise Life reads more as an invitation than as a lecture. It is encouraging to hear this from Amy's perspective, as someone who grew up with smartphones and Instagram as a central part of high school. Amy is honest about how she struggles with what she's writing about—including issues of secrecy, loneliness, and exhaustion. These negative effects aren't invented by tech companies, but they are reframed and coded into the devices we carry around. She doesn't pretend that our problems can be fixed by purging our life of technology. Yet our situation isn't hopeless; Amy offers stories of her successes too. We are not inevitably going to lose to technology. There are ways to live a more meaningful life and to not succumb to the exhaustion of the endless scroll.

The book would be a valuable read for any young adult, but it is written to be most relevant for teens. This is apparent in some of her prompts to discuss technology use with parents, as well as in the emphasis placed on the teen demographic in the Barna research statistics scattered throughout the book. These statistics are based on surveys of young adults, so they primarily add confirmation that everyone else is struggling with the same technology problems. Aside from the statistics and a few of the prompts, the book is applicable to anyone who grew up with digital technology and is needing to reassess their relationship with it.

With its easy-to-read style, *My Tech-Wise Life* is a quick read, and would fit well for a small group wanting to read a book together. It is a hopeful, yet realistic book. It is honest about the problems that we face in using technology wisely, but it also offers concrete suggestions to be more mindful of technology use. Amy invites us into a life that is shaped around relationships and wonder rather than around technology.

Reviewed by Elizabeth Koning, graduate student in the Department of Computer Science, University of Illinois at Urbana-Champaign, Urbana, IL 61801.

RIGHT/WRONG: How Technology Transforms Our Ethics by Juan Enríquez. Cambridge, MA: The MIT Press, 2020. 304 pages. Hardcover; $24.95. ISBN: 9780262044424.

Right/Wrong: How Technology Transforms Our Ethics made me angry, made me think, made me research, made me discuss, made me agree, made me disagree … and it turns out that is what the author was hoping for. His goal was to get people interested in ethics again.

His point was that "technology provides alternatives that can fundamentally alter our notion of what is right and what is wrong." Ethics, he believes, often do (and should) evolve, and technology is increasingly becoming the catalyst for this evolution. He states that this book is not the classic "scholarly" book that provides answers, but one that he hopes will incite debate and provoke questions regarding the status quo.

As a computer scientist, I expected "technology" to be digital technology, but Enríquez uses a broader, and probably more proper, definition. Though he doesn't provide a formal definition, it appears to be something like "applied scientific knowledge." His definition of technology encompasses birth control, medications, gene editing, machines from the industrial revolution, and lab-grown beef, among other examples.

Enríquez begins the book with examples of what he means by technology influencing what we see as ethical. One example is the advent of birth control. The use of birth control afforded women more opportunities in education and career development. This, in turn, allowed them more financial independence which lessened their need to stay in abusive marriages. Even without the aspect of divorce, today many would look back and see the lack of education and career opportunities for women as unethical treatment. Birth control allowed for and encouraged more-ethical treatment of women.

Enríquez also looks to the future with the more contemporary example of gene editing. Many people today are appalled at the idea of editing a baby's DNA, even with the intent of preventing future diseases. They see it as unethical. Could it be that in the future our kids and grandkids will be appalled at how unethical we were for not editing their genes to avoid the cancer that they now face?

A third example of technology influencing our ethics is related to meat production. Currently, almost all of the meat we consume is a result of raising and slaughtering animals. Present-day technologies, however, allow for lab-grown beef. When this product becomes more affordable and perhaps the norm, will future generations regard us as unethical for the "cruelty-ridden" steaks and burgers that we consumed?

Throughout the book, Enríquez addresses controversial issues, including the educational system, mass incarceration, drug legalization, mental health, climate change, and warfare. There are plenty of topics to use as conversation starters. Unlike other books that help us to see the potential ethical dangers of technology, Enriquez focuses on the ways that technology enables us to become more ethical—if we are willing to adapt.

I love the passion that Enríquez brings to the discussion. He believes that technology without ethics is a recipe for disaster, and he wants people to pay more attention to what is right and wrong. He wants us to be open to re-evaluating what we believe to be right actions if we are given new information or possibilities through technology. At the same time, he wants us to be humble, recognizing that it can be hard to decipher right from wrong in new situations and that it can take time for a society to make the changes necessary to produce more-ethical actions. Hindsight is often 20/20, and people that went before us—even if decent people—made mistakes. We will also make mistakes. Furthermore, there are deterrents to making changes: inconvenience, shame, loss of status, and other costs. He wants to encourage us to be aware, kind, civil, and open when we are considering what is right and wrong given new technology. To all of this, I heartily agree.

In keeping with the author's hopes (that the book would also cause us to disagree, but discuss), I also wanted to mention a few things from the book which troubled me. As previously noted, he tells us that this is not a scholarly book, one meant to prescribe or give answers. Yet, he states that the current healthcare system is unethical, the cost of college is unethical, it is unethical to restrict gay marriage, and the ethical thing to do with autonomous cars is to make them available as soon as they can save more lives than with our current system. Agree or disagree with his conclusions, he is prescribing. He does provide plenty of "answers" throughout the book.

In chapter 3, Enríquez addresses those who would absolutely claim to know right from wrong. One of his main areas of focus is religion. He speaks specifically to people of faith who claim to know right from wrong because they know God's word. He then attempts to show how religious principles too have evolved. He declares, "The religions that survive long-term tend to evolve." Of interest to Christians, he states that "the Bible, the word of God, and hence Christian ethics, has evolved, or been reinterpreted, since the good old days of the Old Testament." He cites examples in which Christian ethics have changed over time. Interpretations of passages in the Bible have altered as our society has changed, and as technology has allowed us to communicate more broadly. He cites how Pope Francis has revised how he speaks about various issues. Agree or disagree, these are interesting topics for research and reflection.

But in his zeal to make his point, Enríquez makes certain statements (e.g., "None of the Gospels were written while Jesus was alive, and none by someone who actually met him") that I don't believe would be accepted by mainstream Christians. Yes, the Gospels were not written when Jesus was on Earth, but it appears that most Christian scholars believe, for example, that the Apostle John wrote the book of John. (Although Enríquez does admit in the references that his citation supporting this statement is from a rather controversial book.)

Finally, the author is trying hard to make this ethics book interesting, far from one of those stodgy, dry ethics theory books "that alienate the general reader" (his words). He accomplishes that, but some help from ethicists could be very beneficial. Very early in the book Enríquez states, "Because we never thought we could come close to doing what we take for granted today, we have no framework to deal with changing ethical norms." The truth is, ethicists have several frameworks available, and Enríquez even uses or suggests a couple of them—perhaps without knowing it.

Near the end of the book, he admonishes the reader to "bring front and center several core principles: modesty, generosity, empathy, civility, humility, compassion, decency, truthfulness … That is what underlies what we eventually discover to be ethical" (p. 221). This essentially describes what is known as a virtue-ethics framework. Those "core principles" he mentioned are virtues. The virtue-ethics framework simply asks: what would a virtuous person (someone who is compassionate, generous …) do in this new situation? The second framework is utilitarianism, which asks the question: What would produce the best outcome for the most people? He applies this approach to the authorization of autonomous vehicles and to the discussion of which types of healthcare developments should be prioritized. Both frameworks can be helpful tools for informing tough ethical decisions.

Enríquez brings a wealth of interesting scenarios to this discussion of the future of ethics because of his life experience and work in cutting-edge science. I truly appreciate his desire to write a book that will hold our attention and that is far from a dry textbook on ethics. But the work of those who think about these ideas every day ought to inform the discussion. In glancing through the references, I found only two of hundreds of references that looked to me to be directly related to ethics research. In writing about computer ethics as someone trained in computer science, I have certainly found the literature from those trained in ethics to be enlightening.

This book is an interesting read for those thinking about right and wrong, and this includes people who might not normally be inclined to do so. It can help us realize that we need to re-evaluate frequently and be willing to listen to other points of view with humility. But there is very little information on how to make those tough ethical decisions that we will be continually asked to make. For that, the reader will need to look to other resources.

Reviewed by Lori Carter, Professor of Computer Science, Point Loma Nazarene University, San Diego, CA 92106.

Theology

DIVINE ACTION, DETERMINISM, AND THE LAWS OF NATURE by Jeffrey Koperski. New York: Routledge, 2020. 168 pages. Hardcover; $160.00. ISBN: 9780367139001. Ebook; open access.

When it comes to talking about God's action in the world and laws of nature in the science classes I teach, my students sometimes wonder if God, violating the very laws he created, is a problem. Jeffrey Koperski has written a book for those students and for you, too! You can see that Koperski is a teacher well experienced with explaining philosophical ideas to students majoring in anything but philosophy (who form the bulk of our philosophy teaching). This makes his new book a very accessible and enjoyable read. Moreover, no matter your background, you are likely to learn something new reading this book, perhaps even about your favored approach to divine action in the world.

Koperski is right to point out that philosophy of science—particularly philosophy of physics—is missing from most divine action discussions. If it enters at all, philosophy of science makes only cursory contributions. He is also right to observe that the causal closure of the physical, or of nature as a whole, gets too little attention in the divine action literature despite the outsized role it plays. Koperski ably shows why neither causal closure nor determinism are genuine obstacles to divine action in the world. Philosophy of science allows Koperski to clear a lot of this dead brush from the ground of divine action literature. This is an important contribution to the discussions.

Koperski helps us think more accurately about laws of nature (full disclosure: he and I have talked about these issues and tread a lot of the same ground). The assumption or metaphor of laws as "governing" events in nature has been accepted as largely unanalyzed in the divine action literature. Though he rarely uses this language, Koperski shows why the metaphor of laws "governing" things does not stand up to close analysis. He endorses a view of laws functioning as constraints that enables us to think more clearly about how God can act in the world without violating laws.

Koperski describes his model for divine action as decretalist and nonviolationist. The laws that scientists deal with represent divine decrees—gifts of order and constraint to creation. The regularities of creation genuinely exist and genuinely act. Koperski captures a biblical view of God's relationship to creation; he also considers natural philosophers' critical thinking about laws in the seventeenth century.

As for nonviolationism, Koperski points out that laws—the nomic conditions or features of the world—do not make things go (no "governing" metaphor). Rather, as physicists have recognized, it is forces that make things move. What laws do is provide nomic constraints on the behavior of forces (p. 134). His model is nonviolationist in that these laws are not violated when God acts in nature; rather, when there are nonnomic changes, "the laws adapt to change. This was true when we thought that nature was Newtonian, and it remains true in the age of quantum mechanics and relativity" (p. 135). Koperski's account is consistent with what I think physics reveals to us about the laws of nature—they function as typicality conditions: A law tells us what to expect for the behavior of forces on a system typical for the constraints represented by the law. But when new factors or conditions are introduced, the law does not tell us what to expect. The typicality is shattered, but not the law. Yet, this does not distress physicists; we know how to model and calculate what happens with these additional factors that the original law did not cover.

Consider a simple example: A grandfather clock keeps time well because of the lawlike regularities involved in its functioning. Yet, if I use my finger to keep the minute hand from moving forward, the clock will cease keeping time accurately. No laws have been violated; however, a genuine physical change has taken place regarding the clock's functioning. The regularities are still there—the laws are still operative—but they adapt to the presence of a new effect or force introduced into the clock system. What this means is that "once the laws of nature are distinguished from the behavior that is the *result* of those laws and nonnomic conditions, we find a vast space of contingency in which God can act" (p. 135). Koperski calls this a "neoclassical model of special divine action" (p. 135) because God is not manipulating laws to act in the world. If humans can make genuine nonnomic changes to nature without violating laws (e.g., rockets that overcome gravity's pull), clearly God is able to. The question then becomes one of God's relationship to the contingent order he has given creation.

You may be thinking of possible objections to this account of divine action. Koperski discusses several and I recommend you read what he has to say about them. I will briefly discuss what seem to be the most serious—that is, possible violations of energy conservation. There are many reasons to think that conservation laws function as constraints on systems when particular conditions hold. For instance, as Koperski points out, according to general relativity, energy conservation does not apply to an expanding universe. In a dynamic spacetime, the motion of objects does not conserve energy. More generally, any system whose dynamics depend on time will fail to conserve energy, and there are lots of such systems in the actual world. Physicists have precise ways of quantifying how much a system violates energy conservation and describing the resulting order of the system in question. The idea that any system violating energy conservation can always be embedded into a larger system restoring conservation is just that—an idea and nothing more. Physicists do not have any good reasons supporting this idea (though some defend it to maintain their reductionist intuitions). There is plenty of opportunity for divine action in the world and energy conservation is never an issue.

One could sweat some details. For example, Koperski rehearses arguments to the effect that quantum processes suppress chaos, thus undercutting the amplification of small quantum changes to macroworld effects (pp. 52–53). While it is true that quantum mechanics is no friend of chaos, the amplification argument is more along the lines of a chaotic macroscopic system being sensitive to quantum fluctuations; this doesn't depend on the existence of so-called quantum chaos. There always are stringent constraints on such amplification, however; so, Koperski is correct that banking on this as a route for divine action is still a hopeless cause. And I am not convinced that physics and philosophy of science are pointing toward an eventual rejection of ontological randomness in quantum mechanics (pp. 60–63). Irreducible randomness is not lawless chaos; it is a form of order that God has given to creation even if it offends the deterministic intuitions of some physicists and philosophers. None of Koperski's account stands or falls with these quibbles.

I would like to see Koperski's account enriched with the doctrine of creation, such as in *Understanding Scientific Theories of Origins: Cosmology, Geology and Biology in Christian Perspective,* Robert C. Bishop et al. (IVP Academic, 2018). His discussion in sec. 4.2 suggests that seventeenth-century natural philosophers eventually ditched all forms of divine-mediated action for direct or unmediated divine action as embodied in the laws of nature (the discussion is a little oversimplified, but this is a short book). This amounts to treating the laws of nature as the main mediators of all that happens in creation (back to the "governing" metaphor). In contrast, the doctrine of creation's emphasis on multiple forms of divine-mediated action helps to address the divine relationship to creation in which God is working in and through nature, not outside and apart from it. This is exactly what Koperski's account needs for some of the questions he entertains at the end of the book and for some he leaves unanswered (e.g., why one does not have to restrict divine concurrence to Thomist models only).

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Practical Considerations in Vaccine Conversations

My recently published article "Vaccine Hesitancy: Christian Reasons and Responses" (*PSCF* 73, no 1 [2021]: 4–12) has garnered much interest.[1] In many contexts, including the Diving Deeper discussion in April, I've been repeatably asked, "What should I actually say?" While my article provides a framework of empathy through which we can discuss and respond, it does not actually provide any practical examples. Therefore, the purpose of this letter is to respond to my own article and to the questions I have received from numerous readers. Here I offer my thoughts on a practical dialogue about vaccines.

When discussing vaccines with a vaccine-hesitant individual, I suggest we adopt the same approach we would use when sharing our Christian testimony with nonbelievers. First, listen to their story and understand the origin and basis of their vaccine hesitancy. Then, if the dialogue permits, ask permission to share your story and explain the reasons for your vaccine confidence. This two-step approach is influenced by the PromoVac strategy and the works of Sara and Jack Gorman, Erin Smith, and Arnaud Gagneur et al., whom I referenced in my original article.[2] I have briefly explored both steps below.

1. Listen to their story. Why are they vaccine hesitant?
Have they experienced an adverse reaction from a vaccination? Have they witnessed an adverse reaction in someone they love? If so, share their sadness and demonstrate empathy. Medical exemptions from vaccines are in place for such people.

Have they experienced poor care from their healthcare providers? Have they lost trust in science and/or medicine? If so, share their frustration and pain. Acknowledge that the healthcare system is not perfect. Our feedback can continue to improve care.

Are their views based on misinformation or conspiracy theories? If so, share their desire to find truth, and acknowledge the difficulty in assessing the quality of conflicting sources of information. Without attacking their efforts, encourage them to read all sources of information and investigate both sides of a story.

2. Tell your story. Why are you vaccine confident?
Have you seen the painful and devastating effects of infectious diseases such as polio, influenza, or shingles? If so, emphasize the seriousness of these diseases. Or, conversely, perhaps you have never seen a case of these infections. If so, rejoice over the repression or elimination of these diseases thanks to vaccines.

Are you a parent that wants to keep their children healthy and out of the hospital? If so, share how your children responded to their vaccines. Talk about the peace of mind you have knowing that your children should never have to suffer through whooping cough, measles, or influenza. You have given your children everything you can to help them live a long and healthy life.

Are you a Christian who believes vaccines are one of many ways we can care for our neighbors, especially our vulnerable immunocompromised neighbors? If so, share your feelings. Perhaps you know of someone taking immunosuppressive medications or chemotherapy and you worry about their risk.

Are you someone who trusts scientists and medical doctors, and has good relationships with them? If so, share your experiences. Talk about the help you have received from medical doctors. Talk about the hope and excitement you have regarding scientific progress.

Are you a scientist or healthcare professional who understands the science behind vaccines? If so, share your expertise and experiences. Demonstrate your morals and your will to help people using the skillset that God gave you.

In summary, this two-step approach facilitates a dialogue about vaccines. It promotes discussion instead of intervention, and persuasion instead of coercion. This process begins with listening and transitions to sharing. In doing so, we put the hesitant individual first and demonstrate our genuine care. As I quoted in my original article, "People don't care how much you know, until they know how much you care." We must enter these conversations because we care, and not because we seek satisfaction or personal gain.

As you enter dialogues about vaccines, I pray you show love, patience, gentleness, and self-control. These fruits of the spirit are particularly difficult in disagreements. May the Holy Spirit guide and bless your conversations.

Notes

[1]Rebecca Dielschneider, "Vaccine Hesitancy: Christian Reasons and Responses," *Perspectives on Science and Christian Faith* 73, no 1 (2021): 4–12, https://www.asa3.org/ASA/PSCF/2021/PSCF3-21Dielschneider.pdf.

[2]Sara Gorman and Jack Gorman, *Denying to the Grave* (New York: Oxford University Press, 2017); James Clear, "Why Facts Don't Change Our Minds," September 10, 2018, https://jamesclear.com/why-facts-dont-change-minds; Arnaud Gagneur et al., "A Postpartum Vaccination Promotion Intervention Using Motivational Interviewing Techniques Improves Short-Term Vaccine Coverage: PromoVac Study," *BMC Public Health* 18, no. 1 (June 2018), https://doi.org/10.1186/s12889-018-5724-y; and Erin Smith, "The Role of Psychology in Advancing Dialogue between Science and Christianity," *Perspectives on Science and Christian Faith* 72, no. 4 (December 2020): 204–21.

Rebecca Dielschneider
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