PERSPECTIVES on Science and Christian Faith

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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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The Science and Theology of Creation and Sin

James C. Peterson

This is the first issue of *PSCF* since I took part in the International Summit on Human Gene Editing. The National Academy of Sciences of the USA, the National Academy of Medicine of the USA, the Chinese Academy of Sciences, and the Royal Society of the UK jointly gathered the scientists directly involved (and some advisors) to share the latest developments, and to consider the best societal use, of the newest gene-editing techniques. Every once in a while there is a trigger that accelerates discovery and development in a particular field. CRISPR-Cas9 appears to be such a technology for understanding, and precisely changing, the genes that are central to life. There will be much from CRISPR-Cas9 for us to learn and think through in the coming years.

The development of CRISPR-Cas9 is an example of how fast the sciences keep moving. The sciences, and theology too, are, of course, both human constructs. Hence, from a limited perspective, they try to understand our world. Science focuses on our material universe; theology, on God and what God has revealed. All one has to do is to look at the night sky and what we can see of hundreds of billions of other galaxies, to start to sense how little we know of what is. It is a privilege and a delight to make each step toward better understanding. Many of those steps in the sciences do not tell us much about theology, and there are points of theology that do not further our science.

But a Christian will probably expect that, as these two approaches develop, they will sometimes interact. They are, after all, ultimately studying different aspects of one reality. They can both take wrong turns and both can be improved over time, coming closer to recognizing what God has done and is doing. To the degree that a science or a theological reading approximate what actually is the case, they should cohere with each other. Where they interact, then, is an opportunity to understand more completely. They can trigger questions, challenges, insights, or support for each other.

At the start of this issue of *PSCF*, Sy Garte describes considerable ferment throughout the development of life and throughout the current study of it. He writes,

> To the standard paradigm of slow accumulation of random point mutations as the major mechanism of biological variation must now be added new data and concepts of symbiosis, gene duplication, horizontal gene transfer, retrotransposition, epigenetic control networks, niche construction, stress-directed mutations, and large-scale reengineering of the genome in response to environmental stimuli.

Garte argues that we should recognize these further inputs in an "extended evolutionary synthesis," and that such should open us to realize that it is not just random events that develop life. God might not only have started a planned unfolding of life, what Howard Van Till called in this journal a "fully gifted creation." God might well intervene among or through these many newly recognized inputs, along the way.

Our second article listens to the evidence that we human beings are at our core inherently cultured beings. Benno van den Toren notes that this experience of culture is not optional for human beings. It has always been central to our survival and who we are. He sees recognizing this characteristic of our origin and ongoing nature as potentially insightful for understanding how sin originated and spread.

David Wilcox next lays out in detail some of the newest discoveries and theories from population genetics and paleoanthropology toward a model of human development that recognizes human beings as uniquely made in God's image, yet becoming sinners. Denis Lamoureux follows by offering a hermeneutical approach to the origin of sin described in scripture that seeks to honor the revealing authority of scripture without adding fidelity to ancient science that is referenced, but not the point.

All four authors are looking for how our best current understanding of the sciences and theology might

together reveal more than they do apart. That is a worthy goal at the heart of this journal, to bring into dialogue the best of the sciences and Christian theology. See how well the authors do, and please do pitch in your perspectives as the conversation continues in future issues. ✺

James C. Peterson, *editor*

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New Ideas in Evolutionary Biology: From NDMS to EES

Sy Garte

Sy Garte

The neo-Darwinian modern synthesis (NDMS) has been the bedrock of evolutionary theory for many decades. But the NDMS has proven limited and out of date with respect to several areas of biological research. A new extended evolutionary synthesis (EES), which takes into account more complex interactions between genomes, the cell and the environment, allows for a reexamination of many of the assumptions of the NDMS. To the standard paradigm of slow accumulation of random point mutations as the major mechanism of biological variation must now be added new data and concepts of symbiosis, gene duplication, horizontal gene transfer, retrotransposition, epigenetic control networks, niche construction, stress-directed mutations, and large-scale reengineering of the genome in response to environmental stimuli. There may be implications for Christian faith in this opening of evolutionary theory to a broader and more exciting view of Darwin's great theory.

Theoretical evolutionary biology has been undergoing a crescendo of transformations in recent years. After a long period of general acceptance of the traditional paradigm for how evolution works, new data and concepts from many fields of biological science have begun to challenge the status quo of evolutionary theory. There is no question that evolution occurred, but some of the new ideas are potentially exciting for Christians searching for reconciliation of their belief in a Creator with acceptance of the science of evolution.

Darwin's profound concept of evolution by natural selection remains the best explanation for the diversity of life. Darwin's theory was about natural selection of biological variants. He knew from careful observation that all species contained variants and that selective breeding could magnify variation in animals or plants. He knew nothing about the source of such variation, nor about the basis of the heritability of specific variant traits. Mendel's finding of variant alleles leading to different phenotypes was central to the understanding of the source of variation that could drive evolution.

The Neo-Darwinian Synthesis

In the middle of the twentieth century, even before the chemical nature of the gene was known, biologists were examining mutations in experimental systems of bacteria in order to answer questions about purpose and chance in mutation production. Do bacteria tend to specifically mutate those genes that would help them survive an environmental stress such as starvation or exposure to toxic drugs, or do they simply generate random mutations and then undergo selection according to their fitness? Salvador Luria and Max Delbrück addressed this question in the 1940s with an elegant system called "fluctuation analysis."[1]

The results of these experiments were clear: mutations were random, and the resulting alleles were then selected for

Sy (Seymour) Garte, *PhD biochemistry, was a professor at NYU, Rutgers, and Pittsburgh; division director at the Center for Scientific Review, NIH; and interim vice president for Research at the Uniformed Services University of the Health Sciences. He is now president of the Natural Philosophy Institute, vice president of the Washington DC chapter of ASA, and a member of the John Templeton Foundation Board of Advisors.*

their relative fitness. This finding contributed to the emerging neo-Darwinian "modern synthesis" (NDMS), in which molecular genetics plays the key role in the production of phenotypic variation, and purpose is replaced by chance in the production of variation, which is the first stage of evolution. The next five decades of research into the fundamental mechanisms of cellular and molecular biology confirmed and vastly extended our knowledge of genetic structure and function, including the details of DNA mutations.

In any field of science, if a theory is any good, it will allow for a logical consolidation of isolated fragments of data or disparate knowledge from several fields into a functional and meaningful picture. The NDMS did just that by combining observations from paleontology and evolutionary biology with genetics and molecular biology. However, the advantage of the NDMS, its simplicity as a unifying theory combining evolution and genetics, has also become its weakness, since it fails to accommodate some of the latest information on the enormous complexity of biological function at the deepest level.

The problem with the NDMS is that it has allowed the finding of random mutations in DNA to remain the single signpost of phenotypic variation among individuals. For decades, the causal chain of slow accumulation of mutations, phenotypic variation, and natural selection proved too powerful to be shaken as the foundation of evolutionary theory.

But all scientific theories are dynamic and ever changing, and this is also true for evolutionary biology. We have seen changes enter evolutionary theory for several decades. The eventual acceptance of the neutral drift theory led to a modification of the idea that positive adaptationist mutations are the only drivers of evolutionary change, especially as related to population genetics.[2]

The ideas of Gould on punctuated equilibrium, first roundly rejected by neo-Darwinians, have been debated for decades. The fossil record seems to show long periods (on the scale of hundreds of millions of years) of very little change, punctuated by remarkable brief "moments" (in geological time) of explosions of new forms. The Cambrian explosion is the best known of these, but there are many other examples. The paleontological data is consistent with brief periods of dramatic changes, and new molecular mechanisms are being put forward to explain how this can happen.

It has been suggested that the NDMS is actually serving as a block to progress in evolutionary theory.[3] The selfish gene concept,[4] which underlies a great deal of modern neo-Darwinism, has been challenged by the recognition that the complexity of life extends down to the level of the cell and the genome. As Denis Alexander wrote in a Biologos blog post:

> The "selfish gene" had its day in the sun, but has now been replaced by the image of a finely tuned genomic system in which each type of gene product cooperates via an intricate networking complex to generate the music of life. The vast array of epigenetic signals whereby genes are switched on or off ensures a steady flow of two-way communication between the genome and its wider environments.[5]

There have been a number of publications challenging the NDMS from various points of view.[6] However, while many evolutionary biologists are embracing alternative mechanisms for the source of variation, there remains a strongly opinionated and publicly active hard core of neo-Darwinians who reject any deviation from the accepted dogma, often more for philosophical than for scientific reasons.

The Extended Synthesis

So, evolutionary biology is currently in a state of splendid confusion. The mass of data from many fields, including evo devo and epigenetic control of genome function, has left the neo-Darwinian paradigm open to reinterpretation. There are parallels of the current situation in biology with the twentieth-century revolution in physics. Relativity and quantum theory did not replace Newtonian physics, but supplemented it with a new depth of understanding. Darwin remains the Newton of biology, and evolution by natural selection will not be displaced as the fundamental unifying theme of all biological information. On the other hand, the first stage of the evolutionary process, the mechanisms driving inheritable variation (which Darwin did not address) is undergoing a transformation. The concept that evolution results from a slow steady process of accumulation of minute genetic and phenotypic changes is being replaced by findings of rapid and dramatic alterations of phenotype resulting from a variety of mechanisms.

The debate between those who believe that a new extended evolutionary synthesis (EES)[7] is necessary and those who think that the NDMS covers all the new biology (and that new theoretical concepts are not necessary) has recently been featured in *Nature* with a joint commentary by the two sides.[8] This follows a meeting held six years ago of sixteen evolutionary scientists who began to formulate ideas for the EES.[9] Many of the ideas presented by this group are related to the interaction between genomes and the environment, with a focus on niche construction and epigenetic inheritance of variability. Other areas such as evolutionary development are also being incorporated. While no unifying theoretical framework has yet been proposed, it is clear that many scientists are interested in producing a coherent EES that takes into account findings from many fields.

Some of the leading figures in the efforts to build a new evolutionary synthesis (including James Shapiro, Gerd Müller, Denis Noble, Eugene Koonin, and Eva Jablonka) have established a website called The Third Way to promote their views.[10] The following is from their mission statement.

> The vast majority of people believe that there are only two alternative ways to explain the origins of biological diversity. One way is Creationism that depends upon intervention by a divine Creator. That is clearly unscientific because it brings an arbitrary supernatural force into the evolution process. The commonly accepted alternative is Neo-Darwinism, which is clearly naturalistic science but ignores much contemporary molecular evidence and invokes a set of unsupported assumptions about the accidental nature of hereditary variation. Neo-Darwinism ignores important rapid evolutionary processes such as symbiogenesis, horizontal DNA transfer, action of mobile DNA and epigenetic modifications. Moreover, some Neo-Darwinists have elevated Natural Selection into a unique creative force that solves all the difficult evolutionary problems without a real empirical basis. Many scientists today see the need for a deeper and more complete exploration of all aspects of the evolutionary process.

The above quote makes clear that many scientists are ready for a new theoretical treatment of evolutionary biology in all of its complexity. The statement also clarifies that the purpose of this movement is not at all theistic, but to advance the science of evolutionary biology.

New Sources of Inherited Variation

Ecological and physiological interactions with an active genome are being proposed as important drivers of evolution. Symbiosis and parasitism, whole genome duplication,[11] major genomic losses, horizontal gene transfer,[12] retrotransposition,[13] epigenetic changes,[14] large-scale reengineering of the genome in response to environmental stimuli,[15] and stress-directed mutations[16] are joining the standard model of point mutations in the expansive and liberating postmodern synthesis. The new theoretical contributions to evolutionary biology are based more on the complexity of systems biology than on the simplistic notion of genetic determinism and gene-centric cellular functions.

Among the various DNA sequence alterations that are now known to play dramatic roles in mutation are various degrees of gene duplication, ranging from single genes to the entire genome. There is strong evidence that a whole genome duplication event occurred at about the time of the origin of the vertebrates.[17] At some point between the origin of chordates and that of jawed vertebrates, an entire genome was duplicated at two different times. Whole genome duplication (WGD) is an extremely useful (and rare) event in evolutionary terms, because it allows for a great deal of genomic trial and error in organisms without interference from purifying or balancing selection. By providing an extra, non-essential copy of every gene, WGD allows for very rapid and dramatic evolutionary leaps, such as the development of new structures and functions like cartilage and bony skeletons. There is evidence that WGD events have occurred in flowering plants,[18] at the origin of teleost fishes,[19] and probably at many other critical evolutionary transition points.

Gene duplication is often mediated by a mechanism called retrotransposition, whereby a gene is duplicated at a new location thanks to the action of genetic elements called retrotransposons.[20] The number and locations of these genetic elements are known in the genomes of many species. There is recent evidence that the rapid evolution of karyotype in gibbons was caused by a retrotransposon insertion.[21] Such events were found to occur during primate evolution when the common ancestor of gorillas, chimps, and humans split from the orangutan line.[22] Gene amplification leads to the production of many copies of a single gene, which can then stimulate evolution

at that locus. Exon shuffling and repetitive elements play an important role in gene duplication and new gene creation in flies.[23]

Another mechanism for rapid large-scale genomic change is horizontal gene transfer, whereby one organism transfers a large chunk of genetic material to another organism. This is a well-known phenomenon in bacteria. It now appears that such genetic transfers have taken place between prokaryotes such as bacteria and eukaryotes such as parasites and sponges.[24] Horizontal gene transfer could also explain the origin of animal-like alpha amylase in bacteria as coming from animals and plants. Horizontal gene transfer from bacteria to eukaryotes has been linked to the origin of mineralization in sponges, which led to the eventual development of skeletons in modern animals.

Natural Genetic Engineering

Over the past decades, microbiologist James Shapiro has applied many findings on how cells can accomplish major genomic alterations to develop a model he calls natural genetic engineering (NGE).[25] His view is that the cell can control the genome as much as the genome controls the cell. When applied to evolution, these sources of genetic variation do not fit the neo-Darwinian model of slow progressive changes, but are rapid, dramatic, and involve grand molecular events such as whole genome duplication, transposition of large DNA sections leading to massive reengineering of proteins, and horizontal transfer of coding regions from plastids, viruses, and other organisms.[26]

One such revolutionary event was the huge evolutionary step taken when a cell engulfed a bacterium that remained alive and functional within its host, giving rise to eukaryotic cells with mitochondria. Nobody thinks that event was a slow stepwise process. Richard Dawkins has described it as a one-time incredibly lucky accident, more or less equivalent to the origin of life. (In fact, it happened at least twice, since chloroplasts also started out as bacteria swallowed by an ancient plant cell.)

Stress-Directed Mutations

In 1988, a paper by John Cairns and his colleagues showed that bacteria could produce beneficial mutations targeted specifically to relieve severe stress.[27] Cairns's paper took a major step away from the "purely random" concept for mutation. These beneficial mutations (now called stress-directed mutations or SDM) are produced at rates up to five times higher than other mutations with neutral effects. Numerous researchers have confirmed this phenomenon and have found a number of molecular mechanisms to account for it.[28]

Stress leads to derepression of specific genes whose functions are related to the stress. The resulting higher level of transcription of these genes allows for unpaired and exposed bases in loop structures that are more susceptible to mutation. Several investigators have found evidence that mutants arising from SDM in starving bacteria arise from different molecular mechanisms than ordinary mutational events. Most mutations due to SDM occur in newly derepressed genes. Derepression of genes can lead to supercoiling and much higher mutation rates. Supercoiling of DNA during selective gene transcription is one of the leading molecular precursors of SDM in bacteria. Such changes in supercoiling can result from a variety of environmental stressors, such as changes in osmolarity, temperature, or anaerobiosis.

The following quote from Susan Rosenberg puts the phenomenon of SDM clearly within the context of post neo-Darwinian mechanisms.

> The long-standing assumption of random, constant, and gradual mutagenesis is refuted by observations that mutations occur more frequently when cells are maladapted to their environments …[29]

Evo Devo, Gene Regulation

Evolutionary development is a field of biological enquiry that has made profound and important discoveries in the past decade.[30] The biology of organism development has always been more mysterious than the normal functioning of cells. Questions about how cells differentiate before birth to specialized organs, and how this proceeds in different species, were difficult to address. Recent efforts in *Drosophila* and mice have yielded great insights into the field. The idea that evolutionary mechanisms might be tied to events occurring during development (evo devo) was a tremendous advance whose theoretical implications are still being formulated.[31]

At this point it is clear that animal development involves very specific genes and that many of these

genes function by regulating networks of other genes.[32] The details of the complexity of this aspect of biology are still being explored, but several general principles are becoming clear. First, many of the genes involved in development are highly conserved and can function in species that are very distant in phylogenetic terms. Some of these genes, the Hox genes, have enormously complex webs of interaction, wherein the gene product of one gene might amplify or inhibit the transcription of large numbers of other genes, some of which also regulate expression of other genes in a cascade effect similar to the actions of enzyme cascades seen with hormonal actions in cells.[33] The results of the ENCODE project,[34] showing that there is far more noncoding transcription than was expected, have confirmed the extreme importance of regulation of gene expression for many areas of biology, including development and evolution.

It appears that small alterations—either by mutations or by changes in environmental conditions—in the activity of a few key genes might have major effects on the body plan of an organism. If such genetic and/or epigenetic changes are inherited, dramatic alterations in the shape and structure of organisms are possible within a brief time span.

Gene Regulatory Networks

We know that during development, there are networks of genes that are regulated by other genes, which themselves are regulated by environmental and internal signals. Research into the gene regulatory networks (GRN) that function during development has been intensive and productive, and for some organisms such as the sea urchin (an echinoderm), a vastly complex regulatory network has been described in detail.[35] Similar efforts are underway for vertebrates (chicken, fish) and even mammals (mouse).[36]

As has been postulated by evo devo scientists, mutations in certain genes can have dramatic effects on the development of body plans, allowing for rapid changes in limb morphology, segmentation patterns, and so forth. The phenomena of pleiotropy and epistasis could explain how small genetic alterations could have broad and dramatic effects on phenotypic evolution.

On the other hand, a consequence of the fact that gene regulatory networks are well conserved over deep evolutionary time is that there are strong constraints to evolutionary direction. This is consistent with the phenomenon of genetic buffering, which lends stability to patterns of gene expression and could be connected to observations of evolutionary convergence. This kind of genetic control redundancy allows for storage of genetic diversity and for rapid changes when needed due to environmental factors.

Convergence

Stephen J. Gould famously stated that if one were to rewind the tape of biological evolution and play it over, the results would be different. He was referring to the huge role of accident and random chance that he saw in the evolutionary process, especially with respect to mutation. This statement is probably incorrect. Evolutionary convergence has become clearly established as a biological phenomenon, and it tells a very different story of evolutionary direction.[37] Convergence suggests, in contrast to the ideas of some neo-Darwinists, that there may be directions in evolution. Certain common biological features that arise in unrelated lines of organisms suggest that such features are inevitable, and in fact, tend to develop in surprisingly similar ways on a molecular level.[38] On the one hand, convergence demonstrates the immense power of natural selection. On the other hand, it also tells us something about the sources and limits of variation.

Not all morphological changes are purely genetic in origin. The spines on the shells of mollusks, for example, turn out to be fairly predictable based on biomechanical principles. While they might give a selective advantage to the creatures, recent work has shown that spines arise not from a special mutation but from the biodynamics of the accretion of the mineral material that makes up the shell.[39]

Wings, eyes, fins, intelligence, echolocation, and shells are just some of the biological features that appear to be inevitable in any rewinding of the evolutionary clock. Each of these evolved independently many times. The fact that the wings of birds, bats, and insects share many common properties implies that those properties may be optimal for flight and that alternative plans were simply selected against. This is partially true, but we cannot ignore the "tool kit" paradigm of evolution.[40] Evolution does not allow for

anything and everything: if it isn't in the tool kit, it doesn't happen.

One outcome of the complexity of how mutations affect phenotype may be a high level of constraint on evolutionary pathways with the resulting observed evolutionary convergence. The homology of the Hox genes across hundreds of millions of years of evolution, and between highly divergent phylogenies,[41] suggests an astounding degree of sequence stability and preserved function. An effect of this conservation of function and genetic structure is a severe limitation on the degrees of freedom that organisms have in body plan and developmental programs. These constraints have profound implications for the idea of evolutionary direction, and even of teleology.

Niche Construction

One of the most interesting areas that are part of the EES is the study of the two-way interactions between organisms and their environment. Beavers make dams, corals make islands, and there are scores of other examples of what has come to be called "niche construction." According to F. John Odling-Smee et al.,[42] niche construction (NC) is "the process whereby organisms, through their metabolism, their activities, and their choices, modify their own and/or each other's niches." The guano of seabirds produces grasslands,[43] and snails affect the quality of soil.[44] According to the theorists of NC, the coevolution of organisms and environments should be taken into account in any comprehensive theory of evolution. This process is nonrandom and directed, and is quite distinct from the effects of random environmental variation on natural selection.

Modeling the dynamics of NC-related population genetics gives results that are not consonant with the standard view of random processes of gene-environmental interaction, in which cause and effect are reversed.[45] An example in human evolution is the spread of lactose tolerance in adults. The cultural change in the human environment that involved dairy farming produced a selective advantage for lactose-tolerant alleles.[46] Current models of modern human evolution depend heavily on niche construction theories.[47] By stressing nonrandom, purposeful alterations caused by organisms on their environment (which then have selective effects on these and other organisms), NC is one of the more radical departures from neo-Darwinism within the EES.

Philosophies of Evolution

One byproduct of the NDMS and its strong emphasis on the effects of genes in controlling all of life is the philosophical view of genetic determinism. This is sometimes referred to as a gene-centric (or even "selfish gene") approach to biology. This sort of determinism has been problematic for philosophers, social scientists, and theologians for quite some time.

Physics has moved beyond pure materialist determinism since the 1920s, but biology has been slow to catch up. It seems clear that the EES, a biological framework that incorporates an enormously complex suite of interactions and reciprocal control features, also falls more in line with an open, nondeterministic mechanism for biological evolution than does the gene-centric mutational model of the NDMS. This could allow the EES to represent the first opening in evolutionary thought to a more flexible framework for the mechanisms of change and innovation in living creatures.

I have not seen many references to the EES by philosophers or theologians as yet. I would predict that once the implications of such an open and broadly based theory become better known, it is likely that there will be some interest in the EES on the part of Christian theologians, especially within the theistic evolution/evolutionary creationism community.

Of particular concern to many Christians is the idea that Darwinian evolution by natural selection is based, at least partially, on a random process of mutation. While a strong argument could be made that the natural selection aspect of evolution is entirely nonrandom, not all Christians find this argument convincing enough to view evolution as a nonrandom process. The EES model, with its focus on dramatic environmental events and complex interactions of organisms with their environments and genomes, is easier to reconcile with the concept that life on earth was not entirely shaped by accidental processes than is the neo-Darwinian model of random mutations leading to slow accumulation of tiny changes.

In his book *On the Origin of Species*, Darwin repeatedly points out the difference between artificial selection, wherein human beings exercise their conscious purpose in producing particular kinds of improvements in crops or domestic animals, and the analogous situation in nature, in which no such conscious agency is needed.[48] From this emphasis arose the concept

that evolution is undirected and serves no particular purpose.

However, the idea that the source of variation in individuals of a species is random and not directed in any way did not come from Darwin. In *On the Origin of Species*, he states:

> I have hitherto sometimes spoken as if the variations … were due to chance. This, of course, is a wholly incorrect expression, but it serves to acknowledge plainly our ignorance of the cause of each particular variation.[49]

As the quote demonstrates, Darwin simply had no idea; and more importantly, the distinction between chance and purpose really had no direct consequence on the general theory.

The results to date are sufficient to put to rest the concept that all genomic changes are always produced by purely random processes, independent of extraneous conditions. The role of chance and accident can never be eliminated from any biological theory, nor should they be. But the new extended theory of evolution, unlike the neo-Darwinian synthesis, does not see chance as the only driving force for evolutionary variation.

The issue of randomness or chance is closely tied in with one of the most essential questions in biology: is there a purpose or direction to evolution? With the rise of the NDMS, the idea that evolution is devoid of purpose became engrained in biological theory. Evolution became a theory that neither required nor admitted to any degree of purpose or design.

The theologian/scientist Alister McGrath notes that "some have argued that rejection of any form of teleology is integral to the evolutionary synthesis …"[50] McGrath cites Ernst Mayr, who argued against the use of teleological arguments in biology because of the danger of the forced acceptance of theological or metaphysical doctrines into objective science. While modern science does not generally allow for teleological arguments, the question of whether there is any evidence of teleology of any kind in evolution is still open. McGrath asks, "Yet what if some kind of teleology is discerned within, not imposed upon the biological process? What if an evolutionary teleology is an a posteriori, rather than an a priori, concept?"[51]

With the emergence of the EES and other alternatives to the NDMS model, there is an increasing amount of evidence that the existence of such internal teleology (teleonomy) in evolution cannot be ruled out. The work of Simon Conway Morris on convergence, and his demonstration that evolution, in fact, follows fairly narrow pathways restricted by biological constraints, supports the idea of reexamining this question.[52] Others, such as Francisco Ayala, have found evidence for teleology in the very nature of adaptive change.[53]

McGrath and Mayr, along with Ayala, see purpose as part of natural selection and biology in general. McGrath states,

> Teleological mechanisms in living organisms are thus biological adaptations, which have arisen as a result of the process of natural selection. Such teleological explanations can be considered to be both appropriate and inevitable in biology…[54]

There is clearly a sense of purpose in the way living creatures behave, and we now can see some reflection of this sense in some of the new mechanisms of biological variation. Purpose is still purpose, whether it springs from the genome of *E. coli*, the chromosomes of a chordate, the mind of humans, or the hand of God. The new EES alternatives to neo-Darwinism are not theistic, but the opening up of evolutionary theory to embrace the fundamental complexity of biological systems may very likely contain pointers to the majesty of God's creation, including the diversity of life on Earth.[55]

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Notes

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Article

Human Evolution and a Cultural Understanding of Original Sin

Benno van den Toren

In this article we explore the interface between new theories of human evolution and a cultural understanding of original sin. According to recent theories developed in evolutionary biology, the human being is essentially a "cultured" being with the ability to live in different environments. This is a crucial difference between humans and other species, including other primates. Humans are thus necessarily dependent on socialization by their community. As a result, both the creative insights and shortcomings of human individuals are instilled in their descendants. This article explores whether, and if so how, this can contribute to our understanding of the propagation of sin through the human population. In doing so it becomes clear that while new scientific views concerning the development of the human species do raise problems for Christian theology, they also allow for new creative explorations that may deepen our understanding of classic doctrines.

Many people, both Christians and non-Christians, perceive the relationship between the Christian faith and science as a one-directional retreat. Science is seen as putting faith under ever-increasing pressure, and the Christian faith is seen as increasingly incompatible with science, to such an extent that, for many people, it is no longer worth considering. In practice the picture is much more nuanced, not only because the Christian faith is continually being reinterpreted, but also because the world of science is constantly changing.

Science does not progress simply by adding new insights to what has already been acquired, but also by replacing older theories with newer ones that appear to be more consonant with reality. These newer theories may pose fresh challenges to the Christian faith, but it may also be the case that they remove earlier challenges or allow for new creative interactions. An example of the former would be the theory of the Big Bang that removed the challenge of the universe being seen as eternal in both Aristotelian and Newtonian science. An example of new opportunities for creative interaction can be found in the discovery of the so-called fine-tuning of the universe[1] or in the unpredictability of complex dynamical systems, which allows for new ways of conceiving human and divine action in a world that formerly seemed to be governed by "Newton's rigidly deterministic account" of the natural world.[2]

Scientific theories concerning the evolution of the human species have presented major challenges for Christian understandings of original sin. It has become harder to hypothesize and locate a single first human couple. There is, furthermore, strong evidence that human beings have inherited a significant part of their—apparently flawed—physical and

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psychological make-up from prehuman ancestors. However, in this article we want to argue that, in other respects, newer insights into the evolution and characteristics of the human species are more favorable to the doctrine of original sin and may allow for a creative and constructive interaction with theology. In particular, we argue that the way in which theories concerning the development of the human species have been undermining the "nature-culture" dichotomy, provides new insights into how we may understand the unity of the human race, which is presupposed in the doctrine of original sin.

The unity of the human race is a crucial element of the doctrine of original sin. In technical language this is referred to as the *peccatum originale originatum* or "originated original sin." Why is it that the consequences of the sins of human individuals are determinative for their offspring, so much so that sin becomes their "second nature"?[3] Traditionally, the most common answers come from Augustine and Calvin. In the Augustinian tradition, humanity is seen as a metaphysical unity. The position is sometimes called "realist" in that every future human being was in a real sense present in Adam. When Adam fell, human nature itself fell with him. The Calvinist tradition sees the unity of the human race in sin as a "federal" or covenantal unity: Adam was the covenant head, the covenantal or legal representative of the human race, and therefore God accounts (or imputes) Adam's sin to all of his offspring.

Both of these positions have been confronted with the problem of theodicy, as is shown by Gerrit C. Berkouwer.[4] How can a just God attribute the sin of the first couple to all their offspring? The doctrine of the federal imputation of sin seems to contradict the principle in Ezekiel 18:20 that one can only be culpable for one's own sin and not for the sin of one's parents.[5] Even if the question regarding the justice of God can be sufficiently answered or put aside, the question still remains concerning the reason for this imputation: why would a good God have chosen to do so?[6] The realist understanding of the unity of the human race answers the question by responding that sin is not imputed, because the sin of Adam was our own sin: we were in Adam or "in the loins of Adam." In a certain sense, this does not answer the question, but simply asserts that there is an answer by stating that we were in Adam, which still raises the question of the goodness of God as Creator: why did God create the world in such a way that the sin of one human being became the sin of all God's descendants?

In this article, we intend to show that newer evolutionary understandings of human nature, which see the development of nature and culture as "symbiotic,"[7] provide the basis for a new understanding of the human race, an understanding that shows the powerful nature of inherited sin yet maintains the goodness of creation. It therefore avoids both the semi-Pelagian tendencies of older theories of the cultural inheritance of original sin and Manichean tendencies because it maintains that our sinfulness is a "second nature," but not an inherent part of who we are. This understanding also has consequences for the question of theodicy as it relates to original sin, because it shows that the inheritance of sin is intrinsically bound up with the way God in his goodness created us as "co-creators"[8] and in his image.

There are a number of other issues that are important when considering the doctrine of original sin in the light of modern theories of human evolution that this article will not address. For example, it does not address the issue of how sin came into the world (the *peccatum originale originans* or "originating original sin"). Yet the insights elaborated here are compatible with a number of scenarios, such as the traditional belief that sin came into the world through the fall of an Adamic head of a first undivided human community, a scenario involving a gradual development of sin, or a scenario involving parallel "falls" in different parts of the inhabited world.[9]

The science of human evolution is developing rapidly for a number of reasons, including the use of DNA mapping of populations, the comparison of human DNA with the DNA of near cousins in the evolutionary tree, and, even more recently, the comparison of human DNA with paleo-DNA from Neanderthals and other related *Homo* species.[10] Another crucial field is the study of cognitive science and the extrapolation of contemporary data—often necessarily speculative—into evolutionary history. Because of these rapid developments, it would be unwise to expect too much from or be too worried about specific developments before the field settles. For now, these reflections are therefore tentative and explorative. My amateur opinion, however, is that the understanding of the evolution of the human species as a "symbiosis" or "coevolution"[11] of genes and culture is here to stay.

The argument of this article presupposes a methodological distinction developed elsewhere between "doctrine" and "theological theory."[12] The doctrine that we inherit a sinful "nature" from birth does not depend on specific theological theories such as the realist or federal understanding of the unity of the human race. We intend to show here that the essential elements of the doctrine of original sin may be better expressed and understood with the help of a different theoretical framework: the theory of cultural transmission. In the light of this distinction between doctrine and theological theory, it is revealing that the sixteenth-century Lutheran and Reformed confessional texts contain strong pronouncements on the radicalism and universal spread of original sin, but are virtually silent on the doctrinal theories that might support such pronouncements. They do not, for example, pronounce for or against federalism or realism, and they do not explicate the relationship between original guilt and original corruption, which played a major role in the discussions concerning the appropriate theological explanation of original sin.[13]

The Human Being as a Cultural Animal

As indicated previously, one of the decisive developments in newer theories of human evolution is the breaking down of "the modernist rupture of nature and culture."[14] Biologists no longer conceive of a finished *Homo sapiens* at the conclusion of a long process of biological evolution who subsequently started developing culture. Such a being would not be able to survive. On a purely physical level, the human species is a "Mängelwesen,"[15] a needy being, that is much less well equipped to survive in a harsh natural environment than other species: humans have no fangs, are not well equipped to flee predators, and have no thick fur to protect them from the elements. Although humankind lives in many different habitats, it is not particularly well adapted to any of these, unlike other plant and animal species that are.

Humankind is therefore able to survive only with a certain degree of culture. They need a high level of social collaboration that goes beyond helping those who have identical or almost identical genes;[16] they need to develop tools, hunting weapons, and protection from the elements so that they can compensate for their lack of biological adaptation. The specific biological form of the modern human being must therefore have coevolved with culture: as the brain gradually evolved the ability to use tools, language, and culture, it became through the same process highly dependent on this culture for its own survival.[17]

Ralph Wendell Burhoe has proposed "symbiosis" as a model for understanding how the genetic makeup of the human species became uniquely adapted to living in a cultural environment.[18] He uses the example of the evolution of social termites with that of the species of flagellate protozoa that live in their intestines. Both species are highly adapted to each other and have evolved together to such a point that their existence depends on this symbiosis. Burhoe proposes that one might conceive of human beings living together in culturally shaped social communities as new "super organisms" or "societal organisms" that develop in their own manner, in which the relevant information is no longer transmitted through genes but through cultural memory.[19] These societal organisms do obviously depend on the existence of the genetically coded human species, but the human species, in turn, has developed genetically in such a way that it can only survive—let alone prosper and continue to develop—if it lives as part of a human society with a developed culture. The genetic code of the human species develops not only in symbiosis with the genetic codes of other species (such as domesticated cereals and livestock) but also in symbiosis with this "societal organism." Human culture is therefore itself a biological phenomenon and one of the outcomes of biological evolution—which is, of course, something entirely different from saying that cultural processes can be reduced to biological processes.

This unique evolutionary development, therefore, produced one unique biological species that is capable of the development of culture:

> … human beings are possessed of *two* major information systems, one genetic, and one cultural. It forcefully reminds us that *both* of these systems have potential for transmission or "inheritance" across space and time, that *both* have profound effects on the behavior of the organism, and that *both* are simultaneously co-resident in each and every human being.[20]

Biologists have, of course, pointed to many phenomena in the nonhuman animal world that resemble human culture and seem to undercut the uniqueness of humankind as a creator of cultures: chimpanzees

use tools, many animals engage in complex social interaction, and a number of species have manners of communication that we may call "languages." One answer to this challenge would simply be to indicate the sheer scale of the difference between these species and the enormous quantitative extent to which humans have developed tools, language, and social interaction. This quantitative difference might itself be sufficient to put the human species in a special category. The difference, however, in all probability runs more deeply. Let me, in this respect, point to three studies that give overviews of the differences between human culture and culture-like expressions in other animal species.

Terrence W. Deacon has analyzed the specific character of human language and the coevolution of language and the brain.[21] He compares human language with similar phenomena in the nonhuman world such as the honey bee recruitment dance, the humpback whale song, and vervet monkey alarm calls. He concludes that these do not even constitute a "simple language" in comparison to human languages, because these languages do not constitute a "symbolic" universe, not even in its simplest form.[22] Human languages do not simply express inner feelings or refer directly to certain outer events or realities (as in the call of vervet monkeys), but they create a symbolic universe in which different words become symbols that gain meaning in relation to each other and not just in relation to a nonlinguistic reality. In this sense, human language represents a tool that allows its users to organize and interpret the world in different ways and to transmit this interpretation or organization of the world to their offspring.

The nearest example Deacon provides of the understanding of "symbols" in this technical sense comes from a study of chimpanzees recorded by Sue Savage-Rumbaugh and Duane Rumbaugh.[23] The chimpanzees, Sherman and Austin, were able to cross what Deacon calls the "symbolic threshold," yet the experiment also shows how laborious and difficult it was and suggests that even this small step across the threshold might have never been possible without elaborate training by humans who are already a "symbolic species."

The second difference between human culture and nonhuman approximations of culture is brought out in a comparative study by Michael Tomasello at the Max Planck Institute for Evolutionary Anthropology.[24] After comparing a number of studies of learning and culture among monkeys and primates, he concludes that human learning has a different character, because it allows for cultural learning, namely, for the transmission of culture from one generation to another. Animals do learn from "cultural" practices that are shared in their community (such as potato washing in certain groups of macaques or the use of sticks to retrieve ants from ant holes, in particular, in chimpanzee populations), but this probably occurs through a process that Tomasello and his colleagues call "emulation learning": it is by looking at what their group members do that they discover, by themselves, individually, how these tools can be used. This may happen because they are simply attracted to a place where such practices can be discovered or possibly by understanding the intentions of their fellow group members. This is different from the "imitation learning" by human children in which practices are transmitted that are "opaque" in the sense that their practical value is not immediately clear.[25] This allows for a unique form of cultural progress because of the "ratchet effect"[26] in which cultural gains can be transmitted and thereby elaborated upon by later generations.[27] Tomasello estimates that the genetic difference between modern humans and their genetic ancestors may have been very small, but that this small change had far-reaching implications because it allowed for a new way of progressive learning and cultural adaptation.

A third difference may still need more research, but important comparative studies between human children and other primates suggest that the human species is "ultra-social."[28] "[N]on-human primate (and other animal) culture is essentially individualistic, or maybe even exploitative."[29] Only the human species has motivations and skills for "shared intentionality"—that is, humans will engage jointly in collaborative projects in which different individuals may be assigned different roles.[30]

A different strand of research that underlines the crucial role of culture in human evolution is the study of the role of so-called "niche construction" in the evolutionary process.[31] Different species do not just adapt to their environment through random genetic mutation and natural selection, as in "standard evolutionary theory." Kevin Laland and others have argued about the need for an "extended evolutionary synthesis" in which other factors are considered essential for explaining the evolutionary process. A

crucial element of this "extended evolutionary synthesis" is the role of niche construction. Species not only adapt to their environment, but they also adapt their environment through niche construction or "ecosystem engineering." Well-known examples are earthworms, which change the soil structure, and beavers, which build dams altering the water systems in their habitat. These changes do not impact individuals and groups alone; they also influence habitats across generations.[32] These newly formed habitats consequently form a new environmental factor that can feed back into the genetic development of species.

Niche construction is, therefore, far from unique to humans, but human niche construction has unique traits. The human ability to adapt the environment is not only passed on genetically, but also by cultural transmission.[33] This may strongly increase the speed of evolutionary development, given that cultural changes can happen at a much higher speed than genetic changes.[34] It also means that the human species can adapt to extremely different environments, from the arctic to the semi-desert and from atolls to rainforests. While their adaptability is mainly determined by cultural diversity and hardly or not at all by genetic variation, they do adapt to these environments to a significant extent by adapting the environments to themselves: by constructing igloos and pile-dwellings and by constructing rice paddies and fences to keep roaming predators out.[35]

Human biological existence is therefore cultural through and through. "Nature and culture act as a synergy. If the human is like cake, culture is like the eggs, not like the icing—it is an inseparable part, not a superficial glaze."[36] In the light of this, it makes sense to point with Philip Hefner to the uniqueness of the human species in theological terms as the "created co-creator":[37] the God-guided evolutionary process envisaged the development of a species that is not exclusively bound by instincts, but has a certain freedom to contribute to the creation of their own environment and to the development of culture. In this way, *Homo sapiens* becomes a reflection of its Creator. Here we start using theological language that picks up elements that have long been part of theological discourse concerning the human being as created in the image of God. One prevalent interpretation specifically understands the creation of humankind in the image of God in terms of the cultural mandate: the calling to develop and care for the earth and culture. Others may have a wider understanding of the image of God that also includes interhuman relationality and the invitation to relate to God, but that would still see the human call and ability to develop culture as a consequence and part of this broader understanding of the image of God.[38]

Theological anthropology does not necessarily map one-to-one onto the biological sketch just given. We suppose, for example, that not every being called *Homo* in the biological sense is necessarily a human being created in the image of God in the theological sense. Something needs to be added, possibly a special act of creation, possibly an invitation and call by the Creator into the covenant that lifts this being out of its environment in another sense.[39] It is very hard—perhaps impossible—to determine what type of consciousness and cultural ability was needed for that to happen and when those conditions might have been in place.

The Radical Dependence of Our Species on Parents and Caregivers

In 1940, the German philosopher and sociologist Arnold Gehlen published an influential philosophical reflection on human nature in the light of then recent biological studies: *Der Mensch: Seine Natur und seine Stellung in der Welt*.[40] Gehlen understood the uniqueness of humankind with a notion he borrowed from the philosopher Max Scheler as "*Weltoffenheit*," openness to the world.[41] In this book, he already touched upon a number of themes that we have encountered in the more recent studies about the role of culture in human evolution. The human being is different from other animal species in that all others have evolved to fit into a specific environmental niche. The other animals have both the physical equipment and the instinctive drives that make them highly adapted to specific environments, be it alpine highlands or tropical savannas, swamps or pacific atolls. Humankind is different in that it is not bound to a specific environment nor instinctively programmed to one specific way of life: humans can adapt to different environments. They are open to the world. They can develop culture, but, at the same time, they depend on it. Culture is essential to their biological make-up. "*Die Kultur ist also die 'zweite Natur.'*"[42]

Gehlen is an interesting source for the theme of original sin in that he points to a corollary of this openness to the world. Precisely because they are

"*weltoffen*," humans are "Mängelwesen," "needy beings" compared to other species; they are not naturally equipped to survive in a specific environment. Compared with other mammalian species, human offspring are extraordinarily dependent on their parents. A piglet doubles its birth weight in fourteen days, a foal in sixty days, a human baby only in 180 days.[43] Gehlen also points to other characteristics, such as the development of teeth and the phenomenon of puberty as signs of the postponement of adulthood. Related to this is the ability of human females, in particular, to live on after they have lost their fertility, thus giving them the ability to care for their young for a long period of time. This slow physical development and long dependence on care from parents and the wider community[44] is a necessary corollary of their "openness to the world." Precisely because human beings are dependent on culture in order to survive, they can only survive after prolonged socialization in specific cultural expressions. Humans are unique animals in that they can survive in semi-desert and arctic tundra, in fishing villages and inner cities. Yet, they cannot survive anywhere without adequate socialization. Even if there are incidental stories of lost babies being cared for by wolves, it is hard to imagine that a group of such socialized humans would be able to form a biologically viable community. In order to survive, in order to live, in order to develop, we need to be socialized in a particular culture.

A related difference between humans and other primates is visible in the process of imitative learning. Human children tend to imitate parents and teachers even if they do not understand the meaning of the actions performed, in contrast to chimpanzees who often skip actions they recognize as irrelevant for an action they want to perform.[45] This suggests that the difference between humans and other primates may not be based on humans being more intelligent.[46] The decisive difference is that humans are more collaborative and more inclined and even hardwired to follow the example of their parents and educators. They are hardwired to follow "social conventions." "If the glue of primate societies is individual social relationships, the super glue of human societies is generalized social norms."[47] It is precisely these social habits that allow for the transmission of "linguistic symbols and other cultural conventions whose use cannot be discovered on one's own"[48] and that are crucial for the "ratchet effect" characteristic of human cultural progress. As Tomasello observes,

> Obviously some kind of social environment is also important in the ontogeny of other primate species for developing species-typical behaviors of all kinds, and cultural transmission may even play some role as well. But for humans the species-typical social environment is an absolute necessity for youngsters to develop the cognitive skills required for survival in many very different, and sometimes harsh environments that humans inhabit.[49]

This far-reaching dependence on parental and communal care can contribute significantly to our understanding of original sin. If human offspring are so dependent on socialization by their community, they will necessarily inherit both stronger and weaker aspects, both good and bad, or even detestable aspects of the culture in which they are raised. Children are hardwired to trust their educators.[50] This is precisely why parents can do so much good and so much evil in the lives of their children. Growing up as a member of the human species necessarily means being socialized in one particular cultural expression of this culture, with the good and the bad. When we transpose this analysis from a biological into a theological key, we may conclude that some form of the doctrine of original sin is a close corollary (and, given the nature of our world, a necessary corollary) of the doctrine of the creation of humankind in the image of God. For human beings to be God's created co-creator and capable of freedom in an open relationship with the world, they are necessarily dependent on a long and intense process of cultural socialization by their parents and community. This dependence compensates for the fact that they are not physically and instinctively hardwired to fit in a particular environmental niche and allows for the cultural formation needed to live in a specific cultural niche. Yet, they therefore inherit both the good and the bad symbolic representations of the world and customs of the particular culture in which they grow up. Sinful ideas and sinful habits are necessarily transmitted from one generation to another.

Understanding Original Sin

In the last section of this article, we would like to explore some further implications of this theoretical framework for the interface between the doctrine of original sin and human evolution. It seems to us that this cultural understanding of the transmission of sin is fruitful for the theological understanding of the doctrine of original sin on at least four counts.

In the first place, and possibly most significantly, it provides an answer to the theodicy question that has been haunting the doctrine of original sin. Why would a good God create a world in which remote ancestral sins could have such disastrous consequences for their offspring? At least part of the answer may be that inheriting sinful cultural practices is, in this world, a necessary corollary of the development of human freedom, of the greatness of humankind as created in the image of God as God's created co-creator. It may even be the case that it is a necessary corollary of the other crucial aspect of human freedom: the ability to freely relate to the Creator himself and freely respond to God's offer of love. One may, of course, wonder whether God might not have created a world that did not have this characteristic, but it is clear that such a world would be very different from the world in which we live. God could not just change the inheritance factor while keeping the rest of the world as we know it intact. Such a world would be so different that the question whether such a world would be a better one might be impossible to answer from our finite creaturely perspectives. Furthermore, in such a world human beings would have radically different identities. Can I rationally wish for a world in which I myself with my current identity would not exist?[51]

This understanding of the doctrine of original sin therefore implies a particular stance in a longstanding debate in the Reformed tradition concerning the relationship between original guilt and original corruption. Are all human beings corrupted as a consequence of the "immediate" imputation of Adam's sin to his offspring as in the scholastic Reformed tradition that originated with Théodore de Bèze, 1519–1605? Or is Adam's guilt "mediately" imputed to Adam's offspring because of their own sins which are unavoidable because of the inheritance of Adam's corrupted nature as in Josué de La Place, c. 1596–c. 1655, and the seventeenth-century theology from Saumur, and probably from John Calvin and Jonathan Edwards?[52] The cultural inheritance theory would most naturally be linked to the latter position. The wider theological arguments surrounding this debate are outside the scope of this article.

In the second place, the coevolution of culture and the human biological constitution does allow for an understanding of how sinning can become "second nature" for all human beings, while maintaining that it is not part of God's good creation. Human beings are necessarily cultural and therefore exist without inheriting sinful culture from their parents, yet the concrete shape of this culture is not part of their created being. Being created as a cultural being is itself part of the greatness of what it means to be human and part of God's good creation, thus avoiding Manichaean tendencies. The cultural understanding of original sin therefore differs in important respects from the one developed by Patricia Williams. Williams explains original sin with the help of sociobiology and sees the doctrine of original sin as a theological interpretation of the biological fact that human selfishness is part of our biological inheritance and encoded in our genes inherited from a prehuman history.[53] The cultural inheritance approach to original sin locates sin more strongly on the cultural side of the coevolution of genes and culture, thus locating sin in human action and history rather than in what is given with creation.

More reflection is needed on the question of whether certain biological drives and instincts inherited from our prehuman past, such as the egocentric desire for survival at the expense of others, count as being sinful and are morally reprehensible. This question falls beyond the scope of this article, but two initial considerations are in order. A first consideration that needs to be taken into account with regard to this question is that the drives inherited from our prehuman past do not all point in the same direction. Some seem to hinder the development of moral attitudes; others seem to support them, such as the biological instinct to take care of our offspring and of other group members, which may play a role in the development of altruism.

A second consideration relates to the moral nature of these biological drives. The intrinsic fallibility of our drives does not yet count as sin. Karl Rahner's distinction between different aspects of the theological notion of "concupiscence" is helpful. The fundamental desires that are part of our human history are not in themselves sinful, even if they need to be "mastered" in order to prevent them from leading us into sin. These biological drives only become sinful when they become integrated in a personal response to a God-given moral order.[54] It is the integration of these desires in a life characterized by a sinful rejection of God that makes them count as sin, and the solidification and accumulation of this rejection in human cultural history that counts as original sin.[55]

In the third place, this understanding of original sin answers the constant worry about older formulations of original sin involving imitation or cultural transmission that have been associated with Pelagius and later forms of semi-Pelagianism. This view has, in various ways, been condemned by the orthodox tradition, because it does not take seriously the fact that we are not just free imitators, but that humankind is enslaved to sin, bound by sin. "Original sin is transmitted with human nature, 'by propagation, not by imitation.'"[56] In these newer understandings, cultural transmission does not happen by simple imitation. Human beings are entirely dependent on cultural socialization by and in the communities in which they grow up and are therefore indeed enslaved to these cultural forms.

On the one hand, this approach to original sin does justice to the fact that sin, in general, and original sin, in particular, is not only a qualification of personal choices and personal attitudes. Sin is also an aspect of cultures and societies that enslave individuals. Sin has a structural component. Yet, at the same time, it would be superficial to understand sin as primarily located in cultures and societal structures of which individuals are merely victims. Because human beings are socialized into the cultural value system of their community, they assimilate this sin into their very being, which only exists as a symbiosis of nature and nurture. It is anchored in their fundamental outlook on life (the way they symbolically organize reality), in the way they structure their deepest desires, and in the way they develop their characters.

Culture, however, is not simply an evil straightjacket in which we are trapped. On the one hand, every particular culture in which people find themselves, in this age, is a deeply interwoven tapestry of both good and evil.[57] We inherit both great gifts and important weaknesses, both evil inclinations and restraining strictures from our cultural ancestors. This is the complex reality from which the theological questions surrounding "Christ and culture" issue and with which the question of cultural contextualization deals. On the other hand, every particular culture is, again, in different forms, a mixture of both bondage and freedom, of both limitations and opportunity.[58] In concrete culturally shaped communities, individuals always have varying degrees of freedom and independence to choose from the different traditions at hand which allow for creative innovation. This is what allows for cultural development, for good and for evil. The doctrine of original sin does not mean that human beings have no freedom whatsoever and that nothing good is left in the nature-culture continuum. It does mean, however, that left to their own devices and apart from grace, human beings will not be able to develop healthy cultures that allow any individual, let alone all, to fully flourish and embrace the love of their Creator.

In the light of the questions that have recently been raised at the interface of human evolution and the doctrine of original sin, this theory of cultural transmission has, in the fourth place, the advantage in that it allows for a transmission of sin that moves both downward through the generations and sideways through human communities. This is important given the strong scientific evidence that there never was a single human pair from whom all current human beings are descended. Extrapolation from the DNA in the current human population suggests that there was a population bottleneck of at least ten thousand individuals.[59] How might a first sin in such a community be decisive for the entire human population so that all came to share in the consequences of this first sin? This is a particular problem for the realist understanding of the propagation of sin, since all human descendants can no longer be supposed to share their sinful nature with the first human being in the realist sense that all Adam's descendants were "in his loins" and therefore fell with him. In this respect, both federalism and the cultural model for the human race have an advantage, because they allow for the propagation of sin both vertically and horizontally through the human community. One might conceive of a first individual or couple of a broader human population who became aware of God's calling and were therefore, by definition, the first who could be called "human" in the theological sense. They were therefore, by definition, the first human beings who *could* sin[60] and from them a sinful attitude to life spread out both vertically and horizontally, potentially together with the consciousness of God, so that for all others—apart from this first person, couple, or community—consciousness of God was from the very first instance tainted by a consciousness of sin and guilt.[61]

Conclusion

Given both the recentness and the speed of new discoveries and theories in human evolution and the

profound questions they raise for the doctrine of original sin, it is too early and would be unwise to settle on the "best" theological theory that helps us understand the doctrine of original sin in the light of these discoveries and theories. This engagement will raise major issues, and patience may be a crucial theological virtue in addressing them. This article has, however, intended to show that this engagement should not be conceived only in terms of a one-directional development that puts traditional doctrines under increasing pressure. These developments will also allow for new creative insights and engagement. In particular, we have argued that the new understanding concerning the coevolution of genes and culture allows for new insights into the doctrine of original sin, primarily by strengthening an older so-called cultural understanding of the unity of humankind presupposed in the doctrine of original sin.[62]

Acknowledgment

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Notes

[1]Alister E. McGrath, *A Fine-Tuned Universe: The Quest for God in Science and Theology*; The 2009 Gifford Lectures (Louisville, KY: Westminster John Knox Press, 2009).

[2]John Polkinghorne, *Science and Providence: God's Interaction with the World* (London: SPCK, 1989), 28–30.

[3]John Calvin, *Institutes of the Christian Religion*, 2 vols., trans. Henry Beveridge (1559; Grand Rapids, MI: Eerdmans, 1983), 2.2.11.

[4]Gerrit C. Berkouwer, *De zonde II. Wezen en verbreiding der zonde. Dogmatische studiën* (Kampen: Kok, 1960), 270ff, translated as Gerrit C. Berkouwer, *Sin* (Grand Rapids, MI: Eerdmans, 1971), 424ff.

[5]Berkouwer, *De zonde II*, 210; and Berkouwer, *Sin*, 427.

[6]"*[D]e zin der imputatie (van schuld)*" (Berkouwer, *De zonde II*, 242) has been translated as having "the meaning of an 'imputation of guilt'" (Berkouwer, *Sin*, 461) but can also mean "the reason for the imputation of guilt," which adds an extra layer of meaning to the original Dutch text.

[7]Ralph Wendell Burhoe, "The Source of Civilization in the Natural Selection of Coadapted Information in Genes and Culture," *Zygon* 11, no. 3 (1976): 263–303.

[8]Philip J. Hefner, *The Human Factor: Evolution, Culture, and Religion* (Minneapolis, MN: Fortress Press, 1993).

[9]For a number of scenarios, see Denis Alexander, *Creation or Evolution: Do We Have to Choose?* (Oxford: Monarch Books, 2008), 235–39; 254–56.

[10]See, for example, Dennis R. Venema, "Genesis and the Genome: Genomics Evidence for Human-Ape Common Ancestry and Ancestral Hominid Population Sizes," *Perspectives on Science and Christian Faith* 62, no. 3 (2010): 166–78; and Nicolas Ray, "*Les origines de l'humanité: l'apport de la génétique*," in *Adam, qui es-tu?: Perspectives bibliques et scientifiques sur l'origine de l'humanité*, ed. Lydia Jaeger (Paris: Excelsis, 2013), 89–109.

[11]William H. Durham, *Coevolution: Genes, Culture, and Human Diversity* (Stanford, CA: Stanford University Press, 1991).

[12]Benno van den Toren, "Distinguishing Doctrine and Theological Theory: A Tool for Exploring the Interface between Science and Faith" (forthcoming); and Benno van den Toren, "Not All Doctrines Are Equal—Configuring Adam and Eve," *BioLogos* (blog entry), February 17, 2014, http://biologos.org/blog/not-all-doctrines-are-equalconfiguring-adam-and-eve.

[13]Berkouwer, *De zonde II*, 248ff; and Berkouwer, *Sin*, 466ff.

[14]Philip J. Hefner, "*Culture Is Where It Happens*," *Zygon* 40, no. 3 (2005): 523.

[15]Arnold Gehlen, *Der Mensch: Seine Natur und seine Stellung in der Welt* (1940; Wiesbaden: Akademische Verlagsgesellschaft Athenaion, 1978), 20, 33ff, translated as Arnold Gehlen, *Man, His Nature and Place in the World* (New York: Columbia University Press, 1988).

[16]Michael Tomasello, "The Ultra-Social Animal," *European Journal of Social Psychology* 44, no. 3 (2014): 187–94; and Michael Tomasello, "Human Culture in Evolutionary Perspective," in *Advances in Culture and Psychology*, vol. 1, ed. Michele J. Gelfand, Chi-yue Chiu, and Ying-yi Hong (New York: Oxford University Press, 2011), 6–22.

[17]Hefner, *The Human Factor*.

[18]Burhoe, "The Source of Civilization in the Natural Selection of Coadapted Information in Genes and Culture," 276.

[19]Ibid., 282.

[20]William H. Durham, *Coevolution: Genes, Culture, and Human Diversity* (Stanford, CA: Stanford University Press, 1991), 9, italics added.

[21]Terrence William Deacon, *The Symbolic Species: The Coevolution of Language and the Human Brain* (New York: W.W. Norton, 1997).

[22]Ibid., 39–40.

[23]Ibid., 84ff.

[24]Michael Tomasello, "The Human Adaptation for Culture," *Annual Review of Anthropology* 28 (1999): 509–29.

[25]G. Gergely and G. Csibra, "Sylvia's Recipe: The Role of Imitation and Pedagogy in the Transmission of Cultural Knowledge," in *Roots of Human Sociality: Culture, Cognition and Interaction*, ed. Nicholas J. Enfield and Stephen C. Levinson (New York: Berg Publishers, 2006), 229–55.

[26]Tomasello, "The Human Adaptation for Culture," 512; compare Tomasello, "Human Culture in Evolutionary Perspective."

[27]Whiten et al. give an overview of recent studies in this area that suggest that the contrast between emulative learning in primates and imitative learning in human children is not as sharp as Tomasello suggested, yet these studies do not undermine the fundamental thesis that "our species has acquired more refined capacities for both higher fidelity imitation and cumulative cultural learning" (Andrew Whiten et al., "Emulation, Imitation, Over-Imitation and the Scope of Culture for Child and Chimpanzee," *Philosophical Transactions of the Royal Society B: Biological Sciences* 364, no. 1528 [2009]: 2427).

[28]Tomasello, "The Ultra-Social Animal."

[29]Tomasello, "Human Culture in Evolutionary Perspective," 5.

[30]Ibid., 6.

[31]Kevin Laland et al., "Does Evolutionary Theory Need a Rethink?" *Nature* 514, no. 7521 (2014): 161–64.
[32]F. John Odling-Smee, Kevin N. Laland, and Marcus W. Feldman, *Niche Construction: The Neglected Process in Evolution* (Princeton, NJ: Princeton University Press, 2003).
[33]K. N. Laland, J. Odling-Smee, and M. W. Feldman, "Cultural Niche Construction and Human Evolution," *Journal of Evolutionary Biology* 14, no. 1 (2001): 22–33; and Odling-Smee, Laland, and Feldman, *Niche Construction*, 239ff.
[34]Laland, Odling-Smee, and Feldman, "Cultural Niche Construction and Human Evolution," 31.
[35]There is, of course, a measure of genetic adaptation to different physical habitats, most visible in darker skin-color in populations living near the equator. That cultural adaptation to environments trumps genetic adaptation is apparent in the fact that people with darker skin color have moved to cooler climates and those with lighter color have moved to tropical zones, and that both groups have been able to adapt relatively easily to this new physical environment.
[36]Jonathan Marks, *What It Means to Be 98% Chimpanzee: Apes, People, and Their Genes* (Berkeley, CA: University of California Press, 2003), 177.
[37]Hefner, *The Human Factor*, 23ff.
[38]See, for example, Henri Blocher, *In the Beginning: The Opening Chapters of Genesis* (Downers Grove, IL: InterVarsity Press, 1984), 90; and Charles Sherlock, *The Doctrine of Humanity* (Downers Grove, IL: InterVarsity Press, 1996).
[39]Compare Alexander, *Creation or Evolution*, 236–37.
[40]One reason why Gehlen has received relatively little attention in the English-speaking world may be that he was tainted by his membership in the NSDAP before the war and his opportunistic rise up the academic ladder in the place of others who lost their jobs under the Nazi government. We should be worried about some racist implications he draws from his biological observations (Gehlen, *Der Mensch*, 112–13). These do not, however, necessarily follow from these observations. If Tomasello ("The Human Adaptation for Culture") and Gergely and Csibra ("Sylvia's Recipe") are right that only a small genetic difference might have been the occasion for a radical distinction between humans and the rest of the animal world (humans' ability to develop a progressive culture), then biological differences between human races would be nonconsequential for human identity.
[41]Compare Wolfhart Pannenberg, *Anthropologie in theologischer Perspektive* (Göttingen: Vandenhoeck & Ruprecht, 1983), translated as Wolfhart Pannenberg, *Anthropology in Theological Perspective* (Philadelphia, PA: Westminster Press, 1985) for an exploration of the theological potential of this notion of "Weltoffenheit."
[42]Gehlen, *Der Mensch*, 38.
[43]Ibid., 103.
[44]We add "the wider community" because biological descent is not the decisive factor. Children can also be raised by adoptive parents or adoptive communities.
[45]Andrew Whiten et al., "Imitative Learning of Artificial Fruit Processing in Children (*Homo sapiens*) and Chimpanzees (*Pan Troglodytes*)," *Journal of Comparative Psychology* 110, no. 1 (1996): 3–14; compare, Katherine Nagell, Raquel S. Olguin, and Michael Tomasello, "Processes of Social Learning in the Tool Use of Chimpanzees (*Pan Troglodytes*) and Human Children (*Homo sapiens*)," *Journal of Comparative Psychology* 107, no. 2 (1993): 174–86.
[46]Tomasello, "Human Culture in Evolutionary Perspective," 30.
[47]Ibid., 20; compare p. 28.
[48]Ibid., 28.
[49]Ibid., 38.
[50]Gergely and Csibra, "Sylvia's Recipe"; and Giacomo Rizzolatti, "Imitation: Mechanisms and Importance for Human Culture," *Rendiconti Lincei: Scienze Fisiche e Naturali* 25, no. 3 (2014): 285–89.
[51]The last question sharpens and reformulates the more general issue in this thesis in terms of a nonidentity theodicy as it is developed by Vincent Raphael Vitale, "Horrendous Evils and the Ethical Perfection of God" (PhD diss., University of Oxford, 2012).
[52]See David Llewellyn Jenkins, *Saumur Redux: Josué de La Place and the Question of Adam's Sin* (Norfolk, VA: Leaping Cat Press, 2008).
[53]Patricia A. Williams, "Sociobiology and Original Sin," *Zygon* 35, no. 4 (2000): 783–812.
[54]Karl Rahner, "Zum theologischen Begriff der Konkupiszenz," in *Schriften zur Theologie*, vol. 1 (Einsiedeln, Zürich, Köln: Benziger, 1954), 377–414, translated as Karl Rahner, "The Theological Concept of *Concupiscentia*," in *Theological Investigations*, vol. 1 (London: Darton, Longman and Todd, 1974), 347–82.
[55]Denis Edwards, *The God of Evolution: A Trinitarian Theology* (Mahwah, NJ: Paulist Press, 1999), 65–66.
[56]Catholic Church, *Catechism of the Catholic Church* (New York: Doubleday, 1995), #419; compare with Williams, "Sociobiology and Original Sin," 802.
[57]Edwards, *The God of Evolution*, 68.
[58]Compare with Peter L. Berger and Thomas Luckmann, *The Social Construction of Reality: A Treatise in the Sociology of Knowledge* (Garden City, NY: Doubleday, 1966), 69.
[59]Venema, "Genesis and the Genome."
[60]Keith Ward, *Religion and Human Nature* (New York: Oxford University Press, 1998), 161.
[61]This, of course, leaves the problem of how the sinfulness of such a community might spread to other humans, if there were from the very beginning human communities that lived separated from each other (as the early existence of communities in Australia suggests). In this respect, the federal approach seems to have an advantage, because God's decree is by itself considered sufficient to bind the entirety of humanity to the deed of one individual.
[62]The question of original sin is also related to other doctrines, such as the doctrine of the sinlessness of Christ, which need further exploration, but fall outside the scope of this article. If original sin is inherited culturally through socialization and enculturation in a human community, it suggests that Jesus Christ must have inherited a sinful nature from his mother and adoptive father, which goes against the dominant tradition in western theology. There has, however, been a significant minority tradition that suggests that Christ's sinlessness does not consist in having a nature untainted by sin, but in an ability to resist the sinfulness he inherited. See Edward Irving, *The Orthodox and Catholic Doctrine of Our Lord's Human Nature* (London: Baldwin & Cradock, 1830); Karl Barth, *Die Kirchliche Dogmatik* I/2, *Die Lehre vom Wort Gottes (erster Band, zweiter Halbband)* (Zollikon: Verlag der Evangelischen Buchhandlung, 1938); and Colin Gunton, "Two Dogmas Revisited: Edward Irving's Christology," *Scottish Journal of Theology* 41, no. 3 (1988): 359–76.

David L. Wilcox

Article

A Proposed Model for the Evolutionary Creation of Human Beings: From the Image of God to the Origin of Sin

David L. Wilcox

The qualities usually considered for the imago Dei *– reason, righteousness, relationship, and rule – are interactive and are scientifically measurable. Human uniqueness is a matter of prosociality, recursive consciousness, and plastic neural development. Our brains are genetically designed to be the products and the producers of culture. A model of positive feedback between high-fidelity cultural transmission and the genetic selection for neural plasticity provides a good model of how God produced those unique features. Fossil, genetic, and archaeological evidences indicate how this pattern of human uniqueness developed in Africa during the period of 400,000 to 100,000 years ago. The above model concerning how humans are unique, and how we evolved to be unique, provides insights into theological issues concerning the appearance of the image – and how we became and remain sinners.*

The scriptures are clear. God has made us in his image, different from all the other species of the earth. The data from science are clear. We are the products of a long history of evolutionary adaptation and change, coming from unremarkable animal ancestors. Is there any way to embrace both of these statements as true? Some advocates for each position state that such a rapprochement is impossible, a treacherous Trojan horse seeking the destruction of either sound theology or good science. My thesis is that this is a category mistake, that the two propositions, in fact, illuminate each other dramatically.

What Is the Image of God (or *imago Dei*)?

To show that coordination is possible, we must insure that both sides of the debate are talking about the same thing. Clearly humans *are* unique – after all, we are the ones debating our own uniqueness, not chimps or dolphins. *Homo sapiens* obviously shows a long list of unique qualities (abstract reason, representational art, complex linguistic structure, religious belief, accumulated knowledge, cultural diversity) unequalled by any other species on Earth. But which differences are significant? What is the meaning of the *imago Dei*, and will the methods of science be able to discern it?

Theologically speaking, although God's eternal decrees are considered the source of uniqueness for all creatures, human uniqueness is due to a specific unique decree – no other species was made in God's image. Further, as theologian B. B. Warfield said, design does not rule out natural cause; rather, causal chains in nature are produced by design.[1] Thus both theology and science may legitimately look in the creation for physical evidence of that uniqueness.

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Of course, for insights on the planned essence of things, theology prefers to use the scriptures. A verbal communication from the creator/designer can give inside information on the designer's intent.

> So God created man in his own image, in the image of God created he him; male and female he created them. God blessed them and said to them, "Be fruitful and increase in number; fill the earth and subdue it. Rule over … every living creature … I give you every seed-bearing plant … for food." (Gen. 1:27–30)
>
> The LORD God formed man from the dust of the ground and breathed into his nostrils the breath of life, and man became a living being … and put him into the Garden of Eden to work it and to take care of it. (Gen. 2:7,15)
>
> Cursed is the ground because of you; through painful toil you will eat of it … Until you return to the ground, since from it you were taken; for dust you are and to dust you will return. (Gen. 3:17b,19b)

On the one hand, the scriptures say that humans, in common with other animals, are made of dust (the same material), are given the same food (green plants), and are commanded to increase and fill the earth (same commands). On the other hand, in distinction from other animals, humans, as God's image, are appointed (under God) to rule over the animals and the earth (fleshed out as instructions to care for God's garden, by extension perhaps to extend the order of the garden over the earth). Thus one important dimension of how humans were to image God was a unique commission to act as God's "executive assistants," his representatives to govern the earth.[2] But ecosystem governance (an ecological role) is not the only meaning that has been proposed for the *imago Dei*.

Theological discussion has long contrasted the "structural" aspects of the image—what humans are—and the "functional" aspects—what humans (are supposed to) do.[3] The most familiar structural aspect is "reason," the idea that the human "rational soul" mirrors the mind of God and allows humans to understand God and the world that he made. Thus, humans can communicate with, companion with, and worship their Maker in a unique way. This view was especially meaningful to theologians such as Augustine and Aquinas, who were influenced by the Greek concept of eternal reason.[4] The image as reason has been held more recently by evangelical scholars Carl F. H. Henry and Gordon Clark.

> The image must be reason or intellect. Christ is the image of God because he is God's Logos or Wisdom. This Logos enlightens every man that comes into the world. Man must be rational to have fellowship with God.[5]

This differs from the preeminent Enlightenment understanding of "omni-competent" human reason. Human reason is necessarily either a limited, finite reflection of the rationality of the infinite Creator or a limited, finite product of nonrational nature. And although powerful, if human rationality was damaged by a Fall, it is driven to rationalization rather than to clear insight. The Enlightenment idea that human reason can be "the measure of all things" was a "cut root" conviction derived from forgotten Platonist and Christian assumptions. It has become increasing clear that the Enlightenment vision was illusion. Human reason forms an "image" of the world from our experience; it is not prior to and above reality. Some still accept human rationality as ultimately valid through a "blind faith" in the capacity of irrational physical processes to produce true reason, but the more reasonable materialist view would be that human reason is an evolved mechanism, functionally honed (and thus limited) by its pragmatic usefulness in achieving survival and gaining mates. Still, the nature of human cognition remains a primary parameter of "true humanity." The interesting question currently being raised in anthropology is, what sort of cognition is critical for being human? Is it primarily our understanding of physical reality or of social realities and relationships?

A second structural understanding of the *imago Dei* is "righteousness," human behavior which reflects God's holy character in thought, word, and deed. This was the concept favored by the Reformers Calvin and Luther. The essence of humanness is thus morality, the inward knowledge or perception of truly correct behavior, the "law of God in the heart." Only humans can choose to obey or disobey these inward commands, for only humans are fully conscious of their own selfhood. The doctrine of the Fall describes the defacement of this moral image, although not its complete destruction. "Fallen man" still knows righteousness and still does moral reasoning. However, he freely rejects right actions, refuses to perceive or to accept the evidence for God, and uses his rational faculties to support his rebellious actions.

> For although they knew God, they neither glorified him as God nor gave thanks to him, but their think-

> ing [reason] became futile and their foolish hearts were darkened [perception]. (Rom. 1:21)

In current anthropological studies, the equivalent questions are about unique human prosocial behaviors—cooperation, altruism, selfishness—the nature of morality. A great deal of effort and debate has gone into developing models which can explain our innate impulses toward "helping" behaviors in terms of the essentially "selfish" logic of natural selection, and into more recent alternative models which assume that some form of "group" selection has produced significant human prosociality.[6]

But, of course, the definition of "morality" is hotly debated. For instance, social psychologist Jonathan Haidt points out that modern theorists tend to limit moral questions to two individualized issues—harm versus care, and fairness with justice. In contrast, traditional societies consider three other parameters of equally valid moral questions—in-group loyalty, authority and respect, purity and sanctity—values which bind and stabilize groups. Haidt points out that modern moral theorists often view such group binding issues as dangerous and primitive[7]—but such issues certainly are part of what it means to behave as a full human. In any case, the behaviors which theology calls "righteous" are indeed available for data collection and theory production.

The idea of group "binding principles" leads to a third concept of the *imago Dei*, "human relationships." Humanity is to mirror the triune God in forming relationships—with God, between husband and wife, with other humans (human society), and with the rest of the creation. "So God created man in his own image, in the image of God he created him; male and female he created them" (Gen. 1:27). For Karl Barth, the image consisted in the human capacity for relationship, and cannot be fully expressed in a solitary life. We reason or rationalize, we show altruism or selfishness, within community.[8] G.C. Berkouwer states,

> The preservation of humanness has often been interpreted as the preservation of understanding and will, but actually it manifests itself in a much deeper and more important way in the various sorts of relations between man and fellow man.[9]

In evolutionary anthropology as well, questions about the nature of human relationships lead to questions concerning the structure of human societies. Are there animal models comparable to human groups (think ants, crows, apes, or elephants)? Is the structure of human social bonds detectable in taxa of fossil hominins?

To return to the functional concept of the *imago Dei* as office, the issue is human dominion over the earth, the task that God gave humanity at its inception.

> You made him a little lower than God and crowned him with glory and honor. You made him ruler over the works of your hands; you put everything under his feet. (Ps. 8:4,5)

Reason (cognition), morality, and social relationship "describe" humanity—one can investigate their qualities. The concept of office provides a purpose for those qualities: it implies that the social, emotional, intellectual, and physical qualities of humanity were given to equip us to govern the earth (under God), to further develop God's purposes for the creation, and to mirror the kingly activity of God.

Can observation measure office? If one is looking for "dominion," the fingerprint of true humanness would be our significant—and unique—impact on the ecosystem. The Pleistocene over-kill debate reflects that awareness, as does the impact of agriculture and our current ecological crisis. Clear cultural impact? Yes! The extension of the garden? Hardly!

> For the creation was subjected to frustration, not by its own choice, but by the will of the one who subjected it, in hope that the creation itself will be liberated from its bondage to decay and brought into the glorious freedom of the children of God. (Rom. 8:20,21)

The full realization of the image is therefore seen only in the incarnation, in Jesus Christ himself, the unblemished image of God and the Restorer of the whole creation order.

All the qualities suggested above for the *imago Dei* are obviously characteristic of humanity—all reflect aspects of the eternal decree of God. Unique human qualities are realizations (abet, sometimes badly distorted) of facets of the image. And these characteristic qualities of *Homo sapiens* can be investigated by science. But can they be explained as products of some unique selective pressures acting on our ancestors, molding them into efficient survivors? Is there a reasonable evolutionary model for this? And would such an explanation exclude the hand of God?

What Makes *Homo sapiens* Truly Unique?

True, humans have specific features which we consider important identifiers. But are these features actually measurably unique in humans? That is, if there are unique aspects of the Image, can we quantify them? Are we really all that different from other socially intelligent species? Obviously, some people do not think so—witness the lawsuits advancing the human rights of chimpanzees!

But it seems so obvious that humans are unique. No other species writes poetry, builds ships, will die for an idea, makes maps, envisions a deity, and so forth. Yet many of the characteristics we typically consider distinctively human have been identified in some form in other animal species. Crows and chimpanzees make tools. Dolphins have personal identifying whistles—"names." Elephants, and perhaps crows, seem to mourn their dead. Chimpanzees, elephants, and dolphins pass information between generations—a parallel to human culture. Apes, dogs, and parrots can learn human words for objects or actions. Chimp troops are described as engaging in "war" with their neighbors. So, are our vaunted (or abhorred) human characteristics simply upgrades of the preexisting behavioral software found in other species? Not necessarily. The current best models state that although humans do share cognitive processes found in other species, they transcend them.

To start with a quick overview, Kim Hill et al., in explaining human success, point out unique human physiological, behavioral, cognitive, and emotive traits.[10] They emphasize the critical role played by cumulative adaptive cultural change, pointing out its dependence on social learning. Social learning, they argue, depends on certain behavioral proclivities, cognitive capabilities, and emotional mechanisms which are unique to humans. So, how then do humans differ from chimpanzees?

Consider cognitive capacities: Esther Herrmann et al. compared the performance of young humans (2.5 years), chimps (mean age, 10 years), and orangutans (mean age, 6 years) on an array of different aspects of cognition. In tasks involved with the physical world (spatial, quantity, and causality), human toddlers and chimps scored about the same (but better than orangutans). However, when causality was broken down into the physical use of tools versus the mental understanding of underlying causes, the chimps scored better with tool use, whereas humans showed better causal understanding.[11] In contrast, in social tasks (communication, theory of mind, and social learning), humans were distinctly superior, though chimps were again better than orangutans. Human toddlers were particularly better at social learning, that is, in following demonstrated solutions to problems. Humans, it seems, have significantly greater—possibly unique—social-cognitive skills for communicating information.

Differences in understanding physical causality were further illuminated in a study by Jonas Langer that compared cognitive development in two monkey species, chimpanzees, and humans.[12] The study split logico-mathematical (LM) knowledge (classification and numerical cognition) from physical (real world) knowledge. All species started "physical" learning immediately, but there were wide differences in the developmental pattern and pace of LM knowledge. Neither species of monkey started LM development until after physical learning was complete. Humans started LM development immediately, simultaneously with physical learning. Further, human LM development continued longer, developed more rapidly, became far more complex, and ended later than in monkeys. LM development in chimps was intermediate—initiated well after physical learning had begun, and intermediate in length, speed, complexity, and end point. So, human logico-cognitive development completely overlaps the developing understanding of the physical world and the developing knowledge of the human social world as well. This overlap is a key to understanding human uniqueness.

If the most accomplished nonhuman animals are the chimpanzees and other great apes, it is not by much. A number of other highly social species such as whales, elephants, corvids, and parrots have comparable cognitive skills. Such animals variously learn the behavior of objects in their environment—they develop a usable form of observable "folk physics." Many can make simple tools. Animals must learn to detect "agency"; objects with self-initiating behavior are usually living objects. Their survival depends on the ability to make behavioral predictions from those observations. Some higher primates can perceive quantities up to four items, or evaluate ratios from a larger total. Most animals know their spacial location and home territory.[13] And a few species of animals such as chimps and dolphins can observe

the behavior of their peers well enough to emulate their outcomes, producing a simple form of "cultural" transmission.[14]

But no nonhuman animal has been shown to understand invisible causal forces such as gravity.[15] Likewise, although chimpanzees can predict behavior from observed patterns, there is no definitive evidence that they can attribute invisible mental states, such as intentions or knowledge, to another individual.[16] Chimpanzees may trace another's line of sight to find an object of regard, but they do not look back to their guide. Thus, they work in a dyadic relationship: I and you both see the object, but on our own. In contrast, humans glance back and forth to the guiding eye, forming a triadic relationship with their guide. I see the object, I join you in thinking about the object, and I think about how you are thinking of the object.[17]

Animals certainly communicate, but none has even the beginning of a recursively structured language. Although apes and a few other species can identify the numerosity of up to four objects, they cannot intuit the abstract system behind integer addition. Animals learn to run mazes; they cannot learn to read maps.[18] Although many species such as food-caching scrub jays have very efficient specialized memory systems, not even chimpanzees have been shown to retain episodic memories for more than a few seconds.[19] Apes and other animals use specialized neural modules to derive and update patterns from incoming sensory streams. This perceptual processing is specific to sensory domains, concrete (tied to physical objects), fast acting, automatic, and limited.[20]

Of course, such domain-specific neural modules are also active in human infants and continue to be active throughout adult life. What makes humans cognitively unique is the progressive development of a second, overlying neural integration system—notably involving the parietal lobes and the cerebellum. This integrative activity is closely tied to the default network, one of the unique systems associated with human specific areas of the parietal lobes, for example, the supramarginal and angular gyri.[21] Human thought is characterized by a controlled switching of the brain's conceptual focus between the task-focused attention of the central executive network (primarily the frontal and prefrontal cortex) and the defocused attention of the default network (primarily the parietal lobe, but also the cerebellum).[22] Thus, new combinations of ideas can be generated and tested (the default network connects widely; processes social information; enhances creativity; produces self-awareness, time travels, and daydreams; and is likely unique to modern humans).

This secondary level derives abstract information from the patterns produced by the primary systems—recursive rules and hierarchical structures. It links those patterns together, forming the core of logical cognition.[23] Processed through this system of secondary integration, the expected behavior of physical systems and tool skills becomes theoretical laws and technical reasoning. Numeric perceptions become mathematical deductions and theorems. Perceptions of location are transformed into symbolic representations of space, namely, into maps by age 3,[24] and then further expanded into measures of abstract reasoning, and emotional and relational distances.[25] The prediction of peer behavior becomes the prediction of their mental states, termed "mind-reading" or theory of mind (TOM). (Face reading is well underway by four months[26]). Emulation becomes directed, corrected imitation—in other words, deliberate and expected instruction. The internal logic of all of these disparate areas becomes encoded into symbols and language which allow the structured sharing/recombination of information between different centers in the brain and the sharing of those "abstract" patterns with other intelligences.[27]

This capacity for integrated global mindedness allows humans to become aware of their own mental state, producing consciousness as we know it. Human consciousness is not simply being aware of the environment and one's body, or acting on that awareness. It is the perception of one's own personal awareness. Gerald Edelman identified two levels of cognition: the primary consciousness of our situation (which we share with animals), and the secondary consciousness of our primary awareness (which we do not share).[28] In his view, the human cerebral cortex is unique in that the majority of its neural input is reentrant rather than sensory. Sensory input, he suggests, produces primary consciousness, the "remembered present." Reentrant input produces secondary consciousness, an awareness of our own mental activity which requires semantic capacities or language for its "perception." It becomes a new form of memory, the awareness of self—past, present, and future—in the remembered present.

Such internal discussion or metacognition combines the abstractions emerging from the local integrative systems, including the cerebellum which is tied to *all* the perceptual and motor areas of the cerebral cortex.[29] Since it overlays and combines abstract patterns, secondary consciousness allows internal feedback, conceptual changes, cognitive leaps, and conceptual fusion. For instance, human episodic memory can be fused into mental time travel, facilitating retrospective planning for the future.[30] Or, learned patterns can feed back into the perceptual and motor areas of the cortex, guiding and altering both perceptions and motion.[31] And most remarkably, as the brain develops, new integrative centers can be constructed, for example, the "new" center for visual word recognition. There is no significant evidence of this sort of plastic capacity in any other species.[32]

In humans and other species, the primary sensory integrative systems stimulate a drive for information about the physical and social environment. But, in fact, rather than waiting for sensory input, the human senses are evaluating the sensory predictions being made by the limbic system without sensory input.[33] Likewise, the secondary integrative systems unique to humans also hunger for information—information about abstract system structures, a drive which requires the development of complex representative language. Language allows us to pass our patterns of abstract knowledge directly between brain centers and between generations.[34]

And human language is unique. Chet Sherwood et al. summarize the following unique features from a number of studies: (1) It is independent of modality—the same information can be encoded vocally, by gesture, by writing, and so forth. (2) It is voluntary and independent of circumstance—anything can be talked about at any time. (3) It shows domain independence. Anything can be tied to anything—any object can have any property that imagination allows. (4) It is independent of action. Anything can be talked about without implying some necessary action. (5) It uses the shared meanings of arbitrary symbols. (6) It shows plurality of programming: phonemes→morphemes→sentences, et cetera. (7) It has a nested, hierarchical, recursive structure in which meaning depends on syntax.[35] No animal communication system has any of these features. Human language is not just communication; it is the structural backbone of logical cognition.

To return to chimpanzees, female chimpanzees do provide opportunities for their offspring to watch techniques, but they do not recognize the "needs of the student." They do not correct errors, nor do they attribute the concepts of "knowledgeable" or "ignorant" to individuals. This difference in "teaching technique" is also reflected in the "student response"—chimps and human children do not respond in the same way to instruction.[36] Chimps ignore extraneous actions; human children copy such actions in detail. Chimps learn how to accomplish their goals; humans learn how actions should be done correctly.[37] No nonhuman animal—not even a chimp—has been shown to directly copy (imitate) the specific actions of another. Animals learn by repeated experience, by the observation of outcomes, and thus by emulation. Humans learn by imitation, by repeated observations of process, and by imitation of the means. This implies different motives and expectations for teaching: apes see models as competitors; humans see them as helpers. Humans teach both children and other adults; chimps do not. Further, animals do not learn to copy altruistic behavior, but children do—and children assign "rightness" to observed actions, giving technique a moral shading. The human response to teaching is central to human uniqueness.

Consider the implications for accumulating cultural transmission. All humans, adult or child, voraciously seek social connections and shared information. As we individually systematize the patterns of the world, we project, simulate, elaborate, design, and plan—together. This level of societal linking and thinking is true of no other species.[38] No other species cooperates via shared intentionality.[39] As part of that drive for social connections, in adolescence we even create our sense of personal identity from the socially reflected perceptions of ourselves.[40] And our species is prosocial—uniquely (although imperfectly) altruistic, with an impulse to help and share resources even with strangers, a characteristic seen even in infants.[41] These altruistic impulses are tied to moral perceptions and cognition. When faced with a moral question, different pathways in our brain evaluate and balance our own good versus the good of the other. The "good of the other" is being evaluated by the humanly unique social intelligence areas such as the temporal-parietal junction.[42] And, among other unique conclusions we humans draw about reality, we often uniformly decide during early childhood

that God and/or ghosts exist, we instinctively perceive agency and purpose in the world, and we are cognitively ready to understand "the divine." And this we link as support to our moral judgments.[43] In contrast, agnosticism or atheism must usually be learned from directed instruction.

Unique Genetics Acting in Neural Development Make Us What We Are

Humans are essentially (necessarily) born "prematurely," before the brain has begun to mature, a process which will continue into young adulthood. For humans, knowledge about the physical environment, logico-mathematical reasoning, and social understanding are all developing simultaneously during that early period when the human brain is still in a prolonged process of shaping its neural networks. This allows flexible interactions between all categories of thought, and it actually shapes the early wiring of the brain itself (the "connectome"). It gives a "heuristic logic of experimentation" to human mental/brain formation. This means that each human brain is uniquely shaped in its very structure by its social and physical environment. Each human being is therefore a product of his or her culture, and each person becomes a maker of culture (Joseph Henrich's "cultural brain hypothesis").[44]

And the pattern of neural development in modern humans is indeed dramatically different, unique. Modern human brains balloon into a globular shape during the first few months after birth, due especially to the expansion of the parietal lobe and cerebellum, producing the distinctive rounded shape of the "modern" cranium and face.[45] This growth trajectory does not occur in the chimp, nor did it occur in archaic hominines such as the Neanderthals.[46] But after that early expansion, human neural maturation slows down. Chimpanzees reach 75% of their adult brain size by nine months, Neanderthals reached 75% at fifteen months, but modern humans take thirty months.[47] And it takes another twenty years to mature our neural circuitry. This synaptic rewiring is an extremely energy-intensive task—it uses up to 44% of our metabolic expenditure during childhood, puts the growth of the body on hold for years, and continues through adolescence.[48] Delayed synaptic maturation allows increased experience-dependent neural plasticity.

The extensive cortical rewiring which happens during human development interconnects specialized cortical areas, producing higher networks of complexity.[49] Thus, delayed synaptic maturation is a critical key to understanding the flexible nature of human intelligence, language, and culture.[50] Tomoko Sakai et al. conclude that such delayed synaptic maturation, coupled together with increased human brain volume, allows the rapid refitting of the prefrontal regions with reciprocal connections to posterior regions during infancy. These long connections, they propose, allow increasing levels of human social complexity to literally reshape the patterns of neural connectivity of the growing brain, thus giving the unique human cognition its character.[51]

So, the unique behavioral observations are supported by unique neural and genetic characteristics. Even more significant than the dramatic size of the human brain is the higher degree of neural integration. There are significantly higher levels of white matter at all structural levels. Humans' neurons have an order of magnitude more neural connections than those of chimps, longer axons with more branches, more junctions on the dendrites, and dramatically delayed synaptic maturation (increased neural reorganization).[52] Individual sections of the human cortex have more complex "wiring" (local modularization), and those distant sites are far more heavily interconnected with long fiber tracts than they are in an ape's brain.[53] Further, some cortical centers are unique in humans, particularly those involved with speech, fine-motor learning, and the default network.[54]

As for the genetic evidence, the unique character of the human mind is not due to a "magic genetic bullet." There are not just a few major alterations, not just the injection of a "new" set of genes—although some new loci have been identified. Rather, based on differences with the chimpanzee genome, human neural development depends on the wholesale alteration of the control sequences of the majority of the genes acting in the brain.[55] More than one hundred neural loci show signs of high selection, and most are upregulated and delayed in expression. Humans' neural loci also have higher levels of alternate gene splicing (hence producing a more diverse array of proteins) and altered neural epigenetic markers. Most of these differences are in loci controlling neural development. Much of this variation has been

generated by transposon-driven mutation (ALUs—or jumping genes). As to how this pattern evolved, it seems obvious to point to a selective regime favoring neural complexity. But that is an empty description. The real question for evolution would be, what circumstances would produce such a regime?

First though, what insights do the above descriptions of human uniqueness yield to a Christian understanding of humanity? Biologically speaking, the two most distinguishing features of human function are our unique levels of societal integration and of cerebral integration. We possess automatic information acquisition mechanisms in multiple areas. We do language-based personal extrapolation and scenario building in multiple areas from that information. We are unique because of our social intelligence. We deliberately guide each other's cognitive development; we share our thoughts. We are driven to link with each other at the most profound levels. Our need to connect, as driven by language, generates social learning, mind reading (theory of mind), morality, religion, music, art, and even consciousness itself. And that vision of humanity is brilliantly illuminated by the doctrinal paradigm of the *imago Dei*. Based on that doctrine, the data is precisely what we would expect from a careful, scientific evaluation of the human race.

We need not change our background principles; God has made us in his image. The scientific data clearly illuminates the nature of the *imago Dei*. The long discussions of reason, righteousness, relationship, and rule—or culture, character, community, and commission—are matched by the scientific analyses of human uniqueness. The rational capability of the human mind is a product of a myriad of genetic alterations to neural loci. Questions of morality and community are considered key elements of the functional purpose human rationality played in our survival. The extended plasticity of human neural development and the recursive nature of human language have allowed the growth and retention of culture. These qualities have given us the power—for better or worse—of shaping our environment and of dominion. But finding that the abstract maps of theology and science match does not invalidate either one. After all, what else would one expect in a world in which God used evolution to create creatures in his own image? But, how did he do it? What were his methods? Can science speak to that?

What Would These Insights about Human Uniqueness Mean for a Model of Our Origins?

Obviously, if God has been creating us though a long-term evolutionary process, we could look for his actions over millions of years. However, the more interesting question may be the production of the distinguishing qualities listed above—prosociality, secondary consciousness, neural plasticity, social learning, and so forth.

Kim Sterelny has proposed an intriguing model he terms "the evolved apprentice," a theory of cognitive and social evolution based on ecological cooperation, sociocultural learning, and environmental scaffolding.[56] In this model, the pressures of a difficult and changing environment and of rising population numbers intensified the need for shared planning and coordinated hunting and provisioning. These social needs demanded increasingly complex cognitive work, which pushed the process of cultural (social) learning from simple imitation to structured learning environments. Sterelny suggests that the resulting incremental development of deliberately prepared environments for learning techniques produced an increasingly high bandwidth of intergenerational information flow. This, in turn, created positive feedback loops for greater ability to do complex cognition—feedback between social parameters and genetic parameters. Thus, the ancient environmental demand for "vigilant cooperation" and division of labor drove an ever expanding need for the transmission of expertise in both physical crafts and social interaction.

Transmitting expertise requires task decomposition, an ordered process of skill acquisition, the choice of good exemplars, and expert structured and supervised teaching. It also implies the loss of critical information if the knowledge of an expert "instructor" is lost. This would result in the partial reversals and spotty appearance of technology characteristic of the ethnographic and archaeological record.

The apprentice model also fits with more than "tech" instruction; it applies as well to social skills such as "mind reading," language, and religion and obviously, to such areas as symbol use, music, and art. As a result, humans are information hungry on multiple levels—including technology, language, social navigation, bargaining, and planning. In many ways, we

are more a collectively intelligent species than a society of cognitive-rugged individualists.

Similar models of increasing social interaction and prosociality are also proposed by Hill et al.[57] They too attribute adaptive human cumulative cultural change to social learning, namely, to stored information passed on by processes requiring complex symbolic communication. They also point to increasing nonkin cooperation or prosociality in allowing specialization in the flow of resources, services, information, and alliances; and to communal emotional binding through developing concepts of morality, fairness, justice, anger, guilt, religion, et cetera. They too tie their model to dual inheritance theory—social learning occurs through mechanisms shaped by evolution (genome changes), but the genome is altered by social means which favor certain genes, that is, by positive feedback. The strength of the selection force generated by such social learning depends on the complexity of the cultural information to transmit. Thus, evidence for the growth of cumulative culture is indicated by "traits" which require multiple innovative steps unlikely to be "invented" in one generation. Language and social norms are evolving information systems; techniques, regulations, ID signals, and language are necessary cognitive offshoots.

Likewise, Michael Tomasello's "shared intentionality hypothesis" locates human uniqueness in the development of joint attention and shared conventions.[58] Shared attention seems to be a human exclusive. The social interactions of ape "society" are competitive; communications are imperatives. Humans are far more cooperative, as reflected in human communication. Tomasello traces development from individual intentionality and directive communication (ape individuals) to shared intentionality and cooperative communication (hominine dyads) and on to collective intentionality and conventional communication (human groups). Environmental changes drove the need for more coordinated behavior. In order to survive, humans had to develop the ability to view the world from multiple social perspectives, to draw socially recursive inferences, and to evaluate their own thinking vis-à-vis normative group standards. Thus for humans, shared conceptions become reified, that is, socially created "objects" such as money become viewed as objective features of the world. This makes sense only if humans can conceive of the existence of a group-minded perspective, a universal point of view, thus presumably an objective agent-neutral external authority. This assumption of an objective perspective, Tomasello says, is the source of cultural institutions, linguistic conventions, recursive/rational reasoning, social norms, self-governance, and presumably, the concept of God.

In the proposed model, dietary stress produced by significant changes in the environment, at some point, altered the selection pressures on an ancestral hominine population.[59] Effective survival required higher levels of cooperation for care of the young and for food provisioning, which would include more complex technological skills and more cooperation in hunting and food sharing. Those individuals with the genes for higher cognitive and communicative skills, and the emotional willingness to cooperate, would prosper, relatively speaking. Likewise, as the population was selected for those skills, the social environment would be altered, increasing the importance of those skills, and in turn, intensifying the selection pressure for them. At the same time, the high levels of physiological stress would potentiate the release of new genetic diversity by processes such as de-inhibiting the transcription of ALUs and other retrotransposons. These new genetic variants, particularly at control sites, would be rapidly sorted out (selected) by the increasing need for further neural plasticity and the integrative power needed to prosper in an intensifying social regime.

This model does not necessarily require gradual change. The production of neurogenetic mutations leading to the increasing plasticity and integrative power of the brain would be gradual, but their accumulation would speed up exponentially with the increasing selective power of a complex accumulative culture. The functional nature of individual brains would depend increasingly on the cultural transmission system rather than on genetic determinants. Language development doubtless was crucial. Ian Tattersall, rather controversially, attributes modern culture to an abrupt "invention" of complex recursive language at approximately 100,000 years ago[60]—which is part of an ongoing debate.[61] There are counterintuitive effects, however, to increasing the plasticity of neural systems and the bandwidth of information transmission.

Increasing the "bandwidth" of information transmission by the creation of multiple parallel neural circuits could have both stabilizing and destabilizing effects—vis-à-vis innovation. A parallel effect occurs

in cellular information systems: as parallel information pathways increase, response time becomes inflected, that is, moves closer and closer to a threshold effect. In a cultural sense, as the effectiveness of "apprentice learning" increased, the amount of cultural variation between generations would decrease, producing more cultural stability. On the other hand, when an effective innovation does appear, it can spread with increasing rapidity through the population. Think hunter-gatherers with cell phones! In this way, innovations could become culturally "locked in" and alter the selective pressures on the genome, becoming, in some sense, fixed. Further, outliers (immigrants) to such a "stabilized" population are easily assimilated without altering the culture. We see effects similar to this as populations mix today.

The "assimilation effect" is enhanced by our reactions to easily available information, what Timur Kuran and Cass Sunstein term "the availability cascade."[62] Our drive to connect our minds and to fit into our social norm, and our hunger for information and systematizing, lead us to accept the ideas which we hear the most—often without going through the work of verification. "If it can be recalled, it must be important," so the noisiest or latest or simplest ideas are favored. And we choose to act based on what we deduce others must know and on how they are acting—hence, a cascade of opinion or action sweeps through a population with possible long-lasting effects. The implication is that major irreversible transformations in human society are possible. Further, such social alterations can make changes at the genetic level. The mechanisms are there. We know some physical changes of that sort did happen with agricultural developments, for instance, lighter skeletons and enhanced abilities to digest milk or starch.[63]

But, Did It Happen? Is There Evidence for Such a Pattern?

Can the development of the unique human cognitive traits be identified through the patterns in the archaeological record? The evidence indicates that although archaic hominine populations did possess significant cultural abilities, they did not demonstrate the level of cognitive ability which was expressed early, and fairly abruptly, in the culture of developing modern humans. The use of complex technologies, and especially the use of symbols, is tied to the recursive nature of modern cognition, and developed as a property of the African lineage which produced modern humans.

It is well known that there is a sequence in the paleoarchaeological record of tool making from simple to complex. Assuming a start at the level of living chimpanzees who make simple tools to smash nuts, dig tubers, fish for termites, and kill small animals, we are looking for evidence of new techniques requiring increased cognitive ability.[64] The archaeological record clearly centers in Africa. The standard model recognizes five stages or modes of ancient stone tool making: pebble, biface, core, blade, and microlith.[65] Dwight Read and Sander van der Leeuw have proposed a correlating conceptual schema of seven cognitive advances.[66]

In Read and van der Leeuw's schema, two stages are already present in chimps and presumably in our common ancestor. Chimps recognize (1) an object's attribute and use repeated actions, for example, using a rock to break a nut. They also can (2) impose a foreign attribute on an object, for example, shaping a grass stem for termite fishing. The third stage, rock flaking, was possibly an advance of the Australopithecines. It adds the controlled repetition of a two-handed strike of a rock balanced on a larger stone. Not even Kanzi, the bonobo, has been able to develop that skill.[67] This recently reported pre-Oldowanian tool type, termed "the Lomekwain," was produced in east Africa around 3.3 million years ago. The specific tool-making agent is debated.[68]

In the fourth cognitive stage, Mode 1 tool making, the Oldowan chopper or pebble tool (2.8 million years ago) added the cognitive dimension of the edge as a specific part of a rock and requires controlled iterative action—multiple flaking.[69] The fifth stage or Mode 2 is the Acheulean hand axe. This stage implies the two-dimensional concept of a closed curve: as the edge meets itself, it generates an object with two surfaces. Hand axes appear in Africa around 1.5 million years ago and are associated with *Homo erectus*. After 500,000 years ago, these axes began to show some regional variation as hominines exited Africa.

Mode 3 or the Mousterian (cognitive stage 6) used the Levallois technique (prepared blanks) and refocused on the chip. From the blank, a large flake could be struck and retouched into various forms, and the core reused—thus producing an "algorithm" of

repeated return to a planned form.[70] There is good evidence of such core and flake/blade technique developing between 500,000 and 280,000 years ago at Kathu Pan, south Africa; at the Kapthurin Formation, Kenya; and in Tabun and Qesem Caves, Israel.[71] In Africa, such Mousterian technology replaced the hand axe and was the technology of the first anatomically modern human populations. The technique also reached Europe around 250,000 years ago; the Neanderthals, until they disappeared, used a mix of Acheulean and Mousterian techniques.

This period seems to be a significant point of adaptive departure. The disappearance of elephants in the Levant around 400,000 years ago may have forced an adaptive shift to smaller, more diverse, and agile prey with both anatomical and cultural implications.[72] Around 300,000 years ago, a variety of cultural shifts appear in this region: Acheulo-Yabrudian flint-knapping, habitual fire use and organized hearth building, and home-site meat processing and sharing at Qesem and Tabun Caves.[73]

In Mode 4 tool making (blade/core), long prismatic blades are struck in such a fashion that each blade prepares the surface of the core for the next blade strike. The blades were, in turn, shaped into a wide variety of tools. Thus, cognitive stage 7 uses a three-dimensional concept of intersecting planes which requires recursive planning. Both the present and future blades are simultaneously envisioned. Mode 4 appears in Africa around 200,000 years ago with a lot of regional variation. It reached Europe with the modern human invasion 40,000+ years ago.

Mode 5 tools are the microliths, very small blades used as inserts in compound tools. The manufacture of multicomponent tools requires holding a large number of variables in mind, and learning techniques of complex assembly. Their earliest appearance may be at Pinnacle Point cave in South Africa, around 165,000 years ago, made by fully modern people. After that, there was the spotty appearance across Africa of advanced techniques which in Europe would be considered Neolithic—microliths, cooked silicate, carved bone harpoons, bone spear and arrow points, small backed blades (one side blunted), tanged elements, and complex adhesives (ocher and acacia gum) used to make complex tools.[74]

In summary, changing styles of tool manufacture—and of social interaction—indicate that significant changes in cognition were accumulating in the ancestors of modern humans, especially after 300,000 years ago. Long periods of cultural stasis were "punctuated" by short periods of cultural innovation, a pattern which paralleled patterns of changes in skeletal morphology. Tool making per se does not seem to provide a clear marker for "a beginning" of modern cognition. However, the pattern of increasing cultural acceleration, particularly after 250,000 years ago, and the fixation of new levels of complexity after 100,000 years ago, are as predicted by the gene/culture positive feedback model.

Of course, tools are not the only sorts of things which modern humans make; we also make ornaments and engage in symbolic acts.[75] An artefact made without "practical" application indicates symbolic thought, namely, a recursive connection between multiple cognitive domains—parallel to the linguistic representation of classes of objects and actions. The appearance of paintings and statuettes in Europe and Asia after 40,000 years ago is well known.[76] However, there are significant earlier indications of such modes of thought in Africa. For instance, strings of beads made from marine bivalves and snail shells (*Nassarius* sp.) made 80,000 years ago have been found in Blombas and Sibudu caves in South Africa, and possibly as early as 120,000 years ago at Skhul and Qafzeh caves in Israel, and at the Oued Djebbana shelter in Morocco.[77] The beads were matched by color and size or coated in red ochre.[78] Perhaps they were tribal identifiers. Their presence in sites far from the sea (in the north) suggests a trade network. Other examples of "symbolic" artefacts include cross-hatched ochre blocks and decorated ostrich egg shells.[79] Such artefacts, the use of grave goods and other mortuary practices, and the use of ochre as pigment indicate a significant use of symbolic activities. The possible use of ochre on the skin may date back to 250,000 years ago at the Kapthurin and Olorgesailie formations in Kenya, and possibly at some European Neanderthal sites. It is not clear if it was used to produce a mastic, to enhance body features in some fashion, or to send an agreed-on signal—only the latter being a symbolic use.

So, was this sort of cultural development occurring in all the large-brained hominine lineages, or was there something unique occurring in the lineage which showed modern morphology? Neanderthals were equally large brained, but apparently they were genetically and culturally isolated for at least 650,000

years from the lineage which developed into "moderns" in Africa. (The Sima de los Huesos people of Spain of 430,000 years ago are now understood as early Neanderthals.[80]) But were the Neanderthals also culturally progressive? As noted, Neanderthals used a mixed set of Mode 2 and 3 techniques—both Acheulean and Mousterian. Although there is some evidence of cultural movement in Europe prior to 250,000 years ago, Mode 3 was clearly first developed in Africa. A mixed Mode 3/Mode 4 techocomplex, termed "the Châtelperronian," did emerge around 42,000 years ago in France. Although made by Neanderthals, it was rooted in Mode 3 techniques and seems likely to have been triggered by the early arrival of modern humans using Mode 4 artefacts (in the Middle East by 48,000 years ago, and then on into Europe). The cultural development of Modes 4 and 5 was apparently unique to the developing modernity of the African lineages.[81]

The site where the earliest modern behavioral adaptations seem most evident is the South African coast (at Pyramid Point) during the previous glacial maxima (165,000 years ago). At that time, Africa was broadly inhospitable due to widespread drought, causing a Pan-African population collapse. The southern coast acted as refuge, and it potentiated the development of the systematic use of coastal resources. Curtis Marean comments, "The origin of this coastal adaptation marks a transformative point for the hominin lineage in Africa."[82] He notes that before this point the human adaptive systems were based on highly mobile, low-density, and egalitarian populations. In contrast, typical coastal social developments resemble agricultural groups with "reduced mobility, larger group size, population packing, smaller territories, complex technologies, increased economic and social differentiation," and with more gifting and exchange, boundary defense, and group conflict.[83] Such neighbor-group conflict has been suggested as a driver for prosocial altruism.[84] Survival required learning to exploit the tubers (fynbos) of the coastal vegetation and understanding the movement of the tides to effectively harvest shell fish. It also pushed the survivors to develop complex material processing (cooking silicate and mastic, knapping small blades for composite tools) and later, symbolic objects.[85]

A related plausible driver for cultural development is demography, the idea that the level of cultural expression reflects changes in population density.[86] Both genetic and paleoclimatic analyses suggest that the appearance and disappearance of "advanced" behaviors such as those of Still Bay and Howiesons Poort correspond to sharp changes in climate which triggered changes in human population density.[87] Technologies appeared during periods when high population densities could have stimulated the formation of integrated networks of tribes, and when the population collapsed, isolating the tribes, the technology disappeared.[88] So, an improving environment can trigger a population increase, and increased density supports cultural innovation. In turn, when a population collapses, its cultural attributes become much less complex, possibly due to the loss of "expert" teachers before they can pass on their information, as suggested by Sterelny.[89] The period from 190,000 BC to 130,000 BC was a sustained glacial period. Although there were anatomically modern people in Africa, little advance was seen. Between 130,000 BC and 80,000 BC (an interglacial), new techniques and the use of beads appear in a number of areas.[90] The oscillation of interstadials between 80,000 BC and 30,000 BC saw innovations come and go in South Africa, but the basic technology involving the ochre gums (mastics) continued through the period.[91] In the same vein, the immigration of people into very difficult environments such as Australia seems to be accompanied by a loss of technology.[92]

What Do the Fossils and the Genes Tell Us?

Can these patterns of cultural change be tied to changes in the fossil record? The obvious tie of cognition to the brain has led to the assumption that brain size (or relative brain size) is the key datum which defines modern cognitive abilities. Modern skulls and delayed developmental trajectories appeared in Africa roughly around 200,000 years ago. But what leads up to that?

The most functionally significant comparison between brain sizes is the encephalization quotient (EQ), the expected brain size given the size of the body.[93] Modern chimpanzees have about the same EQ (about 2.45) as did the early australopithecines. The later species, *A. africanus* (a possible human ancestor), had an estimated EQ of 2.7. Robust australopithecines had EQs around 3.1.[94] It is not possible to tell if the australopithecines show derived changes in relative cerebral proportions. In terms of artefacts which show altered cognition, the earliest stone tools

(Lomekwian) are dated at 3.3 million years ago, which predates the earliest *Homo* fossils.

Brain sizes—and EQs—rose in an irregular fashion in genus *Homo*. *Homo habilis* had an EQ of around 3.4 and a brain of 630 cc. Early African *Homo ergaster* was larger, with a brain of 825 cc. but about the same EQ (3.3). Later *Homo erectus* (circa 500,000 years ago), found in Eurasia, with larger skulls and bodies, have an average brain size of 973 cc and an EQ of around 4.3. *Homo heidelbergensis* (600,000 years ago) with a brain of 1200 cc (within the modern size range) still has an EQ of only 4.3. *Homo neanderthalensis* originated around 250,000 years ago; they had very large brains (around 1420 cc, modern size) and thick, cold-adapted bodies. Their EQs were around 4.9. The early modern people such as the Cro-Magnons had the largest brains at 1490 cc, with an EQ of 5.45. Recent modern populations are smaller—our brains average about 1360 cc, with EQs of around 5.33.

So, the EQ did jump with the appearance of genus *Homo*, but it increased only slightly over the next million years. Modern-sized brains appeared a half-million years ago, but as they are matched by bigger body size, the EQ did not rise much. The brains of anatomically modern people were equally large, but since their bodies were smaller, they had a higher EQ. The altered shape of their skulls probably reflects functional changes signalled by globularization. In contrast, the large brains of the Neanderthals were produced by extending the archaic trajectory of neural growth. Such differences in the increases in specific brain areas would be expected to be driven by selection for the enhancement of particular functions—the unique functions in modern human brains vis-à-vis the chimp brain clearly are reflected in differences in their cerebral structures. The developing cranium forms around the developing brain; therefore, changes in cerebral function should produce changes in the shape of the developing brain and in the shape of the skull. The most parsimonious explanation for such changes is a functional alteration in the relative volumes of the various cerebral lobes driven by selection.[95]

One recent suggestion for differences in mental function between Neanderthals and moderns is that Neanderthals had an advanced "modular" system of "expert" performance, essentially an enhanced "executive" control system based in the frontal lobes using long-term memory, but that they lacked the working memory capacity of modern humans.[96] Working memory capacity is needed to hold a diverse amount of "other" information. Thus the "default" system which particularly uses unique areas of the parietal lobes to recursively and creatively compare patterns might not have been available for the Neanderthals—possibly they did not "daydream" of impossible connections.[97]

One aspect of the fossil record which would be particularly interesting to match with cultural development is the period in which modern skull morphology was developing—between 400,000 and 150,000 years ago in Africa. Unfortunately, the fossils which might provide that evidence are pretty sparse. There are Kabwe (300,000?), Guombe (270,000), Florisbad (250,000), Eliye Springs (250,000), Omo I and II (195,000), Herto (160,000), Jebel Irhoud (160,000), Singa (135,000), Ngaloba (120,000), Qafzeh (100,000), and Skhul (90,000). These few specimens have variable degrees of modern and archaic features. The data indicate that over this period the human population was highly diverse—more so than at any other period—and thus probably was divided into isolated bands and widely dispersed.[98] Subdivided populations of this sort undergo fairly rapid local evolution. It is a pattern which potentiates both local drift and group selection, enhancing social recognition and binding mechanisms and increasing prosocial adaptation.

The genetic evidences (for this model) which demonstrate the unique qualities of the human genome vis-à-vis neural function have been extensively documented previously, including known differences between the Neanderthal genome and the modern version.[99] A more recent study by Hang Zhou et al. documented the time that certain loci were under strong selection.[100] They identified six loci involved in brain development which were under strong selection between 200,000 and 50,000 years ago. The loci are involved in synaptic hyperconnectivity, augmented neuronal metabolic activities, and functional plasticity—results which correlate well with a model of culturally driven selection causing increased neuronal plasticity during that period.

The other piece of genetic evidence which seems relevant is the pattern of genetic relationships between human populations. It is clear that our species originated in Africa, that the oldest distinct lineages were in the south, and that our ancestors went through a

period of reduced population around 150,000 years ago. These patterns are robustly supported by multiple studies.[101] The most likely model is that all modern humans are descended from a part ("tribe") of a dispersed subdivided population at around the time modern cultural motifs seem to have become consolidated. That particular population would have provided the largest part of our genetic (and cultural) ancestry, with occasional smaller contributions from isolated groups.

The clearest data showing the effect of such "contribution" is the admixture of Neanderthal genes into the genome of non-African modern humans. Perhaps twenty percent of the Neanderthal genome is scattered throughout Eurasian populations, but very few remaining loci seem to have any significant effects, good or bad—mainly, some immune variants and a gene which allows the people of the Himalayan Mountains to function at high altitudes.[102] Most Neanderthal loci were apparently selected out, presumably because they interfered with normal functions of the modern genome and depressed their owners' survival. The loss of these genes is likely due to the powerful positive feedback between complex cultural transmission and plastic neural genetics.

In summary, I have proposed that the gradual (but rapid) accumulation of genetic changes supporting social and general cognitive intelligence was driven by selection for effective group-coordinated activity. The product of that selection was the broadly integrated and developmentally plastic modern human brain, as reorganized during its genetically prolonged period of enculturation. Thus, the gradually selective accumulation of human potential was functionally stabilized by the increasingly intensive cultural programming of adolescent neural rewiring. Such social and cognitive selective pressures, acting through a "high-band" intergenerational instructional system, became locked in and reliably transmitted increasingly complex adaptive cultural information (the ratchet effect). This produced increasing cultural stability, punctuated by sudden functional changes triggered by alterations in climates, ecosystems, and the resulting demographics, leading to significant innovations in multiple areas. Such sociogenetic fixation would be enhanced by the isolation provided by tribal barriers and would also act to absorb and enculturate outliers. The system of positive feedback between culture, brain, and genes seems to have begun in earnest between 400,000 and 300,000 years ago, becoming progressively intensified and effective and reaching a probable climax of modern levels of function around 100,000 years ago in the South African coastal population. Genetic and cultural evidence indicates that this population was the one which became the genetic and cultural core of *Homo sapiens*.

Theological Implications of This Model of Human Origins

Humans are indeed unique: they show the qualities of the *imago Dei*. But the model proposed for human creation implies that those features developed gradually, especially the genetically driven delay in neurological development which extends the period of neurological plasticity of the modern brain. This may mean that the appearance of the image was gradual, spread over hundreds of thousands of years (under God's providential governance of the process). But not necessarily. John Walton has argued that creation in scripture is primarily about being made functional.[103] That concept gives a handle to understand a "punctuated" model of gradual human creation. Even if the genetic substratum is "prepared," it does not automatically produce a functionally modern brain. It requires particular cultural nurturing during infanthood and childhood to establish the "modern" form of the synaptic array. Since a child's cultural "Weltbild" is a product of the adult brains around it, the realization of a "modern" brain is not possible unless those adult brains are also "modernized."

So, how could a tribal group be made "functional"? A point of sudden appearance of the image might have been produced by the impact of a threshold event in cultural transmission. This could happen due to the profoundly culturally driven (re)shaping of the cerebrum which takes place during early development. It is, after all, those culturally driven qualities which make humanity unique. Such a transformation would not necessarily leave a detectable physical trail in the form of transformed skulls or altered genetic loci. But would such an event take an extended theophany, or perhaps a miracle of neural transformation to make Adam (or a group) truly unique, to jump the gap to full humanness?

A possible model of the giving of the image might indeed include a divine "initiating" act, one in which God interacted "culturally" with developing human

children to alter the shape of their brains' operating systems, producing a self-replicating system of cultural integration. If that was what happened, it would, in fact, be transmissible to other children who were not part of the initial group, just as children moved to a new cultural milieu pick up the local mindset, although it remains forever "foreign" to their parents.

Recall that the gradual selective accumulation of human cultural and mental potential was functionally stabilized by the increasingly intense cultural programming of adolescent neural wiring. Also, note that the most intense environmental and social crisis point for humanity was at the previous glacial maxima, as witnessed by the population bottleneck. At that time, our ancestors were a relatively localized population under intense environmental pressure, a situation potentiating significant cultural change (or maturation, if you will). This situation had both social and genetic implications. Socially, it made a cultural threshold transition more likely. Genetically, it would increase the selective intensity on neurally active loci, and it might even cause further release of ALU transcripts, for instance, increasing available genetic variability.

If God acted at this point in time in a "divine acculturation" mode directed toward cultural maturation, the process went awry. The event could have begun with the isolated human population. It had the neuro-genetic potential for modern function, but it was locked into premodern psycho-cultural complex by the power of the apprentice effect. Divine revelatory activity programed a new cultural operating system into the brain(s) of one (or a few) humans—divine enculturation. I see no reason why this could not imply the extended presence of God "raising/apprenticing" Adam (or his tribe). However, I also do not know how one would rule out this change occurring over multiple generations. In any case, it did not go well.

How Does This Model Apply to the Question of "Original Sin"?

First, it would be well to consider the growth of a moral sense in our ancestors. Many socially aware animals seem to have a sort of "morality" in the sense of a perception and evaluation of fairness directed to themselves, their young—and for some species—their mates and community members. Standard models of "fitness" require that organisms seek their own "good" (personal survival) and their offspring's good (genetic survival). But a full moral sense requires a recursive theory of mind, the mental capacity to not only recognize the other as a "self," but also to see one's own self as an equivalent "self" in the mind of the other—and then to put one's personal "good" against another's "good," and make a choice.[104]

But how did humanity reach the point to be able to choose to so honor the altruistic impulse? For a self-aware species to become a highly coordinated social entity, it must develop something beyond the intelligent competition of the chimpanzee. The question is, what is needed? Chimpanzees (our "next of kin") are intelligent and socially complex. Thus, much of their behavior troubles us—infanticide, murder, and war have all been attributed to them. But though chimps can hold grudges, there is no evidence that they feel shame or guilt. They can coordinate activities, but there is little evidence that they have altruistic impulses. They communicate imperatives, not gossip. What is missing? One key is probably the level of their theory of mind, or mind reading.

It is clear from numerous experiments that chimps can detect from observation what other chimps are observing and anticipate what they probably will do. It is not clear that they are attributing mental states to those other chimps, forming explanations of why they are acting in a particular fashion. In such cases, humans would be "mind reading," but a simple reaction to the observed state or action will explain the chimpanzees' responses—and that is, of course, the simplest explanation.[105] Thus, when they kill, they are "innocent killers." But the ability to do advanced mind reading, to correctly attribute mental states to another intelligence, potentially allows a society to move beyond the "innocent killer" stage.

If the ability to know the other's mind is coupled with an instinctive desire to advance the other's good, a moral choice is presented. In such a moral choice of action, there must be a clear understanding of the good of the other as well as the good of one's self, and they must be seen as equivalent goods. As previously discussed, these evaluations are being done in part at the temporoparietal junction.[106] To choose to "do unto others what you would have them do unto you" requires that sort of mental balancing evaluation. And humans universally are aware of this as

"right"—the principles of the golden rule and loving one's neighbor as oneself are recognized as "good" in all cultures. But though understood, this rosy picture is seldom realized. Rather, we frequently make things worse.

What is the source of the moral insight that the other's good should come first? As long as no exterior command is given to which one is called to react, moral choices are still a balancing of internal drives—the demands of conscience (obeying it will make me feel good) versus other personal desires (beating your head in will make me feel good). Of course, chimps will "command" each other, but when one knows that the source of a demand is a person like yourself—seeking their own "good," the command loses credibility. In fact, we *must* work through this during adolescence to become healthy adults. An imperative to act in the face of exterior force does not translate into an imperative to act due to internal directives, but only to a strategic choice between personal goods. If the sin of Eden was rebellion, the desire to place oneself above God, then the source of the command has become transcendent. Thus God's commands will be objective, outside oneself, the same for all. When that becomes true, the "altruistic impulse" becomes preeminent.

We are intended to hear and heed our inner voice, but I do not think that it could have been just the urging of conscience which made us sinners—even that high level of conscience which requires recursive theory of mind (TOM). In the end, that is still myself talking, and I cannot be sure that the voice in my head is the voice of God. My conscience may be intended to be the image of God's character, but it is not the direct voice of God—it is, in fact, largely influenced by my cultural experience, and we are quite skilled at creating warning signals in our own conscience and in others. Perhaps the first sin was the "Chief" who claimed to speak with the voice of God in his pronouncements and commands!

Thus, the developed ability to do advanced mind reading, to correctly attribute mental states to another intelligence, is also necessary to truly do evil. In a sufficiently advanced, socially aware mind, an act which is of personal benefit but harms another generates both an internal awareness of how the actor feels, and also how the person acted on feels. The decision to do an evil act such as knifing a man for his money is accompanied by a predictive TOM scenario in which a (normal) actor "feels" the outcome for the victim. In both the decision and the act, one feels the personal "good" achieved—and equally, the personal "evil" suffered. No animal apparently has the capacity for such perception of the other, and therefore no animal can truly choose "evil."

In primitive members of genus *Homo*, a full empathy coupled to a complete simulation of another's state of mind was unlikely—that processing takes place in a section of the parietal lobes which is uniquely expanded in the modern human cerebrum. As Michael Graziano suggested, the high level of TOM ability in modern humans may be what produces full consciousness—we become aware not only of what is happening in others' minds, but also, recursively, of what is happening in our own.[107] The Neanderthals probably lacked that modern capacity to balance moral issues. Presumably they were able to make moral judgments for the "community's good," but their archaic morphology indicates that they lacked the modern level of recursive thinking. It seems unlikely that they could say to themselves—and realize that they were making the choice—"I ought to do A, but I want to do B, and I can choose between A and B."

In the suggested model for modern human origins, the feedback between the selection pressures for cooperative behaviors and the supporting genetic capabilities for neural plasticity brought our ancestors to a critical state. The pressure of social selection had made the "law of God" in the heart (instinctive prosocial empathetic altruism) more visible, more poignant, and more clearly in conflict with the necessary survivalist focus on self-love and personal good. But as yet, there was no way to resolve the dilemma, no sure way to judge situations and resolve the tension. In fact, we still are likely to decide that our feelings of "universal" altruism (or "affection for impartial justice" as John Hare puts it) are only the product of those having power over us, that we have been programmed into them by others seeking their own benefit.[108] What was needed to turn altruism into morality was the law—God had to validate our insights. But the law makes sin possible.

Clearly, there is no consensus concerning the meaning of "the Fall." Tensions between theological models and scientific models reflect tensions within both disciplines. What has been proposed as the nature of the Fall? What resolutions might make

sense, assuming neither science nor theology is to be rejected? Shall we view the Fall as a metaphor for retained primitive nature—basically, a lack of altruism—a failure of that evolutionary process which produced prosociability in the human race? Can a universal human sin nature have been produced as a gradual, incremental "fall" with "social compound interest"? Might it be that with increasing internal demands for altruistic acts, there can be increasing pressure (temptation) to not obey due to a clearer prediction of the personal costs?

Or, could universal sinfulness have grown to cover the human race as a spread of rebellion from a seeded event, rather like the spread of crystallization in a super-saturated liquid? Perhaps such a spread would be the expected outcome of producing a highly prosocial species with a culturally induced moral programming of the neural pathways. Would that model allow for the possibility of sudden dramatic change in moral type, an "Eden event" due to new input which caused a threshold event? And if so, would such an event need to be caused by a direct alteration of genes—or of the neural state—or could it be induced through a complex social event, as "literally" described in Genesis?

The sin of the garden must be viewed within the context of the narrative of the garden. Eden was the garden of God, not the garden of humans. The fruit is God's. Adam and Eve are placed within it as caretakers. Humanity's dominion is a promised future, not a present reality, even then. The decision to eat the fruit was to take control of the garden, to set its agenda. The tree of the knowledge of good and evil was able to make one wise (crafty). "To make one wise" is to focus on practical outcomes. Here the "good" equals what works, "evil" equals what does not work, and thus wisdom means choosing actions which are effective in reaching one's goals. The "wisdom" derived by eating is the choice itself. The choice to disobey was the rejection of God as the source of wisdom, the rejection of God's goals and methods. Humankind was now to envision their own goals, choose their own methods, and make their own judgments of rightness. God's "good" was thereby effectively ignored, or even declared "evil." And that means that the growing power of the image of God, which was being given to humanity, was warped into an image of self. Adam bears sons in his own warped image. And all of us are shaped into humanity by our enculturating tribe. If Adam (or his tribe) provided that initial model, we are all humans made in Adam's sinful image. His rebellion is the initiating sin, inherited sin, original sin, and my personal sin.

T. A. Noble has provided a summary list of ten theological definitions of original sin:

1. It is universal—everyone sins;
2. Fallenness—the state of being fallen (decay);
3. The original act as the root of sin;
4. Original guilt—Adam's guilt passed on to us;
5. A disease which we inherit;
6. Hereditary sinfulness;
7. Inner bent disposition—our desires and passions;
8. Propagation by sexual desire (Augustine's idea);
9. The flesh—the power of self-centeredness; and
10. Corporate sin—human solidarity and domination by the system.[109]

Will the proposed model speak to these? I think that it does.

My preferred model proposes that humanity had reached a point of development with the potential to understand God's plan to unite the world, to be inducted into his created role as God's agent, and to be commissioned to direct the process of making "all things one" under God. At that point, God acted (suddenly—by a theophany, or via a threshold effect). Choosing a particular individual or a group, God communicated and clarified his goals. Perhaps he acted by intensively socializing a growing child, by showing the nature of love, by teaching the gift of language, or by equipping with the concept of effective agency in the service of the garden kingdom. In any case, I do not think that it was business as usual. Humanity was being ordained as the intended "priest-kings" to further extend the "sacred space" of the garden as the home of God, and he would dwell among them.[110]

But they rebelled. In my opinion, the first sinning must have occurred among individuals capable of a mature moral choice, but yet innocent in that they had not yet been faced with such a choice. God gave them the chance to grow up—a choice to make. They matured by making the choice, but they matured wrongly, warped, broken—they "learned disobedience." The chance to mature into God's true image was lost. Human rejection of God's authority altered the direction of the "new" cultural program from

altruistic dominance back to egoistic dominance. It inserted a "sin acquisition drive" into the pattern. Evil experienced becomes domesticated, justified, an accepted act. One develops a taste for it. Further, evil experienced due to another's act gives rise to evil in the one who was injured. Evil experienced is projected back on the perpetrator—or on others in his stead—by recursive scenario building. The evil imagination itself contaminates the social mind, and leads, in turn, to additional acts producing deliberate harm.

The resulting warped "modernized" pattern of culture completely and rapidly displaced the premodern cultural complex which existed—possibly at the time of the demographic bottleneck, circa 150,000 years ago. All of us as "Adam's" cultural descendants are necessarily egoistic, with that impulse dominant over our altruistic impulses, in part, because the culture which nurtures and apprentices us determines the shape of the neural programming which makes us human. That cultural alteration likely also altered the selection pressures on epigenetic and genetic loci, increasing the power and malignancy of the fallen pattern (think of the tricky character of pit bulls). For instance, a culture based on class dominance versus an egalitarian culture will select for different genes which assist survival in those different situations. We thus have a "fallen" form of culture reinforced with selected genes (and epigenetic settings). This is not a matter of "sin inherited in the genes." Nevertheless, some genetic differences are indeed likely to weaken or strengthen personal altruism or egoism. For instance, there are known genetic differences in the response of children to abuse and known genetic differences in the degree of felt empathy. An example is sociopathy, the inability to feel empathy, which seems to have a 56% genetic contribution.[111] The genes involved are undoubtedly widely distributed and produce some of the "normal" spectrum of human behavior—and they very well might be selected for in particular cultures. There is some evidence that they make one a better CEO!

We are born as sinners because we can only become human by being nurtured by humans—who are all sinners. Adam's sin is and was therefore indeed our sin—for Adam's sin is embedded in those who make us human, and they can only make us after their image. Adam's rebellion has come down to us generation after generation—culturally transmitted, neurologically inevitable. We seek sin as we do all the other aspects of culture—freely, nay ravenously, from our birth. We instinctively acquire its principles, creatively build sinful scenarios, and become "educated" into the besetting sins of our local culture. That cultural sin is part of our corporate identity as "sons of Adam and daughters of Eve." And these parts of the pattern do fit and explain the theologians' several paradigms for original sin. We need a Savior!

What about physical death? Clearly creatures have died from the beginning of Earth's history. In whatever way one wishes to interpret the biblical text, death is biologically necessary and a spiritual mystery. So let me speculate a bit. Note that in the Eden narrative, eternal life is "literally" offered—not guaranteed. Why else would there need to be a "Tree of Life"? Henri Blocher suggests the following way to untie the knot.[112] Without the law, sin cannot be made the object of judgment. He suggests that Adam's (or Adam's tribe's) sin makes possible the imputation, the judicial treatment, of all human sin. Without that rebellion, there is no basis to judge human actions. Adam directly disobeyed the command—thus all human sinning against the law in the heart is shown to be true sin, a reflection of the rebellion in Eden. This judgment therefore brings universal condemnation and death, for if God sees us in Adam, we are identified with him—seen through the covenant of creation. In this way, all human sin can be viewed as part of—grafted onto—the broken command and sin of Genesis 3. Perhaps then there would be no need for sin to "spread" over the world. And possibly, that is the reason that sins prior to Adam can be judged. If Adam was raised and placed in a "purified" environment and still sinned, it illuminates the true heart of humans. Moses's law did not have to be there for sin to be judged, but it increased the efficiency of judgment. However, it is God's demands, which he built into our hearts—even if that building took 300,000 years—which condemn us.

As the good taste of the fruit in Eden was accompanied by the dawning awareness of evil, so began the sorrow of breaking trust with the loving Father God. Having broken faith with God, easy dominion in the earth was taken away. The *imago Dei* was warped and twisted. We do not see humans playing the role described in Psalm 8. Rather, we see humanity destroying the earth, and we long for the return of Jesus who will make all things new and who will restore the vision born—and aborted—in Eden. ✺

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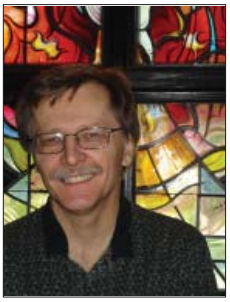

Denis O. Lamoureux

Article

Beyond the Cosmic Fall and Natural Evil

Denis O. Lamoureux

The traditional doctrine of the cosmic fall asserts that God launched natural evil upon the world because Adam sinned in the Garden of Eden. Rooted deeply in a concordist hermeneutic of Genesis 1–3, this doctrine claims that the Creator originally made a "very good" world (Gen. 1:31), and then following Adam's sin, he "cursed" the earth (Gen. 3:17). This article argues that belief in the cosmic fall and natural evil is based ultimately in ancient science, ancient origins motifs, and the juxtaposition of two conflicting ancient phenomenological perspectives of the operation of nature. In particular, the Hebrew terms tōb *(good) in Genesis 1 and* ʿārar *(curse) in Genesis 3 refer to physical attributes and nature's functionality and malfunctionality, respectively. The optimistic Priestly writer perceived an idyllic and bountiful creation; whereas the pessimistic Jahwist writer viewed a dark sinister world bound by death, suffering, and limited productivity. Thus, the cosmic fall in Genesis 3 from an original paradisiacal state in Genesis 1 is an artifact of redaction.*

This article challenges the concordist interpretation of the Bible's overarching metanarrative of Creation-Fall-Redemption. It suggests that there never was an idyllic de novo *creation followed by a cosmic fall with natural evil thrust upon the whole creation, and consequently there is no need for a cosmic redemption from the bondage of any curse. Instead, these ancient scientific paradigms are incident vessels that deliver the inerrant spiritual truths that God created the world, humans have fallen into sin, and Jesus redeems us from all our sinful acts. The article concludes that the concept of natural evil has no place within the Lord's creation and that the fulfillment of theodicy is found only in Christ (Matt. 5:19).*

Christians have struggled with the problem of evil throughout the ages. The doctrine of the cosmic fall has traditionally offered a theodicy to justify the existence of natural evil.[1] This belief asserts that God launched suffering and death upon the entire world because Adam sinned in the Garden of Eden as described in Genesis 3. Or stated another way, evil in nature did not exist prior to human sin because, in Genesis 1, God had originally made a very good and perfect creation. According to the cosmic fall, divine punishment for Adam's sinfulness resulted in significant physical changes to the natural world.

Protestant reformer John Calvin presents a classic example of the doctrine of the cosmic fall and the origin of natural evil. In his *Commentary on the Book of Genesis*, he argues that humanity was "subjected to death" because it was "a just punishment which God, in the person of Adam, has indicted on the human race."[2] Calvin adds that "the earth was cursed on account of Adam" and "the *whole* order of nature was subverted by the sin of man."[3] He explains,

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> It is to be observed, that in the works of the six days, those things alone are comprehended which tend to the lawful and genuine adorning of the world. It is *subsequently* that we shall find God saying, "Let the earth bring forth thorns and briers" [Gen. 3:18], by which he intimates that the appearance of the earth should be different from what it had been in the beginning [Gen. 1]. But the explanation is at hand; many things which are now seen in the world are rather *corruptions* of it than any part of its proper furniture.[4]

To use a modern category, Calvin was a young earth creationist. He believed that God had originally created a perfect world.[5] Commenting on the divine declaration that the creation was "very good" in Genesis 1:31, he notes that God "pronounces it *perfectly* good; that we may know that there is in the symmetry of God's works the highest *perfection*, to which nothing can be added."[6]

Calvin lists a number of "corruptions" that entered the world through God's judgment of Adam's sin, and he deems these as "evils," affirming his belief in natural evil.

> Moses does not enumerate all the disadvantages in which man, by sin, has involved himself; for it appears that all the *evils* of the present life, which experience proves to be innumerable, have proceeded from the same fountain. The inclemency of the air, frost, thunders, unseasonable rains, drought, hail, and whatever is disorderly in the world, are the fruits of sin. Nor is there any other primary cause of diseases … For ever since man declined from his high original [state], it became necessary that the world should gradually degenerate from its nature. We must come to this conclusion respecting the existence of fleas, caterpillars, and other noxious insects. In all these, I say, there is some deformity of the world, which ought by no means to be regarded as in the order of nature, since it proceeds rather from the sin of man than from the hand of God. Truly these things were created by God, but by God as an avenger.[7]

With regard to animal predation, Calvin asks, "Whence comes the cruelty of brutes, which prompts the stronger to seize and rend and devour with dreadful violence the weaker animals?"[8] He notes that "there would certainly have been no discord among the creatures of God, if they had remained in their first and original condition."[9] But "when they exercise cruelty towards each other … it is an evidence of the disorder which has sprung from the sinfulness of man."[10] Calvin believed that animals were vegetarians in the original creation and points to Genesis 1:30 and God's provision for the animals, "I give every green plant for food." Calvin adds, "For if the stain of sin had not polluted the world, no animal would have been addicted to prey on blood, but the fruits of the earth would have sufficed for all, according to the method which God had appointed."[11] Animal predation, then, is a natural evil and a consequence of the cosmic fall.

Calvin also appeals to the apostle Paul to support his belief in the cosmic fall. In Romans 8:20, Paul asserts that "the creation was subjected to frustration, not by its own choice, but by the will of the one who subjected it." Calvin writes,

> At the present time, when we look upon the world corrupted, and as if degenerated from its original creation, let that expression of Paul recur to our mind, that the creature is liable to vanity, not willingly, but through our fault (Rom. 8:20), and thus let us mourn, being admonished of our just condemnation.[12]

These passages by Calvin summarize the fundamental tenets of the doctrine of the cosmic fall: (1) God created a world that was originally very good and perfect; (2) sin entered the world through a historical individual named "Adam"; (3) God judged Adam and launched corruption, disease, predation, and death upon the entire world; and (4) there are aspects of nature that are indeed evil. The cosmic fall in Genesis 3 is the first theodicy in the Bible. It provides a justification for the existence of suffering and death in the world made by an all-knowing, all-powerful, and all-loving personal God—Adam sinned and God judged him by thrusting the cosmic fall upon the whole creation.

However, science has made remarkable advances in understanding the natural world since the sixteenth century and Calvin's belief in the cosmic fall. The fossil record offers overwhelming evidence that predation, suffering, and death have been on Earth for hundreds of millions of years prior to the appearance of humans and their sins. Geology also provides indisputable evidence that floods, droughts, and ice ages have occurred throughout Earth history, indicating that they are not "the fruits of sin." And environmental science reveals that "noxious insects" play an essential role in maintaining ecological

balance. In fact, the so-called "evils of the present life" such as animal predation are necessary components in a normally functioning biosphere.

Calvin's belief in the cosmic fall and natural evil is based on the assumption that the opening chapters of the Bible are a record of actual events at the beginning of time. But questions must be asked. Are the origins accounts in Genesis an outline of real events in nature that occurred in the distant past? Does scripture actually reveal that God created a world that was originally perfect? And is the idea of natural evil found in the Bible?

Ancient Science, Ancient Motifs, and Genesis Accounts of Origins

Biblical interpretation is the key to determining whether or not scripture affirms a cosmic fall and natural evil. Throughout most of church history, Christians have embraced concordism. This interpretative approach assumes that statements about the natural world in the Bible align with the facts of science. John Calvin was clearly a concordist, and today most evangelicals accept this interpretive approach.[13] It must be acknowledged that concordism is a reasonable assumption. God created the world and he inspired the Bible, and to believe that there is a correspondence between science and scripture is a fair expectation. But is a concordist interpretation of the Genesis accounts of origins correct?

My answer is "no." The best evidence against concordism comes from passages that deal with the creation of the heavens in Genesis 1. On the second day of creation, God creates a firmament (Hebrew *rāqîa'*) to separate a heavenly sea of "waters above" from an earthly sea of "waters below."[14] Then on the fourth day, God places the sun, moon, and stars in the firmament. Of course, this understanding of the structure of the world makes perfect sense from an ancient phenomenological perspective.[15] In fact, this conceptualization of the structure of the heavens was the science-of-the-day in the ancient Near East, as depicted in figure 1.[16]

Acknowledging the ancient astronomy in Genesis 1 provides a very significant interpretive precedent. Creation day two begins, "God said, 'Let there be a firmament …'"; and day four opens, "God said, 'Let there be lights in the firmament …'" However, there is no firmament overhead; and the sun, moon, and stars are not embedded in a solid heavenly dome. God's very words ("Let there be …") in the Word of God do not align with physical reality. Genesis 1 is not an account revealing actual events in the creation of the heavens. Therefore, to state the interpretive precedent incisively, *the Bible makes statements about how God acted in origins, but these events never happened*.[17]

This precedent poses absolutely no threat to scripture or to our faith if we recognize that the Holy Spirit accommodated in the revelatory process and allowed the biblical authors to use the science-of-the-day. The ancient astronomy in Genesis 1 is an incidental vessel that delivers the inerrant spiritual truth that God is the Creator of the heavens. To be more specific, the Bible uses the ancient concept of *de novo* creation, whereby a divine being creates something quickly and completely (fully developed).[18] In this way, the *attribution of divine creative action* in the origin of the heavens in Genesis 1 is filtered and accommodated through ancient astronomical categories.

Recognizing the ancient astronomy in Genesis 1 naturally leads to the question of whether the Bible also has an ancient biology, and in particular, an ancient understanding of the origin of life. Most ancient people embraced the ancient biological notion that living organisms were immutable (unchanging),

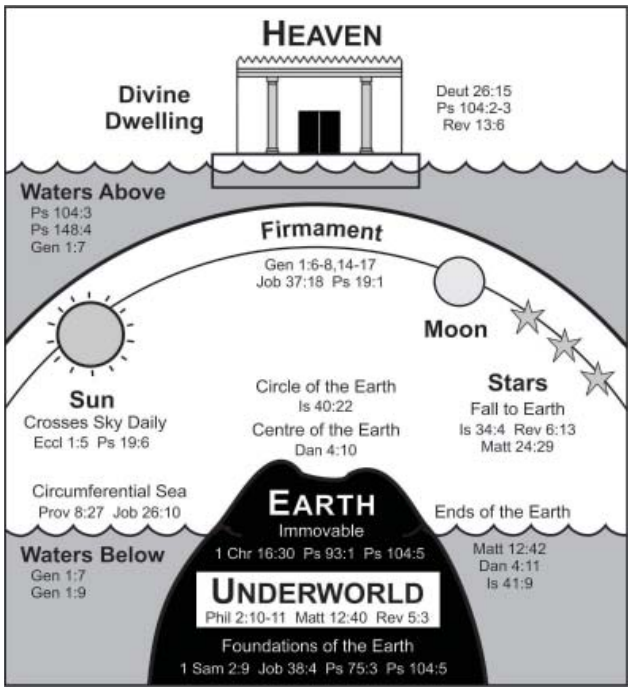

Figure 1. The 3-Tier Universe

because from their ancient phenomenological perspective, a certain kind of creature only descended from the same kind of creature. For example, they saw that a goat always gave birth to a goat, which always gave birth to a goat, et cetera. In attempting to understand the origin of living organisms, the ancients quite reasonably reversed (retrojected) the series of immutable organisms back in time to the *de novo* creation of the first individual (monogenism) or group (polygenism) of every kind of creature. Thus, a goat today was birthed from an earlier goat, which was birthed from an even earlier goat … which was ultimately birthed from an original goat/s that was created *de novo* by God or the gods.

The ancient biological notion of immutability appears in Genesis 1. This chapter states ten times that living organisms were created and reproduced "according to their/its kinds" (v. 11, once; v. 12, twice; v. 21, twice; v. 24, twice; v. 25, thrice). Similar to the creation of the heavens, the *attribution of divine creative action* in the origin of life is accommodated through the ancient concept of *de novo* creation, whereby the original kinds of creatures were made quickly and completely. As a consequence, Genesis 1 does not reveal how God actually created living organisms.

The implications of the *de novo* creation of life for human origins should be evident. The creation of Adam is the retrojective conclusion of the ancient biological concept that humans are immutable. Stated more precisely, Adam never existed because he is an ancient conceptualization of human origins.[19]

The *de novo* creation of a human/s by a divine being using clay or earth in craftsman-like fashion is found in other ancient Near Eastern accounts of origins.[20] This creative mechanism appears in the *Epic of Gilgamesh* in which a pinch of clay is used to make a man.[21] In the *Myth of Enki and Ninmah*, an intoxicated divine being forms seven imperfect humans from moist earth.[22] A goddess in the *Epic of Atrahasis* mixes clay with the blood from a slain god to fashion seven males and seven females.[23] And in the Pyramid Texts and Coffin Texts, the Egyptian god Khnum creates people from clay and fashions them on a potter's wheel.[24]

Clearly, these examples are similar to the creation of the first human in Genesis 2:7, "And the Lord God formed the man from the dust of the ground and breathed into his nostrils the breath of life, and the man became a living being." Once again, the *attribution of divine creative action* in scripture is accommodated and filtered through ancient scientific categories of origins. With this being the case, Genesis 2:7 does not reveal how God actually created the first man.

It follows that since the Bible has an ancient biology regarding the origin of life, then scripture should also have an ancient biology regarding the origin of suffering and death.[25] To understand this notion, it is necessary to appreciate one of the main purposes of origins accounts. They are etiological and function as scientific and historiographical paradigms.[26] In particular, they offer explanations for the origin and existence of *both* the good and the bad in the world, including things, situations, people, tribes, and nations.

Two motifs often appear in ancient accounts of origins: (1) *De Novo* Creation Motif—an original peaceful and idyllic world usually characterized by intimate presence of heavenly being/s, abundant food (often vegetarianism), friendship and communication with animals, no work, and no death; and (2) Lost Idyllic Age Motif—a cosmic disruption in the distant past whereby the effects of this event continue to impact people and the world negatively in the present.[27]

In his encyclopedia of *Creation Myths of the World*, Leeming observes,

> Usually, the original world created by a deity or deities is a world in which death does not exist … Typically, death enters the world *after* humans,[28] corrupted by a power such as a devil or trickster, commit some essential crime that leads to a loss of immortality, a loss of the original paradise.[29]

The existence of death, suffering, and the struggle to survive demanded an explanation, since ancient people faced these nearly every day. To assume that these brutal realities were the judgment and punishment of God or the gods angered by human misbehavior was quite reasonable. In many ways, the ancient motif of the lost idyllic age was one of the earliest theodicies conceived by humans.

Genesis 3 has a number of features found in the lost idyllic age motif—a sinister trickster in the form of a talking snake (vv. 1–5), the disruption of an original idyllic period because of human sinfulness

(vv. 15–19), the alienation of animals from humans (v. 15), the procurement of food through hard labor (vv. 17–18), the entrance of suffering and death into the world (vv. 16, 19), and the loss of God's intimate presence since humans are driven out of the garden (v. 24). These striking similarities suggest that the Holy Spirit accommodated in the revelatory process and allowed the inspired author of Genesis 3 to use the motifs-of-the-day, such as the lost idyllic age. This motif functions as an incidental vessel to transport the inerrant spiritual truth that God judges humans for their sinfulness.

Similar to the attribution of divine creative action being filtered through the ancient motif of *de novo* creation in Genesis 1 and 2, the *attribution of divine judgmental action* in Genesis 3 is accommodated through the ancient lost idyllic age motif. To recast the interpretive precedent above, *the Bible makes statements about how God launched suffering and death upon the whole creation, but these events never happened*.[30]

To conclude, concordism fails to recognize and respect the ancient science and ancient origins motifs in the Bible. Concordist interpretations of the Genesis accounts of origins, like that of John Calvin, have led most Christians throughout history to believe in the cosmic fall and natural evil. However, these beliefs are rooted ultimately in an ancient phenomenological perspective of nature. Adam never existed and as a consequence there is no causal connection between his sin and the origin of physical suffering and death. Therefore, the cosmic fall never happened and natural evil never entered the world in divine judgment of sin.

In order to move beyond concordism, Christians today must separate (and not conflate) the incidental ancient paradigms in scripture from the inerrant spiritual truths—that God is both the Creator of the world and the Judge of human sinfulness.

Sources and Genesis Accounts of Origins

Concordist readings of the first chapters of scripture have also led generations of Christians to assume that the creation of Adam and Eve in Genesis 2 is an elaboration of the events on the sixth day of creation in Genesis 1. But comparing these two chapters reveals numerous difficulties. For example, in Genesis 1, birds were created on day five before the creation of male and female humans on day six. However, in Genesis 2, birds were made after the creation of Adam and prior to Eve.[31] Similar problems exist with land animals and fruit trees.[32] Put in perspective, conflicts in the order of creative events are ultimately incidental since most Christians would agree that when birds were created relative to humans is utterly irrelevant to their faith. Yet these inconsistencies offer more biblical evidence that points away from concordism and the assumption that scripture reveals scientific facts about origins.

Conflicts also indicate that the Holy Spirit inspired two independent creation accounts, commonly termed "Priestly" (P) for Genesis 1 and "Jahwist" (J) for Genesis 2. God then led a redactor to juxtapose these two renditions. This divinely inspired process is similar to that of how the four Gospels of the life of Jesus were written and then compiled together in the New Testament.

It is reasonable to ask whether the Genesis accounts of origins also feature two conflicting views regarding the character of the natural world. To answer this question, the sources in Genesis 1–11 must be identified.[33] The P account of origins includes creation (Gen. 1:1–2:3), genealogies (Gen 5:1–28, 30–32; 9:28–29; 11:10–26, 32), flood (Gen. 6:9b–22; 7:6, 9, 11, 13–16a, 18a, 19–21, 24; 8:1–2a, 3b–5, 7, 13a, 14–19; 9:1–18a, 19; 10:1b), and nations after the flood (10:2–7, 20, 22–23, 31–32). The J origins account comprises creation (Gen. 2:4b–25), fall of humans into sin and cosmic fall (Gen. 3:1–4:17), genealogy (Gen. 4:17–24, 26b), flood (Gen. 6:1–8; 7:1–5, 7–8, 10, 12, 16b–17, 18b, 22–23; 8:2b–3a, 6, 8–12, 13b, 20–22), nations after the flood (9:18b, 20–27; 10:8–19, 21, 24–30), and confusion of language (11:1–9).

Stylistic differences between Genesis 1 and 2 provide further evidence that these chapters were originally two separate creation accounts. The P author uses a poetic (structured) and repetitive writing style. Genesis 1 is framed on a pair of parallel panels as shown in figure 2. Each creation day also follows a basic formula: introduction (God said), command (Let it be), completion (It was so), judgment (God saw it was good), and temporal referent (Evening and morning—the n^{th} day). In contrast, the J author uses free-flowing narrative with little structure in Genesis 2. His style is also distinguished by allegorical features: a fast-talking snake, two mystical

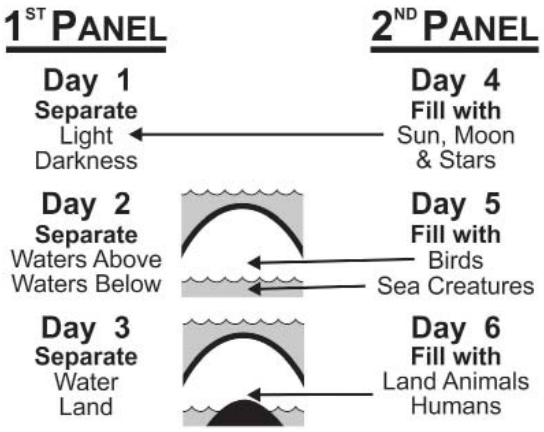

Figure 2. The Parallel Panels in the Priestly Creation Account

trees with one imparting eternal life and the other knowledge of good and evil, cherubim (composite creatures like the Sphinx in Egypt), a spinning and flaming sword, and word play such as *ādām* (man, earthling, Adam) and *'ădāmāh* (earth, ground).

In particular, the flood account in Genesis 6–9 intertwines verses from the P and J sources.[34] Reassembly of the original P and J flood accounts produces two coherent renditions.[35] Moreover, the terminology in the P flood is similar to the P creation (Genesis 1) as is the J flood to the J creation (Genesis 2).[36] Typical of the poetic style of the P author, a chiasm emerges in the reassembled P flood (figure 3).

The weaving of P and J verses also appears in Genesis 10 with the nations that arise after the flood. Reconstructing the P version produces a concise account with a definitive structure (figure 4) in con-

A Noah & His Sons before the Flood (6:9b-12)
B Promise to Flood & Making Ark (13-17)
C God & the Covenant (18)
D Preservation of Life & Food to Live (19-22)
E Entering the Ark (7:6, 9, 11, 13-16a)
F Mountains Covered (18-20)
G **150 Days** Waters Prevail (21, 24)
CENTER **GOD REMEMBERS NOAH** (8:1a)
G' **150 Days** Waters Decrease (1b, 2a, 3b)
F' Mountains Uncovered (4-5, 7, 13a, 14a)
E' Leaving the Ark (15-18)
D' Multiplication of Life & Food to Live (9:1-7)
C' God & the Covenant (9:8-10)
B' Promise Never to Flood & Making Covenant (11-17)
A' Noah & His Sons after the Flood (18a, 19; 10:1b)

Figure 3. The Chiasm in the Priestly Flood Account. The chiasmic center in Genesis 8:1a presents the primary message of faith—God remembers the righteous man in the midst of his judgment of sin.

10:2 **SONS OF JAPHETH**:
Gomer, Magog, Madai, Javan, Tubal, Meshek & Tiras.
3 Sons of Gomer: Ashkenaz, Riphath & Togarmah.
4 Sons of Javan: Elishah, Tarshish, Kittim & Dodanim.
5 From these the maritime nations spread into their lands each with its own **language** by their clans within their nations.
6 **SONS OF HAM**:
Cush, Egypt, Put and Canaan.
7 Sons of Cush: Seba, Havilah, Sabtah, Raamah & Sabteka.
20 These are the sons of Ham by their clans and by their **languages**, in their lands and in their nations.
22 **SONS OF SHEM**:
Elam, Asshur, Arpachshad, Lud & Aram.
23 Sons of Aram: Uz, Hul, Gether & Meshek.
31 These are the sons of Shem by their clans and by their **languages**, in their lands and by their nations.
32 These are the clans of Noah's sons, by their lines, in their nations. From these the nations spread on the earth after the flood.

Figure 4. The Structure of the Priestly Post-Flood Nations Account

trast to the wordy and free-flowing J rendition.[37] Note that the P account in Genesis 10 refers to different languages. The P author does not have a confusion of language episode. Instead, this event appears only with the J author who makes no reference to languages in his account of nations after the flood. In addition, combining the P genealogies in Genesis 5 and 11 along with reference to Isaac produces a definitive framework (figure 5). These genealogies also include a repetitive formula for each individual, typifying the poetic writing style of P.

Finally, the P author often uses the stylistic numbers 5 and 7 and their multiples. For example, Genesis 1 repeats the divine name "God" (*'Elōhîm*) 35 times (5x7). In the P flood, the waters prevail and decrease during periods of 150 days (10x15). Noah's sons and their descendants total 35 individuals (15 including Japheth; 10, Ham; 10, Shem) in the P post-flood account. And the Genesis 5 and 11 genealogies, including Isaac, total 25 people (5x5) and feature numerous multiples of 5 and 7 (15 multiples of 5 in the former and 10 in the latter).

In reassembling the Priestly and Jahwist sources, significant differences emerge between their views of the natural world. First and foremost, *there is no cosmic fall in the P account of origins*. In fact, there is no connection between sin and death, and no hint that death is divine punishment for sin.[38] Immediately following the P creation account (Genesis 1), the P author introduces a genealogy (Genesis 5) in which

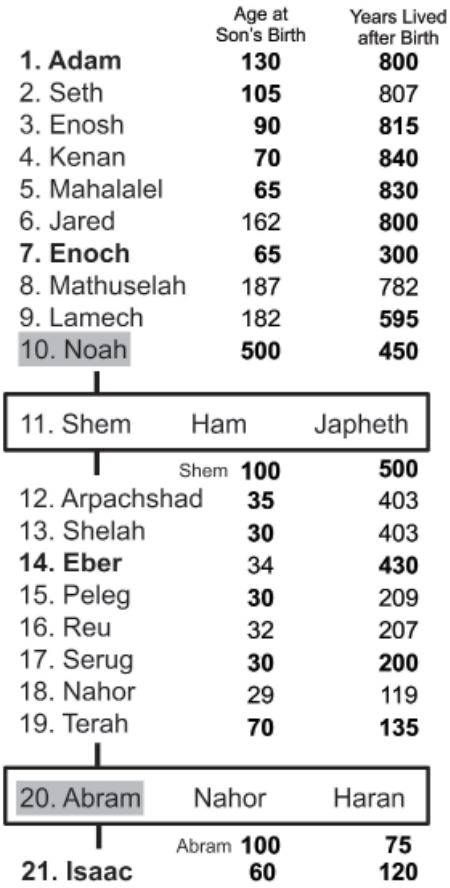

Figure 5. The Framework in the Priestly Genealogies. The ages and time periods in bold numbers indicate multiples of 5.

nine of the ten individuals die. Death is presented as being perfectly normal following an extremely long life averaging 912 years. In addition, there is no mention whatsoever that God cursed and changed the physical world in judgment of human sin.[39] Instead, the P writer in Genesis 6:11–13 identifies that human violence is the corrupt and destructive (*shāḥat,* 3 times) element in the creation. As punishment, God launches the flood. Though the P author acknowledges the gravity of human sin, the only sinful events he records in his account of origins are these three verses.

Overall the tone of the P rendition of origins is uplifting and optimistic. In using stylistic 5s and 7s, the P creation account declares the work of the Creator as being "good" (*tōb*) six times (Gen. 1:4, 10, 12, 18, 21, 25) and "very good" once (v. 31), making a total of seven times. God blesses (*bārak*) his living creatures five times (Gen. 1:22, 28; 2:3; 5:2; 9:1), commands them to be fruitful *(pārā')* five times (Gen. 1:22, 28; 8:17; 9:1, 7), and to multiply (*rābāh*) seven times (Gen. 1:22 twice, 28; 8:17; 9:1, 7 twice). The P writer perceives the natural world to be wonderfully bountiful, even after the flood.

In sharp contrast, the J author makes no claim that the creation is good or very good. At best, he states only that the fruit and trees in the garden are "good for food" (Gen. 2:10, 3:6).[40] The J author never refers to God blessing his creatures or calling them to be fruitful and multiply. But more importantly, *the cosmic fall appears in the J account of origins*. The Lord curses the ground in Genesis 3:17, and refers to this event later in Genesis 5:29 and 8:21.[41] Divine judgment for sin results in physical changes to the world. The serpent loses its legs (Gen. 3:14), the woman experiences greater labor pain (v. 16), the ground is infested with thorns and thistles (v. 18), and the man is condemned to death (v. 19).

The tone of the J account of origins is pessimistic and offers a dark and sinister picture of human nature by presenting episodes of sinful behavior throughout—disobedience of Adam and Eve (Genesis 3), murders by Cain and Lamech (Genesis 4), overwhelming evil prior to the flood (Genesis 6), Ham seeing the nakedness of his drunk father (Genesis 9), and human arrogance fueling the construction of a tower that attempts to reach heaven (Genesis 11). The J author emphasizes that "every inclination of the thoughts of his [man's] heart was only evil all the time" even "from childhood" (Gen. 6:5; 8:21), and this sinful proclivity continued even after the divine punishment of the flood.

The terminology of the J writer is ominous and threatening. He employs the words "evil" (*ra'*: Gen. 2:9, 17; 3:5, 22; 6:5; 8:21), "curse" (*'ārar*: Gen. 3:14, 17; 4:11; 5:29; 9:25; *qālal*: 8:21), and "kill" (*hārag*: Gen. 4:8, 14, 15 twice, 23, 25). And the noun "sin" is found in scripture for the first time with the J author. Genesis 4:7 warns, "Sin is crouching at your door, it desires to have you." None of these negative terms are used by the P writer.

The P and J accounts of origins present two completely different pictures of the natural world. The optimistic P author sees a creation that is "very good" even though sin exists within it. The pessimistic J writer views a "cursed" earth overwhelmed by human sinfulness. The cosmic fall is pivotal to the J account, while the P account makes no mention of it at all. But similar to conflicts in the order of creative

events between Genesis 1 and 2, these contrasting perceptions of nature are ultimately incidental and not relevant to Christian faith. They reflect two different ancient phenomenological perspectives of the natural world. Despite their striking dissimilarities, the P and J accounts of origins affirm the central inerrant spiritual truths in Genesis 1–11: God created the world and he judges human sinfulness.

The Very Good and Cursed Creation

The redaction of the Priestly and Jahwist accounts of origins produced in scripture a paradigm of cosmic and human history in which the very good creation in Genesis 1 was cursed with suffering and death in Genesis 3. This has led most Christians throughout time to believe that God originally created a morally good world and that, in judgment of human sin, he launched evil upon it. In this way, the cosmic fall and natural evil are firmly connected in their minds, similar to Calvin's teaching. But questions arise. Are the ethical terms "good" and "evil" appropriate for qualifying the physical world or parts of it? Or more to the point, does the Bible actually refer to the moral goodness or moral badness of nature?

An examination of the Hebrew words translated as "good" and "cursed" in scripture offers insights to begin answering these questions. There are over seven hundred occurrences of *tōb,* and it carries a wide range of meanings: good, virtuous, kind, pleasant, agreeable, appropriate, suitable, prosperous, fruitful, luxurious, valuable, excellent, beautiful, orderly, and usable.[42] The *Theological Dictionary of the Old Testament* notes,

> In all Semitic languages, *tōb* is used in the context of everyday life to designate the practical utility of an object, an action, or a situation, with reference to its being "useful" or "advantageous." … The most common meaning of *tōb* in the OT is *utilitarian*. From the perspective of the suitability of an object or person, the focus is on the functional aspect, as being in proper order or suited for the job. We are thus dealing with "goodness for something," with a very concrete and tangible meaning in the background.[43]

This dictionary entry adds that Genesis 1 is the "parade example" of the utilitarian meaning of *tōb*.

> In this way the functionality of the work is emphasized, the fact that the world God has created is "in good order." … The utilitarian interpretation is underscored by indicating the functions served by the works of creation. They are good for the purpose for which they were fashioned.[44]

In his classic volume *Genesis 1–11: A Commentary*, Claus Westermann asserts that *tōb* in Genesis 1

> is not to be understood as indicating some fixed quality; the meaning is rather functional: "good for …" The world which God created and devised as good is the world in which history can begin and reach its goal and so fulfill the purpose of creation.[45]

Similarly John Walton in *The Lost World of Genesis One* contends that the term "good" in Genesis 1 refers to the creation "functioning properly," and in particular, the "functional readiness of the cosmos for human beings."[46] Walton adds that the term "'good' is a reference to being functional, not a matter of moral goodness."[47] Continuing he notes,

> This is an important distinction because it does not suggest that we ought to look for moral goodness in the way the cosmos operates. When we think of "good" in connection to being functional rather than moral, we don't have to explain how predation can be part of a morally good world.[48]

Or stated another way, predation is not a natural evil because it carries no moral status. Instead, animals preying on others can be viewed as a functional component in a properly working biosphere.

It is in the light of this functional meaning of *tōb* in Genesis 1 that the cursed earth in Genesis 3 must be understood. The Hebrew verb *'ārar* occurs over sixty times in the Old Testament, and it is translated as "curse/d" in Genesis 3:14, 17; 4:11–12, 5:29, and 9:25. In *The Problem of "Curse" in the Hebrew Bible*, Herbert Brichtco observes that the stem of *'ārar* means "to bind, hem in with obstacles, render powerless to resist," and that it "has the sense of to impose a ban or barrier, a paralysis on movement or other capabilities."[49] Brichtco adds that all occurrences of the verb *'ārar* and its related noun have "the force of 'curse' only in the operative sense of the word."[50] This "material, operative sense" refers to a lack of or limited functionality.[51]

Therefore, in Genesis 3:14, the serpent is cursed by being bound to the surface of the earth and thus forced to eat dust. The cursing of the ground in Genesis 3:17 refers to a barrier imposed on the earth that restricts its fruitfulness (so too Gen. 5:29). The

curse upon Cain in Genesis 4:11–12 is both a ban to stop him from working the ground and a binding of the earth from producing crops. And the cursing of Canaan in Genesis 9:25 is a forcing of his descendants into bondage and slavery. Notably, the cursing of the earth refers to its malfunction and a loss of or restricted productivity.

The Hebrew words translated as "good" in Genesis 1 and "cursed" in Genesis 3 do not refer to the moral goodness or badness of nature. These terms deal with *physical* characteristics of the natural world—its functionality and malfunctionality, respectively. Similar to their ancient conceptions of the structure (3-tier universe) and origin of the universe and life (*de novo* creation), ancient people had views about its operation, such as the daily movement of the sun across the sky. They would also have experienced both the fruitful ("good") and the frustrating ("cursed") aspects of the world, and quite reasonably attempted to offer explanations for their origin and present existence.

Similar to the conflicting order of creative events between Genesis 1 and 2, the redaction of the Jahwist and Priestly accounts of origins juxtaposed two contrasting ancient perspectives on how nature operated. The optimistic P author viewed an idyllically functioning and bountiful creation,[52] while the pessimistic J writer saw a malfunctioning world bound by suffering, death, and limited fruitfulness. Yet like all other statements about nature in scripture, the views of P and J reflect an ancient science that is based on an ancient phenomenological perspective. Therefore, biblical passages referring to the origin of the world's *physical* functionality or malfunctionality are ultimately incidental and irrelevant to Christian faith, like the order in which God created living organisms in Genesis 1 and 2.

It is worth noting that these two conflicting views on the operation of natural world reappear throughout scripture. Many psalms provide examples of the optimistic functional perspective. There is no hint of a cursed earth in Psalm 85:11–12: "Faithfulness springs forth from the earth … The Lord will indeed give what is good [*tōb*], and our land will yield its harvest." Psalm 104:21 and 28 acknowledge that God is involved in feeding all creatures, including those that prey on other animals. "The lions roar for their prey and seek their food from God … When you [God] give it to them, they gather it up; when you open your hand, they are satisfied with good [*tōb*] things." The functional meaning *tōb* best fits the context of these two psalms.

Similarly, Job 38:39 states that God hunts prey for the lioness, and Job 39:27–30 asserts that he commands the eagles whose "young ones feast on blood." Jesus also seems to embrace the optimistic functional perspective of nature. In Luke 12:24 he notes, "Consider the ravens: they do not sow or reap, they have no storeroom or barn; yet God feeds them." Ravens scavenge off the remains of dead creatures but are also known to eat small reptiles and birds, including their young and their eggs. In these passages, there is no indication that predation is immoral, and the notion of natural evil is nonexistent.

The pessimistic depiction of a malfunctioning natural world is also found outside the Genesis accounts of origins. It is *implicit* in eschatological passages. Isaiah 11:6–7 envisions a time when predation will come to an end, inferring that the creation had earlier gone awry.

> The wolf will live with the lamb,
> the leopard will lie down with the goat,
> the calf, and the lion and the yearling together;
> and a little child will lead them.
> The cow will feed with the bear,
> their young will lie down together,
> and the lion will eat straw like an ox.

Similarly, Isaiah 65:17–25 looks to a time when God "will create new heavens and a new earth" in which there will no longer be crying, infant mortality, and predation.[53] Colossians 1:15–20 also points to a world gone astray and in need of reconciliation with God. This passage opens by claiming that Jesus is the Creator of "all things" and "in him all things hold together" (vv. 16–17). But a cosmic fall is implied because God called Christ "to reconcile to himself all things, whether things on earth or things in heaven, by making peace through his blood, shed on the Cross" (v. 20).

The pessimistic picture of a malfunctional creation is *explicit* in Romans 8:20–22. The apostle Paul writes,

> For the creation was subjected to frustration, and not of its own choice, but by the will of the one who subjected it, in hope that the creation itself will be liberated from its bondage to decay and brought into the glorious freedom of the children of God.

> We know that the *whole* creation has been groaning as in the pains of childbirth right up to the present time.[54]

The English translation of the Greek noun *phthora* as "decay" does not fully capture the thrust of its meaning. In the ancient world, this word referred to ruin, corruption, deterioration, and destruction.[55] Paul is clearly pointing back to the cosmic fall and the entrance of suffering and death into the world. The Greek noun *douleia* rendered as "bondage" is better translated as "slavery" and reflects the cursing and binding of the earth in Genesis 3:17.[56] But liberation from the effects of the cosmic fall, in particular "the redemption of our bodies" (Rom. 8:23), awaits the children of God.

An eschatological vision of "a new heaven and a new earth" also appears in Revelation 20–22. The biblical author asserts that "death and Hades [the underworld] were thrown into the lake of fire" (Rev. 20:14), and consequently "there will be no more death or mourning or crying or pain, for the old order of things has passed away" (Rev. 21:4).[57] Revelation 22:3 explicitly states that, in this new creation, "no longer will there be any curse." This verse clearly points back to the binding curses of Genesis 3 and the effects of the cosmic fall. According to Revelation 20–22, God will free the creation of its bondage at the consummation of this world. In other words, the natural world awaits a cosmic redemption at the end of time.

The redaction of the conflicting Priestly and Jahwist depictions of the operation of the natural world has profound implications. The traditional concordist interpretation of the Bible's overarching metanarrative of Creation-Fall-Redemption fails to recognize the incidental ancient science undergirding its ancient motifs, as well as the juxtaposition of P's idyllically functioning fruitful creation against J's malfunctioning world enslaved by suffering, death, and limited productivity.[58]

In the light of this biblical evidence, we can recast the interpretive precedent previously mentioned, using the terms *tōb* and *'ārar* within the context of ancient origins: *Genesis 1 makes statements about how God created a very good idyllic world, but these events never happened; and Genesis 3 makes statements about how God cursed the world with suffering and death, but these events never happened*.[59] Or stated even more incisively, there never was a cosmic fall and a launching of natural evil upon the whole creation; and thus there is no need for a cosmic redemption from the bondage of any curse. The traditional Christian paradigm of a cosmic fall (Genesis 3) from an original idyllic state (Genesis 1) is an artifact of redaction and based on ancient conceptions of nature.

Yet by grace, the Holy Spirit accommodated in the biblical revelatory process and allowed the inspired human authors to employ their ancient notions about nature and ancient techniques of redaction. In doing so, these incidental ancient elements have throughout the ages effectively delivered the inerrant spiritual truths—that God is the Creator and Consummator of the world, and that he is the Judge of all of us and of our sinfulness.

Jesus, Natural Evil, and the Fulfillment of Theodicy

Did Jesus believe in natural evil? Numerous biblical passages of his miraculous healings often present a causal connection between demonic activity and various medical conditions such as blindness, deafness, speechlessness, and crippling afflictions (Matt. 12:22; Mark 9:25; Luke 13:16). One significant account is recorded in Luke 9:38–40, 42.

> A man in the crowd called out, "Teacher, I beg you to look at my son, for he is my only child. A spirit seizes him and he suddenly screams; it throws him into convulsions so that he foams at the mouth. It scarcely ever leaves him and is destroying him." … Even while the boy was coming, the demon threw him to the ground in a convulsion. But Jesus rebuked the evil spirit, healed the boy and gave him back to his father.

The casting out of an evil spirit by Jesus seems to indicate that he believed the medical disorder was caused by demonic activity. This miracle is also recorded in Matthew 17, and verse 15 identifies the condition as epilepsy. But are epileptic seizures caused by demon spirits? Medical doctors today would say "no." Could there be another way to understand this passage? In ancient medicine, evil spirits were often believed to be the cause of disease; incantations, exorcisms, and sacrifices were common healing protocols used to expel them from the stricken individual.[60] By considering this ancient context, was Jesus accommodating to his audience

in Luke 9 and Matthew 17 by using the medicine-of-the-day? I believe so.

There are many examples of the Lord employing ancient science during his teaching ministry. In the mustard seed parable, he used the ancient belief that the mustard was "the smallest of all seeds on earth" (Mark 4:31) to reveal a message about the kingdom of God. Of course, orchid seeds are much smaller. In prophesying his death and resurrection, Jesus said, "Unless a kernel of wheat falls to the ground and dies, it remains only a single seed. But if it dies, it produces many seeds" (John 12:24). Seeds are alive and function metabolically at an extremely low rate.[61] But their outer casing breaks down before germination, giving the perception that seeds rot and die. Jesus stated that following his death he would be "three days and three nights in the heart of the earth" (Matt. 12:40). There is no evidence of an underworld in the core of planet Earth, only solid iron. And in discussing the Second Coming, the Lord claimed that "the stars will fall from the sky" (Matt. 24:29). From an ancient phenomenological perspective, this passage makes perfect sense. Stars look like tiny specks and a streaking meteorite gives the impression that they fall to Earth.

In the same way, the causal connection between medical conditions and demonic activity in the healing accounts of Jesus is an accommodation using an incidental ancient medicine. The Lord is not offering a revelation that diseases and disabilities are natural evils. It is worth pointing out that there are roughly thirty-one individual healings and eleven mass healings performed by Jesus, amounting to nearly twenty percent of the verses in the Gospels.[62] One would expect that given the prominence of these miraculous events, the Lord would have *at least once* attributed medical conditions ultimately to the cosmic fall, if indeed that was the case.

Jesus was certainly aware of the opening chapters of the Bible and appealed to them in his teaching. For example, in Matthew 19:4–5 he refers to humans being created "male and female" (Gen. 1:27) and that a man and a woman "become one flesh" in marriage (Gen. 2:24). The Lord also points to the murder of Abel (Gen. 4:8) in Luke 11:51 and to widespread sinfulness prior to Noah's flood (Gen. 6:9–13) in Matthew 24:37–39.[63] Therefore, in healing afflicted people, Jesus had over forty opportunities to teach that God had cursed humans with diseases and natural evils because Adam had sinned in the Garden of Eden. But he never did and he made no reference to the cosmic fall in Genesis 3. Why?

Biblical revelation must always be viewed in the light that Jesus Christ is the fulfillment of scripture. As the Lord himself stated, "Do not think that I have come to abolish the Law or the Prophets; I have not come to abolish them but to fulfill them" (Matt. 5:17). Yet in fulfilling the scriptures, Jesus ushered in revolutionary changes. For example, in the Old Testament certain foods were deemed "unclean" (Lev. 11:1–47), but with the Lord all foods were declared "clean" (Mark 7:19).[64] Adulterers were to be stoned to death under Mosaic Law (Deut. 22:22), yet in the New Testament Jesus tells a woman caught in adultery simply to "leave her life of sin" (John 8:11). And most importantly, the atonement for sin changes radically with Christ. In the Old Testament, animals were sacrificed to atone for human sinfulness. However, in the New Testament this practice was completely abolished with the "once for all" sacrifice of Jesus on the Cross (Heb. 10:3, 11–12). The enormity of Jesus fulfilling the scripture on atonement for human sin cannot be overemphasized.

Obvious questions arise. Does this radical fulfilment of scripture in Christ also extend to understanding suffering and death in nature? Stated another way, is there a revolutionary change with regard to theodicy between the Old and New Testaments? And to be even more specific, does the causal connection between human sinfulness and the divine judgment of suffering and death upon the world in Genesis 3 get abolished with Jesus?

My answer to these questions is "yes." As Jesus admonished, "No one pours new wine into old wineskins. If he does, the new wine will burst the skins, the wine will run out and the wineskins will be ruined. No, new wine must be poured into new wineskins" (Luke 5:37–38). There is no better example of the Lord's "new wine" than his radical approach to physical suffering in the account of the man born blind in John 9:1–3.

> As he went along, he saw a man blind from birth. His disciples asked him, "Rabbi, who sinned, this man or his parents, that he was born blind?" "Neither this man nor his parents sinned," said Jesus, "but this happened so that the work of God might be displayed in his life."

The Lord completely undermines the causal connection between sin and suffering in this passage.[65] If suffering blindness was ultimately connected to the sin of Adam and the cosmic fall, then Jesus had the perfect opportunity to say so. But he never did. Instead, the Lord offers the revolutionary and counterintuitive notion that suffering is meant to reveal the power of God in the lives of men and women. And this was the case since the man was healed of his blindness (v. 7). Suffering is not meaningless, but rather it has a divine purpose within God's creation.

It is necessary to qualify that Jesus's teaching about the man born blind is not a heartless disregard for suffering, because he certainly identified with human agony. For example, after Lazarus had died due to an illness, the Lord was "deeply moved in spirit and troubled" and he "wept" (John 11:33, 35). Yet in presenting disease and death from a radically new perspective, Jesus proclaimed that the passing of Lazarus "is for God's glory so that God's Son may be glorified through it" (v. 4). Indeed, the resurrection of Lazarus, like the healing of the man born blind, glorified God because it demonstrated the Lord's sovereign power over suffering and death. Again, Jesus had an excellent opportunity to remind his audience that Lazarus's disease and death were ultimately connected to the sin of Adam and the cosmic fall in Genesis 3, should that be true. But once more, he never did. In fulfilling the scriptures, the Lord declared that even death serves a purpose in the world God created.

Again the radicality of Jesus's fulfillment of scripture cannot be overstated. In dealing with the atonement of sin, he completely abolished the practices demanded in the Book of Leviticus and disconnected making amends for sin through animal sacrifice. The fulfillment in Christ also extends to theodicy. Jesus sets aside the "old wineskin" in Genesis 3 of a causal connection between sin and the cosmic fall, and he then reveals the "new wine," that suffering and death in nature have a divine function. They serve to glorify God and display his power in our lives. In this way, the notion of natural evil has no place within the Lord's creation.

Final Reflections

The doctrine of the cosmic fall and the belief in natural evil are products of concordism and redaction. The traditional concordist interpretation of the overarching metanarrative in scripture—Creation-Fall-Redemption—is rooted ultimately in an incidental ancient science and ancient origins motifs. In particular, the notion of a perfect creation soon followed by a fallen cosmos in Genesis 1–3 emerged from the juxtaposition of two conflicting ancient phenomenological perceptions of the operation of nature—the optimistic Priestly author's idyllically functioning creation with no hint of a fallen cosmos, and the pessimistic Jahwist's malfunctioning world enslaved by the effects of a cosmic fall.

Of course, the identification of these ancient scientific paradigms only began well after the birth of modern science in the seventeenth century. It is therefore understandable why a number of Christian creeds, councils, and confessions of faith include concordist interpretations of scripture.[66] They were formulated within a prescientific mindset. Consequently, incidental ancient scientific concepts such as *de novo* creation, cosmic fall, and cosmic redemption were inadvertently conflated with inerrant spiritual truths of the Bible.

To move beyond concordism and conflation, it is necessary to separate the incidental ancient science from the Holy Spirit's life-changing messages of faith. I term this hermeneutical approach the "Message-Incident Principle."[67] In this way, the ancient paradigms of the physical world embedded in the Creation-Fall-Redemption metanarrative become vessels that deliver metaphysical or spiritual foundations of the Christian faith. A nonconcordist interpretation of this grand narrative in scripture redirects attention to the inerrant spiritual truths. Figure 6 presents the Message-Incident Principle and separates the spiritual messages associated with

Figure 6. The Message-Incident Principle and a Non-Concordist Interpretation of the Bible's Creation-Fall-Redemption Metanarrative

Creation-Fall-Redemption from their incidental ancient understandings of nature—*de novo* creation, cosmic fall, and cosmic redemption.

Let me further explain. The doctrine of creation does not affirm the *de novo* origins of an idyllic world, but instead reveals that the God of Christianity is the Creator of the entire cosmos and every living organism. Belief in creation is not about *how* God created, but *that* he created. The doctrine of the Fall does not deal with a lost idyllic age and the origin of natural evil, but rather with the reality that sin entered the world through humans. The cosmos is not fallen, the human heart is. And the doctrine of redemption is not a reversing of changes in nature caused by a cosmic fall or a return to a perfect garden without suffering and death. Redemption is spiritual, not physical. Jesus died to free us from our sins and to restore our relationship with God.

To state my position precisely: I fully embrace the inerrant spiritual truths of the Bible's Creation-Fall-Redemption metanarrative because these are nonnegotiable Christian beliefs for me; and I reject the incidental ancient scientific paradigms that undergird this overarching account in scripture.

There is a question that I suspect most readers have: "What are we to make of the Bible presenting two contrasting views of nature?" The answer rests in the belief that the Holy Spirit inspired not only the biblical authors, but also the redactors and compilers of their writings into scripture. For example, Genesis 1 (P) presents a transcendent cosmic Creator and Genesis 2 (J) an immanent personal Lord, resulting in a more complete picture of God, with him being both beyond us in heaven and yet near to us on Earth. Similarly, the Bible offers a creation that optimistically "declares the glory of God" (Ps. 19:1) and pessimistically is in "bondage to decay" (Rom. 1:21). This intellectual tension is experienced by all Christians. It both confirms the existence of God through the stunning intelligent design in nature, and it looks forward to the consummation of the present world with the "redemption of our bodies" and "our adoption as sons" (Rom. 8:23).

Another question that must have arisen in your mind is this: "Why did God allow the cosmic fall and the causal connection between sin and death to appear in scripture?" Let me offer a *speculation*. Hebrews 10:4 states with regard to the elaborate sacrificial system of the Old Testament that "it is impossible for the blood of bulls and goats to take away sins." In other words, despite what the Mosaic Law claimed and commanded, the slaughter of thousands upon thousands of animals did not atone for sin. However, animal sacrifice did have a spiritual function. As Hebrews 10:3 explains, "Those sacrifices are an annual reminder of sins."

Could it be that the cosmic fall and the connection between human sin and physical death in scripture are also reminders for us? Too often we forget that we are creatures who are accountable before God. Death is the perfect reminder of our sinfulness and thrusts us to the feet of our Creator. Funerals often repeat the divine judgment in Genesis 3:17, "For dust you are, and to dust you shall return." Physical death reminds us that there will be a Judgment Day when we will stand before our Maker to give an account of our life.

We no longer live in Calvin's young earth creationist world. Today many scientists who embrace evangelical Christianity believe that the Lord created the universe and life, including humans, through an ordained, sustained, and intelligent design-reflecting evolutionary process.[68] In scripture, the Holy Spirit has given us an example and a template for incorporating the science-of-the-day as a platform for presenting inerrant biblical truths to our twenty-first century scientific generation. It behooves us to formulate an evangelical evolutionary theodicy. By moving beyond the ancient wineskin of a cosmic fall and natural evil in Genesis 3, we can pour the new wine of Jesus's fulfillment of theodicy into a modern evolutionary beaker. ❁

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Notes

[1]F. F. Bruce in *The Epistle of Paul to the Romans* (London: Tyndale Press, 1963) offers a traditional understanding of the cosmic fall.

> The doctrine of the cosmic fall is implicit in the biblical record from Genesis 3 to Revelation 22 … Like man, creation must be redeemed because, like man, creation has been subjected to a fall. (p. 169)

Some view the cosmic fall as preceding the appearance of humans and due to satanic forces. Troubled by carnivory, C.S. Lewis in *The Problem of Pain* (New York: Macmillan, 1962) hypothesizes,

> I say that living creatures were corrupted by an evil angelic being … The Satanic corruption of the beasts would therefore be analogous, in one respect, to the Satanic corruption of man … [S]ome mighty created power had already been at work for ill on the material universe, or the solar system, or, at least, the planet Earth, before ever man came on the scene. (pp. 133–35)

[2]John Calvin, *Commentary on Genesis*, 2 vols., trans. John King (1554; Grand Rapids, MI: Baker, 1996), 1:102. Online at http://www.ccel.org/ccel/calvin/calcom01.pdf.

[3]Ibid., 1.114, 117–18; italics added.

[4]Ibid., 1.62; italics added. The clause "Let the earth bring forth" is actually from Genesis 1:11, 24.

[5]Calvin argues, "Moses relates that the work of creation was accomplished not in one moment, but in six days." He also dismissed the notion of "infinite periods of time" and claimed the world has existed for a "period of six thousand years" (John Calvin, *The Institutes of the Christian Religion*, trans. Henry Beveridge [1536; Grand Rapids, MI: Christian Classics Ethereal Library, 2005], 142–43). Online at http://www.ccel.org/ccel/calvin/institutes.pdf.

[6]Calvin, *Commentary on Genesis*, 1.57; italics added. Calvin adds, "On the whole, this language is intended merely to express the perfection of the fabric of the world," ibid., 1.62.

[7]Ibid., 1.62–63, 117; italics added. Calvin's reference to "Moses" reflects a precritical understanding of the authorship of the Genesis accounts of origins. This assumption will be challenged later in this article.

[8]John Calvin, *Commentary on Isaiah*, 4 vols., trans. William Pringle (1559; Grand Rapids, MI: Christian Classics Ethereal Library, no date), 1:296. Online at http://www.ccel.org/ccel/calvin/calcom13.pdf.

[9]Ibid.

[10]Ibid.

[11]Ibid.

[12]Calvin, *Commentary on Genesis*, 1.63.

[13]A 2004 survey of American adults reveals that 87% of evangelicals believe in six-day creation and a global flood. Survey conducted Feb. 6–10, 2004, by International Communications Research Media, PA.

[14]See "*rāqîa'*," in *The Dictionary of Classical Hebrew*, 8 vols., ed. David J. A. Clines (Sheffield, UK: Sheffield Academic Press, 1996), 7:552–55; Paul H. Seely, "The Firmament and the Water Above. Part I: The Meaning of *rāqîa'* in Gen. 1:6–8," *Westminster Theological Journal* 53 (1991): 227–40.

[15]This category is not to be confused and conflated with our *modern* phenomenological perspective of nature. What the biblical writers saw with their eyes, they believed to be real, such as the literal rising and literal setting of the sun. When we see the sun "rising" and "setting," we know that it is only a visual effect caused by the rotation of the earth.

[16]See John H. Walton, *Ancient Near Eastern Thought and the Old Testament: Introducing the Conceptual World of the Hebrew Bible* (Grand Rapids, MI: Baker Academic, 2006), 165–78; Kyle Greenwood, *Scripture and Cosmology: Reading the Bible between the Ancient World and Modern Science* (Downers Grove, IL: IVP Academic, 2015), 71–102. Walton in *The Lost World of Genesis One: Ancient Cosmology and the Origins Debate* (Downers Grove, IL: IVP Academic, 2009) notes,

> Through the entire Bible, there is not a single instance in which God revealed to Israel a science beyond their own culture. No passage offers a scientific perspective that was not common to the Old World science of antiquity. (p. 19)

For an introduction to ancient science in scripture, see my chapter entitled "Ancient Science in the Bible," in *I Love Jesus and I Accept Evolution* (Eugene, OR: Wipf and Stock, 2008), 43–70. This chapter is also online at http://www.ualberta.ca/~dlamoure/ilj_ancient_science.pdf.

[17]One of the reviewers of this article complained that this precedent and the three others similar to it that follow "shock" the reader. To soften the language of this sentence, I could have written: The Bible makes statements about how God acted in origins *that are not literally true*. Or, the Bible makes statements about how God acted in origins that *do not correspond to physical reality*. Of course, by employing the clause, "*but these events never happened*," I am being polemical. In teaching biblical hermeneutics at the university level for nearly twenty years, I have found that in order to move beyond concordism, it is necessary to expose that it completely fails as an interpretive approach. Moreover, it is critical to understand that with this hermeneutical precedent I am not saying that God lies in the Bible. Lying requires a deceptive intent. In fact, scripture states directly in Titus 1:2 that God "does not lie" and Hebrews 6:18 asserts that "it is impossible for God to lie." The God of the Bible is not a God of deception. Instead, the Holy Spirit by grace accommodated in scripture and came down to the intellectual level of the biblical writers and their readers and used their scientific categories in order to communicate as effectively as possible.

[18]*De novo* creation is not restricted to instantaneous creation or creation out of nothing, and it does not preclude creation through a natural process. For example, on the sixth day of creation in Genesis 1, land animals came forth from the earth fully developed in just one day, using a mechanism seemingly similar to the origin of plants on the third day. In fact, the word translated as "produce" in Genesis 1:12 and 1:24 is the same Hebrew verb *yāsā'*. Also see endnote 20.

[19]Of course, Adam plays a critical role in scripture in that he is the archetypal sinner—he represents us and our sinfulness. Yet the implications of Adam not existing are significant for the doctrine of original sin. See Denis O. Lamoureux, "Beyond Original Sin: Is a Paradigm Shift Inevitable?," *Perspectives on Science and Christian Faith* 67, no. 1 (March 2015): 35–49.

[20]David A. Leeming observes in *Creation Myths of the World: An Encyclopedia*, 2 vols. (Santa Barbara, CA: ABC-CLIO, LLC, 2010), "In a vast number of creation myths from all parts of the world the creator makes the use of soil—usually clay—in the creative process … More often earth—as dust, mud, or especially more logically, as clay—is used to create humans" (2:312). Another creative mechanism was a plant-like sprouting of humans from the earth. For example, in *KAR 4* the gods plant the seeds of people and humans later "sprout from the ground like barley." Quote in Richard J. Clifford, *Creation Accounts in the Ancient Near East and in the Bible* (Washington, DC: Catholic Biblical Association, 1994), 30.

[21]Clifford, *Creation Accounts*, 48–49.

[22]Ibid., 39, 75.

[23]Ibid., 74.

[24]Ibid., 105, 107.

[25]In fact, a corollary of *de novo* creation is that suffering and death can only occur *after* living organisms have been made.

[26]Leeming notes in *Creation Myths*, "It is common practice to treat [creation] myths etiologically—that is, as primitive science" which is based on "limited scientific understanding" (1:xviii). Kenton L. Sparks, *Ancient Texts for the Study of the Hebrew Bible* (Peabody, MA: Hendrickson Publishers, 2005), also acknowledges the ancient scientific and historiographical concepts in ancient accounts of origins. "For the ancients, their cosmological myths also reflect their scientific ideas about the cosmos … Often they viewed their myths as history" (p. 337). Note that my use of the term "paradigm" is intended to reflect the modern concept of scientific paradigms. I am arguing that ancient people had ancient scientific paradigms based on an ancient phenomenological perspective of nature.

[27]Leeming explains the logic behind these two motifs.

> Not surprisingly, the awareness of a lack of perfection in the world and the capacity for evil and wrongdoing in the human personality have led many cultures to describe a *fall* from grace in the early days of creation. Central to the *fall* from grace theme is the assumption that the world originally created was perfect but that, either through the manipulation of a devil figure or because of some inherent need in the human to disobey the creator or to give in to an inherent selfishness and arrogance, humans have *fallen* from a state of grace to one that characterizes the actual world in which we live. (*Creation Myths*, 2:329; italics added)

[28]See my comment in endnote 25.

[29]Leeming, *Creation Myths*, 2:317–18; italics added.

[30]See endnote 17 regarding my polemical use of the clause "*but these events never happened*."

[31]Sparks argues that attempts to render "God formed" in Genesis 2:19 to the pluperfect "God had formed," as seen in evangelical Bibles such as the NIV, "does not suit the immediate context, where God works to resolve Adam's solitude" (Kenton L. Sparks, *God's Word in Human Words: An Evangelical Appropriation of Critical Biblical Scholarship* [Grand Rapids, MI: Baker Academic, 2008], p. 83, note 8). Moreover, if birds and land animals were created earlier, why would the author not simply say that God brought them to Adam instead of referring to their creation?

[32]See Greenwood, *Scripture and Cosmology*, 110.

[33]The identification of the sources with some of my minor modifications is based on Richard E. Friedman, *The Bible with Sources Revealed: A New View into the Five Books of Moses* (New York: HarperSanFrancisco, 2003), 33–50; Gordon J. Wenham, *Genesis 1–15*, *Word Biblical Commentary*, vol. 1 (Waco, TX: Word Books, 1987), xxviii–xxxii, 163, 214. Note that I have excluded verses added by the redactor such as Genesis 4:25–26 and the *tōlēdōt* title ("These are the generations of … ") in Genesis 5:1; 6:9; 10:1; 11:10; and 11:27. The argument that the Genesis sources are faded parallel memories fails to appreciate its underlying concordist hermeneutic. For example, whether or not birds were created before humans, the J and P sources still affirm their *de novo* creation.

[34]Similar to Genesis 1 and 2, recognizing the original P and J flood sources eliminates conflicts between events in Genesis 6–9. For example, there are two divine orders regarding the loading of birds. The P source has "two of every kind of bird" in Genesis 6:9, while J states "seven of every kind of bird" in Genesis 7:3.

[35]Reassembled J and P flood accounts are online at http://www.ualberta.ca/~dlamoure/h35.pdf and http://www.ualberta.ca/~dlamoure/h37to38.pdf.

[36]Similarities between the J and P creation and flood accounts are online at http://www.ualberta.ca/~dlamoure/h36.pdf and http://www.ualberta.ca/~dlamoure/h39.pdf.

[37]I am assuming that reference to Sheba and Dedan in Genesis 10:7 is a later addition or interpolation that was incorporated into the text. In this way, the Priestly author's structural style is preserved along with his use of the stylistic numbers of 5 and 7. Moreover, this avoids the repetition of the birth of Sheba and Dedan in Genesis 25:3. This doublet reflecting two sources is clearly seen in 1 Chronicles 1:9 and 1:32.

[38]It is interesting to note that the Hebrew term *sheōl* referring to the underworld does not appear in P accounts of the Pentateuch, but six times with the J renditions (Friedman, *Sources Revealed*, 10). It may be that P viewed humans going directly to heaven after death as somewhat implied in Genesis 5:24 when "God took him [Enoch] away."

[39]Animals becoming fearful of humans in Genesis 9:2 is not in the context of divine judgment and should not be construed as a cosmic fall (in fact, if it were, it would be the only change in nature). Rather, this verse appears to be etiological only and it is found *after* God reissues the commands for animals to multiply and be fruitful in Genesis 8:17.

[40]The Jahwist author makes only one other reference to anything in nature being "good," the gold in Havilah (Gen. 2:12). As the next section of this article reveals, this use of the term "good" is functional and not moral.

[41]Genesis 5:29 seems to indicate some relief from the curse of toil in Genesis 3:17–19, but this verse is best seen as expressing a hope or prayer ("May Noah bring us relief …"—Wenham, *Genesis 1–15*, 128). As well, Genesis 8:21 appears to imply that the cursing of the earth might be lifted. However, Wenham argues that

> God is not lifting the curse on the ground pronounced in 3:17 for man's disobedience, but promising not to add to it … Furthermore, it is also quite apparent that the curses pronounced in Genesis 3—weeds, toil, pain, death, enmity with serpents—are all part of humanity's present experience, so that 8:21 cannot be stating they are lifted after the flood … It is simply the threat of another flood that is lifted. (Ibid., 190)

[42]"*Tōb*," in Clines, *Classical Hebrew*, 3:349–56; Robert P. Gordon, "*Tōb*" in *New International Dictionary of Old Testament Theology and Exegesis*, ed. Willem A. VanGemeren (Grand Rapids, MI: Zondervan, 1997), 2:353–57. Notably, the Septuagint translates *tōb* in Genesis 1 as *kalos* and not *agathos*. Bertram notes, "By using *kalos*, the translator introduces the idea of the beauty of the world" (Georg Bertram, "*Kalos*," in *Theological Dictionary of the New Testament*, 10 vols., ed. G. W. Bromiley (Grand Rapids, MI: Eerdmans, 1964), 3:544. In combining the functional and esthetic nuances of *tōb*, Genesis 1:31 might be translated as "God saw that all he had made was *working beautifully*!"

[43]I. Höver-Johag, "*Tōb*," in *Theological Dictionary of the Old Testament*, 14 vols., ed. G. J. Botterweck and H. Ringgren, (Grand Rapids, MI: Eerdmans, 1974), 5:299, 304; italics added.

[44]Ibid., 5:304.

[45]Claus Westermann, *Genesis 1–11: A Commentary*, trans. J. J. Scullion (1974; Minneapolis, MN: Augsburg Publishing, 1984), 166.

[46]Walton, *Lost World*, 51. Walton attempts to argue that Genesis 1 does not deal with material origins, but functional origins only. I disagree and contend that *both* aspects appear in scripture. See my criticism subtitled "The Material Origins versus Functional Origins Thesis," in *Four Views on the Historical Adam,* ed. Matthew Barrett and Ardel B. Caneday (Grand Rapids, MI: Zondervan, 2013), 119–22.
[47]Ibid., 150.
[48]Ibid., 149–150.
[49]Herbert C. Brichtco, *The Problem of "Curse" in the Hebrew Bible*, Journal of Biblical Literature Series, vol. 13 (Philadelphia, PA: Society of Biblical Literature, 1968), 116, 216–17. See also "*'ārar*" in Clines, *Classical Hebrew*, 1:397–98; Christopher J. H. Wright, "*'ārar,*" in *New International Dictionary of Old Testament*, 1:24–26.
[50]Brichtco, *Problem of "Curse,"* 114.
[51]Ibid., 113.
[52]As Mark S. Smith notes in his *The Priestly Vision of Genesis 1* (Minneapolis, MN: Fortress, 2010), "Genesis 1's vision [of the world] is *wildly optimistic,*" p. 113, italics added.
[53]However, death will continue to exist within this new creation. Isaiah 65:20 states, "He who dies at a hundred will be thought a mere youth; he who fails to reach a hundred will be considered accursed [*qālal*]." This appears to reflect the view of the P author in that death is normative after a long life. Yet it seems that in this new creation the serpent of Genesis 3 remains, in that "dust will be the serpent's food" (v. 25). This discrepancy between Isaiah 11 and 65 is the result of the Book of Isaiah being written by at least two authors, and maybe three: Isaiah 1–39 (pre-exilic), 40–55 (exilic), and 56–66 (post-exilic). See Sparks, *God's Word in Human Words*, 104–108.
[54]Italics added.
[55]Henry George Liddell and Robert Scott, *A Greek-English Lexicon*, 9th ed., revised by Henry Stuart Jones (Oxford: Oxford University Press, 1996), 1930.
[56]The term *douleia* is found most often in contexts dealing with slavery. Echoing the Hebrew *'ārar*, Rengstorf notes that in the New Testament, "*doulos* is the classical picture of bondage and limitation" (Karl H. Rengstorf, "*Doulos*," in *Theological Dictionary of the New Testament*, 2:271).
[57]In contrast to the 3-tiered world of Revelation 5:3 and 13 ("no one in heaven or on earth or under the earth"), the new heavens and earth of Revelation 20–22 is a 2-tiered cosmos without an underworld. This seems to be a return to the 2-tiered universe of the P author in Genesis 1.
[58]A metanarrative is a comprehensive account of the ultimate meaning of history, human experience, and justification for the structure of society. In particular, scientific and historical paradigms are vessels that transport the metaphysical beliefs of a community or culture. See Jean-François Lyotard, *The Postmodern Condition: A Report on Knowledge* (Minneapolis, MN: University of Minnesota Press, 1984), 34–37. In referring to "Creation-Fall-Redemption" as the Bible's "overarching metanarrative," I am distinguishing the incidental ancient paradigms from its inerrant spiritual truths—God created the world, humans have fallen into sin, and Jesus redeems us through his death. See endnote 26 for my use of the term "paradigm."
[59]See endnote 17 regarding my polemical use of the clause "but these events never happened."
[60]David C. Lindberg, *The Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, 600 B.C. to A.D. 1450* (Chicago, IL: University of Chicago Press, 1992), 18–20.
[61]I am grateful to botanist Keith Furman for making me aware of this scientific fact.
[62]"31 Individual Healings of Jesus Christ," accessed December 22, 2015, http://www.stronginfaith.org/article.php?page=111.
[63]Of course, Jesus's use of the early chapters of Genesis is archetypal in order to reveal theological lessons. None of these passages is a debate about the historicity of the events or people.
[64]This uncleanliness is ceremonial rather than ontological since 1 Timothy 4:3 states, "For everything God created is good."
[65]In fact, Exodus 4:11 challenges the idea that sin is connected to physical disabilities. "The Lord said to him [Moses], 'Who gave man his mouth? Who makes him deaf and dumb? Who gives him sight or *makes him blind*? Is it not I, the Lord?'" Italics added.
[66]For example, reference to the underworld (*hādes*) appears in the Apostles' (The Received Form) and Athanasian Creeds; the *de novo* creation of Adam is found in the Councils of Carthage and Trent and the Augsburg and Westminster Confessions. I am grateful to James Peterson for his assistance with this issue.
[67]Denis O. Lamoureux, *Evolutionary Creation: A Christian Approach to Evolution* (Eugene, OR: Wipf and Stock, 2008), 106–11.
[68]Ibid., xiii.

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Book Reviews

Environment

WHO RULES THE EARTH?: How Social Rules Shape Our Planet and Our Lives by Paul F. Steinberg. New York: Oxford University Press, 2015. 352 pages. Hardcover; $29.95. ISBN: 9780199896615.

In *Who Rules the Earth?,* political scientist Paul F. Steinberg argues that achieving environmental sustainability requires more than individual lifestyle changes; instead, people must work together to change the rules that govern societies. Written in a popular style and drawing on numerous real-life examples, this book offers an accessible, engaging introduction to the literature on institutions and what it can teach us about addressing today's environmental crisis.

The book is divided into four parts. In Part One, Steinberg establishes the meaning and importance of social rules. Such rules shape interactions between people by defining roles, rights, and responsibilities, and can be formal or unwritten. By this definition, social rules are ubiquitous, ranging from the operating manual of a private company to unwritten social customs to national laws and international treaties. Steinberg also discusses the barriers to creating good rules, countering one of the key objections to his argument: the idea that if better rules were possible, they would already have been created.

Part Two delves into three types of social rules that play key roles in environmental issues: property rights, rules around markets (including market-based incentives for environmental protection), and national environmental laws. In each of these chapters, Steinberg uses concrete examples to show how rules vary over place and time. While acknowledging the complexities of designing effective rules, this approach also reinforces the idea that rules are contingent and changeable.

Part Three discusses two contemporary trends in environmental regulation: increased international coordination, exemplified by the European Union's *acquis communautaire*, and decentralization of power, evident in initiatives such as community-based resource management. Both trends offer examples of innovative change and emphasize the importance of thinking strategically about new rules.

Finally, Part Four addresses strategies for achieving social change. Steinberg argues that positive change will not happen automatically through technological progress, economic growth, free markets, or individual lifestyle changes; instead, new ideas must be deliberately anchored and formalized as social rules in order to endure. At times, this involves changing the "super rules"—rules that determine how other rules are made. The book closes with several practical principles for action.

Who Rules the Earth? is a welcome addition to the environmental literature. Steinberg's argument is clear, convincing, and timely. He draws together theoretical and empirical research and a wealth of examples to reinforce two key points that may offer hope for today's ecological crisis: humans created the rules that have permitted, and even caused, so much damage to natural systems, and humans are capable of changing those rules. In learning about the progress that has been made in many countries over the past several decades, readers frustrated by stalled international negotiations and government heel dragging may see possibilities for future progress as well.

It is often tempting for Christians to limit our attempts at creation care to individual actions such as recycling, rather than getting involved in the messy and frustrating business of building coalitions and pushing for policy change. We know that isolated actions are insufficient to address the problem, but, we reason, are we not called to be faithful rather than successful? This book is a reminder to us that being faithful often does mean diving into complicated problems together, making our voice heard in the public square, and being an example—not only of individuals trying to do the right thing, but also of a whole community living a different way of life.

Unfortunately, Steinberg makes no mention of the role that faith or faith communities can play in influencing social rules. Given that the past few decades have seen Christian churches and organizations increasingly educating their members about creation care and engaging environmental issues in the public square—advocating for policy change, issuing public statements, joining the divestment movement—this may be a disappointing omission for readers of *PSCF*. On the other hand, it may also serve as a call to action, encouraging further efforts that are broad and effective enough to draw the attention and perhaps even cooperation of our secular colleagues.

The book is pitched at a level that will serve nonexperts and students well as an introduction to the literature on institutions from a variety of fields, including politics, economics, sociology, and business. While not offering new theories or data, Steinberg does an excellent job of drawing together existing research to offer a coherent, accessible argument about how it applies to the current ecological problem. Despite a few clunky metaphors, the book is well written and avoids jargon and dense academic prose. Numerous contemporary and historical examples, drawn from a range of industrialized countries and the Global South, keep the text interesting and engaging.

One topic that could have been discussed more extensively is the unwritten social norms, values, and attitudes that shape people's willingness to create and obey social rules. Steinberg certainly acknowledges the importance of these factors, especially in chapter 9. However, he only briefly discusses some factors that cause attitudes to change, before moving on to strategies for entrenching new ideas as formal rules. Given that changes in attitudes and rules must go hand in hand, more discussion of the literature from psychology, sociology, and other fields could have offered additional insight here.

Overall, *Who Rules the Earth?* offers a clear argument, firm grounding in research, and practical guidance for those who want to have a voice in shaping the rules that we live by. It will certainly be of value to Christians as we learn to work together to help our society achieve greater sustainability.

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CREATION IN CRISIS: Science, Ethics, Theology by Joshtrom Isaac Kureethadam. Maryknoll, NY: Orbis Books, 2014. xii + 388 pages. Paperback; $50.00. ISBN: 9781626981003.

King David was enjoying his relationship with his wife Bathsheba and their infant son, when Nathan the prophet came over and told him a story of a rich man, who, for his own convenience, had taken away his poor neighbor's one resource, a valued lamb. Angered, David declared, "The man who did this deserves to die!" only to be told by Nathan, "You are the man!" (2 Sam. 12:5, 7). Now Joshtrom Kureethadam declares that the one resource of many poor in the tropics, productivity of the land, has been taken away because of climate change. We in the wealthy countries are to blame: our affluent, sinful lifestyle has caused an ecological crisis, an injustice with physical, moral, and spiritual aspects, and we must repent through an ecological conversion. The author is a Roman Catholic priest, born in Kerala, India, in 1966, who defended his doctoral thesis, *René Descartes and the Philosophical Roots of the Ecological Crisis,* in 2007, and is now secretary and lecturer in the Faculty of Philosophy of the Salesian Pontifical University in Rome.

A brief introduction outlines the book's message. Then, Part I, "Are We Tearing Down Our Home?," traces the formation of Earth and its biosphere—home to humanity—from the Big Bang, through the accretion of the solar system, to the origin and evolution of life, culminating in modern humans. Over millennia, agriculture and industrialization shaped civilization, and "some of the major world religions were born: the great mystical religions of the East like Hinduism and Buddhism, and the great religions of revelation like Judaism, Christianity and Islam in the Middle East …" (p. 45). All this occurred on Earth, "a unique home for life in the infinitely vast universe" (p. 46). But now our home is evidently in peril: the scientific community has confirmed the ecological crisis, with global climate change its worst feature. Humans are deliberately destroying our common home.

In Parts II, III, and IV of the book, Kureethadam describes the ecological crisis as "a triple cry—of the earth, of the poor, and of the gods" (p. 78). The earth cries out: Your greenhouse gases have made my climate intolerable for present-day life, with the rising oceans inundating the best land, and with droughts, extinctions, pollution, and waste. The poor cry out: Insecure food supply, scarce fresh water, and bad sanitation are driving us from our homes as ecological migrants. Growth in our population is not the problem, but injustice is: you rich consume and destroy the earth's productivity, while we poor suffer the worst consequences. The gods cry out: You fail "to look at the physical world as God's creation and abode, and to treat God's home with the due reverence" (p. 293). You have lost sight of how the whole of creation is "destined to be redeemed and transformed in Christ" (p. 324). The ecological crisis is a "sin against God, humanity, and the world" (p. 340). Kureethadam's conclusion is then a call to respond to the ecological crisis. Following the example of Francis of Assisi, "we need to embrace the poor with the same love" shown by him, and to "adopt a lifestyle that is sober and frugal, remembering the words of Jesus that it is only the meek who will inherit the earth" (p. 372).

Kureethadam thoroughly documents his statements with numerous citations from the Intergovernmental Panel on Climate Change (IPCC), of journals including *Nature, Science*, and *Philosophical Transactions*, and references to related books for nontechnical audiences (but not to environmental textbooks). The moral and theological aspects are supported by quotations from scriptural texts, mostly biblical but a few Islamic and Hindu, by declarations of several modern Popes, and by writings by Roman Catholics and other Christians. Calvin DeWitt, John Houghton, Alister McGrath, John Polkinghorne, and Fred Van Dyke are among those cited. The book has a 14-page index but no illustrations other than a devastated landscape on the cover designed by Valentín Concha-Núñez.

Kureethadam's *Creation in Crisis* is a deeply troubling account of the ecological crisis, with a clear explanation for those without a background in science, and with an original discussion of the morality and theology that challenges all readers. However, Kureethadam implies that the emission of greenhouse gases is a wanton

destructive act, rather than the by-product of development of energy resources which has greatly increased the quality of life for many. There is no mention of much progress in environmental stewardship, for example, by closing coal-fired power plants, by lessening runoff of nutrients into water bodies, or by curbing industrial and vehicular air pollution. Nevertheless, the book's importance is confirmed by its parallels with the May 2015 encyclical of Pope Francis, *Laudato si' Care for Our Common Home*, http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html. This relatively brief encyclical has better advice than *Creation in Crisis* on practical actions to take to lessen the ecological crisis, but it has to summarize much, whereas Kureethadam provides a good resource for those wanting more details. ASA members need to pay attention to the message of this book, although its liberal and Roman Catholic theology will be an obstacle for some evangelicals.

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Ethics

COSMIC COMMONS: Spirit, Science, and Space by John Hart. Eugene, OR: Cascade, 2013. xi + 415 pages. Paperback; $40.00. ISBN: 9781610973182.

John Hart is professor of Christian ethics at Boston University's School of Theology (2004 to present). For two decades before, he was a professor, theology department chair, and founding director of the Environmental Studies Program at Carroll College, a Roman Catholic liberal arts college in Helena, Montana. Hart has three graduate degrees, including the PhD from Union Theological Seminary in New York City, and has worked as principal writer of various pastoral letters for the Midwestern Catholic, the Western US, and the Canadian Catholic bishops regional groups. In addition, he has participated in native spiritual leaders and human rights initiatives, which involved being a member of the delegation of the International Indian Treaty Council (an NGO) to the United Nations International Human Rights Commission, Geneva, Switzerland (1987, 1990), and as an invited observer at the World Conference of Indigenous Peoples, Rio de Janeiro, Brazil, which was connected with the UN Earth Summit (1992). Hart is widely published as an academic theologian, including four books prior to the one under review: *The Spirit of the Earth—A Theology of the Land* (Paulist Press, 1984); *Ethics and Technology: Innovation and Transformation in Community Contexts* (Pilgrim Press, 1997); *What Are They Saying about … Environmental Theology?* (Paulist Press, 2004); and *Sacramental Commons: Christian Ecological Ethics* (Rowman & Littlefield's Nature's Meaning Series, 2006).

These credentials need to be emphasized so that readers do not dismiss out of hand—as most academics and scientists have been instinctively trained to do—the thought experiment that is at the heart of *Cosmic Commons*: how might human beings prepare themselves for meeting and interacting with extraterrestrial intelligent (ETI) beings should they exist in the universe? Hart's pilgrimage to this topic began with formal training in social ethics, developed through engagements with environmental theologies, and has been honed over prolonged conversation with native, indigenous, and Amerindian conversation partners. Amid growing discussions of the need for humankind to attempt space travel, and perhaps even to colonize and inhabit other planetary environments, Hart is particularly concerned that we will be propelled by morally deficient and behaviorally destructive models of exploration and conquest such as those encoded in what scholars have called the "Discovery Doctrine." He argues that we should be guided by more recent ethically cogent and ecologically friendly guidelines such as those produced by the United Nations on Earth and outer space, rather than by a doctrine which facilitated European genocide in the Americas over the past five hundred years. Encounters with ETI premised on "Discovery" mentality and attitudes could be tragic, not only for alien creatures but surely for the human species, particularly if these "others" are more technologically advanced in their destructive capacities than we are.

There are four steps to Hart's thought-experiment, each (part) of which includes three chapters. *Terra Firma*, Part I, uncovers both the economic and political roots of Earth's socioecological crisis, the latter especially as unfolded in the history of the Americas, and overviews initial steps that humanity has taken toward restoration of the Earth's socioecological commons. Part 2, *Terra Conscientia*, follows through on the trajectory charted by deployment of "Discovery" commitments as applied to possible ETI "contact," retrieves voices, specifically from the Christian theological tradition, that are suggestive of alternative postures and convictions for considering the possibility of ETI, and outlines an overarching socio-eco-ethical framework for such "contact" between *Homo sapiens* and others. *Terra Incognita*, Part 3, presses forward into imaginative construals of "contact" along three lines: (1) theoretically through the filling out of Hart's proposed "cosmosocioecological praxis ethics"; (2) documentarily through analytical assessment of internationally developed and agreed upon space documents and principles developed in the last generation; and (3) historically through scholarly assessment of alleged prior encounters with ETI, including in Roswell, New Mexico, in 1947, and in the Hudson River Valley, New York region, in the early 1980s—topics taken up at greater length in Hart's companion *Encountering ETI: Aliens in* Avatar *and the Americas* (Cascade Books, 2014).

The final section of the book details Hart's normative proposals toward envisioning "cosmic coexistence" (on cosmic consciousness and cohesion), articulating a "cosmic charter" (on constructive consultation and consociation), and building a "cosmic commons" (on celestial cohabitation, conservation, and compassion).

Pascal's "wager" seems apropos at this juncture: even if there were no ETI elsewhere in the cosmos, Hart's work would be helpful at least for thinking about how our approach to outer space would be ethically responsible, environmentally sustainable, and theologically informed. But if we neglected such offerings, and "contact" were to occur, it would be confrontational rather than productive of commonality, and in that case, no second chance may exist for us to retrace our steps. Beyond such possibilities, however, I suggest that at least for religious persons and others who are uninclined to think that intelligent life is reducible to terrestriality or materiality, this volume invites consideration of how we might interact with creatures that "have a different form of existence," what some have called "Extra-Dimensional Intelligence" (pp. 286, 295). This would require perhaps another book, but the seeds reorienting human values toward such possibilities are sown here. Academics and theologically oriented readers can be assured that *Cosmic Commons* is well worth the investment of time (it is not a short book) and money (nor is it cheap, relatively speaking) since its "fictional" character builds concretely on what we know and seeks to anticipate, at least ethically, how we might further understand and better orient ourselves toward what otherwise "now we see in a mirror, dimly" (1 Cor. 13:12, NRVS).

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History of Science

DARWIN'S DICE: The Idea of CHANCE in the Thought of Charles Darwin by Curtis Johnson. New York: Oxford University Press, 2015. xxxii + 253 pages, endnotes with each chapter, appendix on primary sources, bibliography, index nominum. Hardcover; $31.95. ISBN: 9780199361410.

In the 1920s, quantum physicists proposed that indeterminacy was part of the nature of elementary particles. In 1953, James Watson and Francis Crick announced their discovery of the structure of the DNA molecule, thereby providing a mechanism that can account for mutations—the random modification of a single nucleotide. Following upon these discoveries, the phrase "we live in a chance-governed world" has today become cliché. Charles Darwin knew none of this and yet chance variation was a critical factor in his theory of evolution. Thus Darwin is often linked to the chance-governed-world notion. So what did Darwin actually understand by "chance"?

Darwin was a nineteenth-century scientist who shared the Enlightenment perspective that the natural world was governed by deterministic laws; "chance" for Darwin was shorthand for "cause unknown." Nevertheless, Darwin viewed chance events as gratuitous and "accidental." Darwin reconciled this apparent inconsistency by defining "chance" as meaning that variations among offspring were independent of the adaptive needs or opportunities of species; this is the definition of "chance" that distinguishes the way randomness is used in biology today from other sciences. That is, variations could be deterministically produced by unknown causes acting according to unknown laws but still be gratuitous from the perspective of the species' needs.

However, "chance" for Darwin also had other aspects—sometimes Darwin used "chance" in the sense of probability—what is the chance that a particular offspring will survive? He also used it in a deeper sense. "Cause unknown" at times conveyed the additional meaning of "cause unknowable." That is, he saw many chance variations as unknowable because they were not guided by a directing rational agency; he came to this conclusion because

> there seems to me too much misery in the world … I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance. (p. xviii)

This was the heart of the problem with Darwin's theory for his contemporaries; no one could object to "unknown causes"; however, causes that were not designed and irrational posed a serious obstacle. Nevertheless, while these concepts are clearly presented, this book could have benefitted from a more systematic analysis of Darwin's concept of chance. While Johnson attempts this in the first chapter, new meanings and nuances on meanings pop up in subsequent chapters making it difficult to nail down exactly what chance meant to Darwin.

Darwin's Dice is not a book about Darwinism. It is a book about Darwin's views of chance. However, Johnson does briefly discuss Darwinism; in particular, he suggests that for Darwin, the most important feature of his theory was not natural selection but variation among offspring. Without variation, natural selection would not have alternatives to select among. Darwin thought a lot about the causes of variation—he pioneered the study—but he never succeeded in discovering them. This is not surprising given that Mendel's work on

inheritance and the concepts of the DNA molecule and mutations were unavailable to him. He believed that the causes were real, deterministic forces. He accepted the Lamarckian idea of use-inheritance and the notion that external circumstances could exert influence on the reproductive organs; however, later in his career, he came to believe that the nature of the organism was a more significant cause of variation than the nature of the conditions surrounding the organism. That is, he moved closer to the contemporary idea of random variations acted upon by natural selection.

Johnson forcefully argues that Darwin's understanding of the role of chance in his theory of evolution never changed. However, Darwin's ways of expressing this role changed enormously. By the sixth edition of the *The Origin of Species*, the word "chance" had almost dropped out of the book. This theme is Johnson's main focus and he spends four of his ten chapters on it, tracing a path that began with the word "chance" and ended with the phrase "spontaneous variation," using a number of other terms along the way. This evolution of terminology was Darwin's way of responding to criticism and making his theory more palatable to his contemporaries without changing the theory. Johnson also discusses two major examples Darwin used to communicate his theory. The first illustrates how order can arise from chance: an architect picks up random pieces of stone that have fallen from a precipice and fashions them into a beautiful building. The architect in Darwin's metaphor is not an intelligent designer but laws of nature. The second example is giraffes, used by some of his critics to argue for use-inheritance. Darwin did not dismiss use-inheritance but used this example to argue that chance variation plus natural selection were more important.

Johnson addresses Darwin's religious views at several points; however, from my point of view, he is too heavy-handed in revealing his preference for atheism and applauding Darwin whenever he seems to move closer to it. Darwin saw no role for an active God in nature; early in his career, he wrote that he saw no problems with the deistic notion that God had created the laws that governed nature. Later in his career he doubted this perspective, although he never embraced atheism in his public or private writings. An 1860 letter to Asa Gray articulates his ambiguity:

> I see a bird which I want for food, take my gun and kill it, I do this *designedly*. —An innocent & good man stands under a tree and is killed by a flash of lightning. Do you believe … that God *designedly* killed that man? Many or most persons do believe this; I can't and don't. If you believe so, do you believe that when a swallow snaps up a gnat that God designed that that particular sparrow shd. [sic] snap up that particular gnat at that particular instant? I believe that the man and the gnat are in the same predicament. If the death of neither man nor gnat are designed, I see no reason to believe that the *first* birth or production should be necessarily designed. Yet I cannot persuade myself that electricity acts, that the tree grows, that man aspires to the loftiest conceptions all from blind, brute force. (p. xix)

Darwin never settled his uncertainty about God. He also never wavered in his faithfulness to Enlightenment science, but, as far as we can tell, he never could bring himself to fully embrace materialism.

The book concludes with two chapters exploring some of Darwin's philosophical reflections. One examines Darwin's denial of the existence of human free will on grounds that the world is governed by deterministic laws; in this sense, he regarded free will and chance as the same. The other discusses Darwin's view of human morality in light of his denial of free will. In brief, Darwin argued that humans make moral choices based on seeking pleasure; he also believed in an inborn moral sense that made certain states of affairs more pleasurable than others.

I would recommend this book but only to a somewhat specialized audience—readers who want to look carefully into this aspect of Darwin's thought, scholars who want to explore how biology acquired its unique definition of randomness, and anyone interested in exploring the way contemporary culture understands chance.

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Origins

HUMAN EVOLUTION: Genes, Genealogies and Phylogenies by Graeme Finlay. New York: Cambridge University Press, 2013. 359 pages. Hardcover; $79.99. ISBN: 9781107040120.

Human Evolution is an interesting read that will appeal to a broad scientific audience and anyone interested in evolutionary biology. The author's purpose is to persuade the reader that humans and primates (namely chimps) diverged from a common ancestor. In the prologue, the author makes it clear that his intent is not to dance between genetic evidence and theology to explain human origins, but simply to relay scientific facts. He proceeds to do so by presenting the reader with various examples of genetic mechanisms and accompanying diagrams. True to his word, there is no mention of God, a creator, or any reflection on Christian beliefs or principles in these examples.

The book is arranged into four sections, each section a collection of a distinct type of genetic evidence in

support of our common ancestry with primates. The discussion shifts from the study of retroviruses to transposons (genes that actually "copy and paste" or "cut and paste" themselves throughout the genome) to pseudogenes (genes that do not code for functional protein), to the phenomenon of gene formation. The author keenly describes these various pieces of evidence as "very compelling." Christian or not, the supposed evolution of humans from a common primate ancestor has received attention for years, but only relatively recently have we had the necessary tools to investigate questions regarding the human and nonhuman primate genomes.

The similarity of the human genome to the chimp genome is reported to be anywhere from 96–99%. The author capitalizes on this similarity and not only provides the reader with details in support of this point, but also attempts to convince us that this likeness is the result of a common evolutionary lineage. He believes that the most convincing piece of information in support of this argument lies within the shared mutated regions of the chimp and human genomes. Mutations can exist in many forms: a change in a single building block of DNA, the insertion of a stretch of DNA into a gene, or even the deletion of part of a gene, to name a few. The basis for the author's argument that humans share a common ancestor with primates goes something like this: humans share genes with other mammalian species. Some of these shared genes are functional in certain species, but nonfunctional in others. For a species with a nonfunctional copy, a mutation must have occurred within the gene at some point, rendering it nonfunctional. When two species share the same mutation within the same gene, it is then believed that the species diverged from a common ancestor.

While I understand that the aim of this book was not to relate genetic evidence to the biblical account of creation, the book almost seemed incomplete without some mention of how all of this genetic evidence might coexist with faith. The closest that the author gets to this is in the epilogue, where he acknowledges that although humans and primates are similar genetically, many differences in cognition, intelligence, and spirituality separate us as species.

An additional critique is that the author's argument seemed to ignore the potential for new technologies to lead us to conclusions that challenge present understanding. For instance, the analysis of high-throughput genomic data is a relatively new area of science. As much faith as I place in the potential power of genomic data, I am equally aware of the assumptions, caveats, and potential errors that accompany such analyses. Unfortunately, the author fails to draw attention to this. He mentions that sophisticated algorithms and statistical analyses are performed to conduct the types of phylogenetic analyses that he spotlights, but he does not inform the reader of the potential biases or assumptions that accompany them. Numerous methods and software packages exist to sequence DNA, call genetic variants, and align DNA to a reference genome—each method with its associated error rates and inconsistencies. In fact, there is still much debate within the genetics, bioinformatics, and statistics communities regarding which software and methods are best for analyzing these data. This is a clear indication that there is still much to learn in this field of study. I was both surprised and a little disappointed that the author did not acknowledge these potential problems and shortcomings.

Lastly, I also think it important for the author to mention the *differences* between the human and chimp genomes. For example, what about the striking dissimilarity of the human Y chromosome to that of the chimp Y chromosome?

Human Evolution is a good read for anyone interested in phylogenetics, molecular genetics, or evolutionary biology, but will disappoint those looking for a theological perspective or discussion.

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Philosophy & Theology

CREATOR GOD, EVOLVING WORLD by Cynthia Crysdale and Neil Ormerod. Minneapolis, MN: Fortress Press, 2013. 168 pages. Paperback; $18.00. ISBN: 9780800698775.

Crysdale and Ormerod have written an excellent and accessible book for "those in the middle" of the culture wars on the issue of evolution and Christian faith. They argue that science and faith are complementary pursuits and do so assisted by the groundbreaking methodology of the late Jesuit philosopher and theologian Bernard Lonergan.

First, the authors furnish a brief overview of the emergence of modern science and the legacy of the problem of God's relation to nature bequeathed to us by the interaction of Newton and Laplace. Newton's system was deterministic, but it required "intermittent divine interventions" (p. 5) to keep things running smoothly. The central theological question here is, "Is God not only a primary cause but also a secondary cause, intervening occasionally to ensure God's order in the universe?" (p. 5). Newton's invocation of God as a secondary cause maintaining the solar system's stability, with Laplace's famous retort, has set the mold for the unfortunate "God of the gaps" pattern that science and faith have pursued for hundreds of years. Newton's

deterministic worldview was rather recently shattered with the introduction of Darwin's statistical model of science and the advent of quantum mechanics. This was a revolution in thinking, since, for the first time, probability was viewed as a valid way of doing science. Thus, with Newton, we have a model of science that focuses on regularities, while with Darwin (and quantum physicists), we have a model of science that admits of the random. A question for theology and ethics is whether the universe is, at bottom, purposeful or chance-driven.

The authors introduce readers to Lonergan's way of characterizing the progress of the physical sciences as a function of the nature of the inquiries we make. Newton's approach to the physical world led to an emphasis on its regularities, and classical science was its result. Darwin's approach emphasized the contingent or conditional nature of such regularities, and its result was statistical science. Classical science heads toward regularities that hold "all things being equal," that is, if certain contingent conditions are met. Statistical science heads toward ideal frequencies with respect to which actual frequencies are expected to diverge in a nonsystematic way, that is, in a random fashion. Each kind of science grasps a different sort of intelligibility, "Classical science seeks the *intelligibility of system* while statistical science seeks the *intelligibility of probability*" (p. 24). These two "models" are not, Lonergan insists, separate endeavors, but interweave when giving an account of the natural world.

The authors have a very helpful clarification of the meaning of random. They argue that there is no such thing as "a random event," since randomness can only be determined relative to a patterned aggregate (ideal frequency) from which that event diverges nonsystematically. Such a nonsystematic divergence cannot be determined by a single instance. Conversely, the claim that the universe is absolutely random would require virtually omniscient knowledge since it "would require a grasp of some intelligible pattern … from which all events diverge nonsystematically" (p. 31).

Lonergan argues that the interweaving of classical regularities and statistical probabilities yields the world process of "emergent probability." This is Lonergan's umbrella concept referring to nature as a self-assembling, hierarchically structured reality. Such a structured reality emerges as a result of certain "schemes of recurrence." The latter are any cyclical series "in which the occurrence of any one of these events sets off a recurrent scheme" (p. 32). The authors use examples such as Earth's water cycle and the Krebs cycle for the production of energy in the cells of our bodies. The basic idea is that as such schemes assemble and repeat themselves they become intertwined in such a way that new orders and structures emerge and flourish. The emergence of these new structures makes further, more complex interdependencies more likely, that is, it "shifts the probabilities of certain further events occurring" (p. 35). This point is employed to challenge "intelligent design's" account of certain biological structures as "irreducibly complex." The authors summarize, stating that (1) natural selection is not a random process, (2) it pertains to populations and not individuals, and (3) it occurs as a result of the interaction of random and nonrandom processes in accord with Lonergan's notion of "emergent probability" (p. 39).

Crysdale and Ormerod go on to defend the classical conception of God as eternal (beyond time and space), unchanging, omniscient, omnipotent, and so forth, from certain charges of process theologians. Since they believe that the classical conception makes God too remote, process theologians have wished to bring God closer to the evolving world. They wish to introduce change, limitation, and contingency into the divine essence. Thus, God's nature, in the process view, would be "dipolar": one pole having the classical attributes; another possessing more limited, conditioned traits. In short, God would be both a necessary and a contingent being (p. 44). The authors reject this proposal on the grounds that it is unnecessary and bad theology.

The central issue is how the eternal God is related to the contingent process of the world. If all things are willed by divine providence, how can there be free will or contingency? Everything would already be determined. If, on the other hand, free will and contingency are real, then how can God be sovereign over creation? According to the classical tradition, God's providence can only be effective if God has created all things *ex nihilo* "with no preconditions or constraints" (p. 45). God can only be God, if the Creator is not subject to creation and its contingencies. God has ordained, says Aquinas, certain things to happen necessarily and other things to happen contingently. This schema is transposed into primary and secondary modes of causality (pp. 45–46). God is the primary cause of existence; the rest of creation belongs to the realm of secondary causality and is the purview of scientific investigation. Scientists are free to pursue an investigation into the intelligibilities of the causal mechanisms of the natural world (whether or not they acknowledge God) and God, the one who "breathes fire" into the equations of physicists, is the sole necessary cause of the contingent universe.

The authors take a page from the physicists in their critique of process theology. It is the consensus of contemporary physics that time and space are not separate "things" but comprise one reality, "space-time." Against process theology, they argue that if a temporal element is introduced into God's nature, then a spatial one will also have to be introduced. In short, God will

have to have a body. This is unacceptable to the authors since this makes the Creator too much in the likeness of a creature.

The issue of purpose and meaning in relation to evolution is examined. Building upon emergent probability, they refer to Lonergan's notion of "finality" to characterize the dynamic, "upwardly directed" but "indeterminate" nature of the evolutionary epic. Recall that Lonergan views natural process as having an inbuilt capacity for self-assembly in which schemes of recurrence pyramid and yield ever greater systems of complexity and intricacy. While nature possesses this dynamic tendency, it is "open ended," that is, it does not have a predetermined goal and does not imply "automatic progress" (pp. 71–73). Thus, finality implies direction and flexibility.

In the final chapters, the authors consider theodicy and related questions of suffering, evil, and ethics. God wills the entire universe of emergent probability and it is governed by God's providence, but such providence does not sequester us from suffering. Furthermore, our sufferings may lead us to develop virtues that the absence of suffering may never have called forth. God has created us free, and the good of freedom is so great that God "risked" making the sort of beings who could abuse their freedom by sinning.

Emergent probabilities for human beings do not pertain solely to the physical constituents of survival, but also to the survival of meaning and purpose. They contrast an "ethic of control" with an "ethic of risk" (p. 110). An ethic of control implies a belief in the sovereignty of the agent and his ability to achieve "clear results" (p. 110). An ethic of risk accepts a more limited, situated agency and is "committed to the struggle over the long haul" (p. 111). The authors endorse the ethic of risk as more effective in "shifting probabilities for change" (p. 110) and as more respectful of others and God's creation.

Crysdale and Ormerod conclude their book by reiterating their claim that the eternal, transcendent God of classical theism is a personal God and that this conception of God, alone, can do full justice to the Christian conception of creation, salvation, and redemption. Throughout the work, excellent examples are provided to clarify and illustrate. The book is highly recommended for undergraduate courses in science and religion.

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As space permits, *PSCF* plans to list recently published books and peer-reviewed articles related to science and Christian faith that are written by our members and brought to our attention. To let us know of such works, please write to patrick.franklin@prov.ca.

Science & Biblical Studies

THE LOST WORLD OF ADAM AND EVE: Genesis 2–3 and the Human Origins Debate by John H. Walton. Downers Grove, IL: InterVarsity Press, 2015. 255 pages. Paperback; $17.00. ISBN: 9780830824618.

Walton approaches the creation accounts in Genesis theologically. It is his belief that these chapters are not giving a description of the actual origins of the universe. His interpretive method is characterized by perspectives found in the literature of the ancient Near East, for the simple reason that human language can only function within the perspectives and presuppositions of its culture. The account of origins therefore has to do with order, function, and roles rather than the material universe. The order that God created inaugurated sacred space in the cosmos. God intended a place for people created in his image where he would be in relationship with them and present among them.

Genesis 2 is the establishment of a terrestrial center of sacred space in what is identified as a garden. Adam and Eve are commissioned as priests in this sacred space, mediating revelation of God and access to God. This is in keeping with biblical theological themes. Walton developed the concept of the Genesis account describing a cosmic temple in his *NIV Application Commentary: Genesis* (Zondervan, 2001). Temples in ancient Canaan were images of creation, so it is natural that the creation story of Genesis be told in temple terms with temple functions. In "Equilibrium and the Sacred Compass" (*Bulletin for Biblical Research* 11, no. 2 [2001]: 293–304), Walton develops this concept from the book of Leviticus. The temple is a reminder that creation is God's sacred space. The objects of the Hebrew verb "atone" (*kāpar*) are those of the sanctuary, not the people. Leviticus ritual is focused on sacred space; individuals are the beneficiaries in that their status is restored because of the cleansing that has taken place on their behalf. Walton's hermeneutics of Genesis has a solid basis, not only in its cultural setting, but especially in biblical theology. The confessional rituals of Israel make the functional interpretation of the creation accounts the only one that is biblically justifiable.

The narrative of Genesis 2 presents the formation of Adam and Eve as archetypes, in keeping with other ancient Near Eastern accounts. They are representatives of a group. All members of the group participate in the actions of the representative archetype. This concept is defended in an interpretation of Romans by N. T. Wright (pp. 170–80). Paul's treatment of Adam has to do with the kingdom of God and the whole creation project rather than salvation from sins. For Paul, the parallels between vocations (functions) of Adam and Israel are

more important than questions of human origins or the origin and transmission of sin. Drawing on Psalm 8, Paul sees the glory that God intended for humanity as already fulfilled in Jesus and shared with those that are one with the Messiah. Unfortunately, the question of cosmic and human origins has become completely muddled with the *soteriological* question as to whether an "original Adam" is necessary for the biblical doctrine of salvation. In biblical theology, the promise to Abraham in Genesis 12:1–3 is the answer to the plight of humanity depicted in Genesis 3–11. The divine answer to the problem of Adam (as explained in Rom. 1:18–3:20) is found in the fulfilment of the covenant with Abraham in the saving work of Christ. Romans 5:12–21 is a summary of how the promise to Abraham deals with the sin of Adam and its effects. Paul is focused on the glory the Creator intended to give his human creatures, their dominion over the world.

While the biblical account has similarities with others of the ancient Near East, there are also significant differences. Other accounts consider the creation of humanity to be *en masse* in order to supply the needs of the gods. The Hebrews had no such concepts of deity. Instead, Genesis emphasizes that humans have mortal bodies empowered to serve in sacred space. Humans serve in the relationship of families. It is for this fundamental reason that their bodies are created as male and female. As an archetypal account, questions of chronology or material origins are not addressed by the narrative in any sense.

Walton distinguishes between concepts conveyed by cultural analogies of language and the theology which they articulate. It is typical in the ancient world to depict the heart (*lēb*) as the center of intellect and emotion. Though biblical writers may have actually believed that to be the case, it has no theological relevance. Translators must decide whether *lēb* should be rendered as mind or emotion in modern terms, but it has no bearing on the biblical understanding of the human person. In the same way, it is not necessary to treat Adam as the sole progenitor from whom the whole human race descended (p. 204). This is no more necessary than a requirement that mental activities must be associated with the human heart. In dealing with theological questions such as that of human origins, language has a greater context than what may be perceived as immediate literary implications. To use a parallel example (pp. 96–101), Melchizedek had human progenitors, a fact certainly believed by the biblical author. But progeny was irrelevant to him serving as a priest. Such a priesthood, in complete contrast to the Levitical priesthood, serves as an analogy for the priesthood of Jesus. The theology of priesthood is critical, not a knowledge of the human ancestors of Melchizedek.

The book is divided into twenty-one propositions which address various modern questions of human origins or interpretation of ancient accounts. The last proposition asserts that humans may be a special creation of God even if there is material continuity with the rest of biological creation. But proposition 11 asserts that Adam and Eve are real people, though their names are representative, in part because Adam is listed in genealogies. This need not require that they be the first human beings (p. 103), but they are the humans that serve as the archetype of all humans.

The book is a concerted attempt to avoid any use of science as a means to interpret the Genesis account. Science is simply unreliable as a guide to absolute or inerrant truth. Science is constantly in process and there is no certainty as to where it may lead. For example, Rajat Bhaduri of McMaster University has joined a growing group of scientists challenging the general theory of relativity which requires that the universe begin with a "big bang." Their model attempts to answer the gravitational question and account for dark matter by a theory in which the universe is retained at a finite size which therefore gives it an infinite age. Biblical accounts simply do not address such questions. Biblical writers are not trying to reconstruct the world that was; they are providing a theology which explains the world that is.

The book is written in a nontechnical style, making it comprehensible to any nonprofessional reader. It does lead the reader to consider Genesis as part of a biblical theology which is surely the purpose and intent of its author. As a complement to Walton's work, I would recommend Mark S. Smith, *The Priestly Vision of Genesis 1* (Fortress, 2010). Smith develops the linguistic significance of the terminology of Genesis which shows the priestly vision of time and space, humanity and divinity.

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THE BOOK OF *GENESIS*: A Biography by Ronald Hendel. Princeton, NJ: Princeton University Press, 2013. 287 pages. Hardcover; $29.95. ISBN: 9780691140124.

Ronald Hendel is a well-respected Jewish biblical scholar who became even more well known in 2010 for writing an essay in the *Biblical Archaeology Review* entitled "Farewell to SBL: Faith and Reason in Biblical Studies" (SBL in his title refers to the Society of Biblical Literature). In his essay, Hendel lamented that this esteemed scholarly society, numbering many thousands of members and devoted to the critical study of the Bible, was now welcoming explicitly religious/ideological points of view. As a result of this change, he withdrew his membership.

Hendel's negative appraisal of the role of faith in biblical studies should not lead us to prejudge *The Book of* Genesis*: A Biography*, since it is a delightful read that both informs and engages the reader through its fascinating retelling of selected aspects of the history of interpretation of Genesis, from the beginning up to the modern period. Indeed, I had only a vague memory of Hendel's 2010 position statement while I was reading the book; it was only after completing it that I went back and re-read his earlier statement about faith and reason. In the end, I will suggest that Hendel's overall argument in *The Book of Genesis: A Biography*, and even the structure of the book, aligns with his position in the 2010 article.

The book contains seven chapters, an introduction that surveys Hendel's approach, and a very brief (and, I judge, quite weak) afterword that reflects on living with the book of Genesis in the contemporary world. Of the seven main chapters, the first, "The Genesis of Genesis," sketches Hendel's modern, scholarly understanding of the origin and meaning of the book of Genesis, while chapters 2–4 trace the premodern history of interpretation and chapters 5–7 address Genesis in the modern period. Although it might seem that Hendel's account is evenly divided between premodern and modern eras with three chapters on each, the chapters on premodern interpretation add up to only 62 pages, in contrast to the 165 pages devoted to the modern period. If we combine this with the first chapter, which clearly draws on modern critical scholarship to understand the origin of Genesis, we find that fully 196 pages are devoted to a modern interpretation of Genesis.

The dividing point for Hendel is between a "literal" or "realist" interpretation of Genesis and a "figural" (nonliteral) interpretation. According to Hendel, the book of Genesis

> envisions a single, God-created universe in which human life is limited by the boundaries of knowledge and death. We are earth-bound, intermittently wise, often immoral, mortal creatures. There is a harsh realism in the Genesis accounts of human life. (p. 9)

This realism of Genesis, which Hendel attributes to the original meaning of the text in ancient times, and which he unpacks in often illuminating ways in chapter 1, was compromised by two nonliteral approaches to the world, both of which became lenses for interpreting Genesis. In chapter 2, "The Rise of the Figural Sense," Hendel draws on James Kugel's famous analysis of four assumptions in *The Bible as It Was* that had become standard by the first century of the Common Era, namely that the Bible was *cryptic*, *relevant*, *perfect*, and *divine*. Hendel explains how these assumptions led interpreters to go beyond the surface meaning of Genesis—in one of two directions, which he names the *apocalyptic* and the *Platonic*.

In chapter 3, "Apocalyptic Secrets," Hendel gives a selective, but nonetheless interesting, introduction to the rise of apocalyptic interpretation of the Bible in, or soon after, the Babylonian exile, beginning with Ezekiel's integration of aspects of the Eden narrative into his vision of a renovated Jerusalem. He cites speculation about the restoration of Eden and the glorious renewal of humanity at the "end of days" (a favored phrase of Hendel's) in the Dead Sea Scrolls and the Targums (later Aramaic paraphrases of the Old Testament), and ultimately in Paul's writings in the New Testament.

Where the chapter falters, however, is in Hendel's reading of Paul as an "apocalyptic" theologian. He claims (against the grain of almost all NT scholars) that Paul's mysterious experience in the "third heaven" (2 Cor. 12:2–4) was formative for his theology, and then uses these few verses as the basis of reading an "esoteric" Paul. He also misunderstands completely the nature of the resurrection in 1 Corinthians 15, taking the "spiritual body" as a body composed of spirit (*pneuma*) or ethereal "stuff" so that it is fit for living in heaven. James Ware's recent article, "Paul's Understanding of the Resurrection in 1 Corinthians 15:36–54," in the *Journal of Biblical Literature* (which is sponsored by SBL), addresses Paul's argument in 1 Corinthians 15, and should permanently lay this interpretation to rest. Underlying these misreadings of Paul is Hendel's equivocation on the meaning of "apocalyptic." Whereas he initially defines the term as having to do with the revelation of mysteries and secrets, he later uses it as equivalent to eschatological; then on the basis of Paul being an "apocalyptic" (read: *eschatological*) thinker, he imports esoterism into Paul.

In chapter 4, "Platonic Worlds," Hendel traces the rise of figural (specifically, allegorical) interpretation of the Bible back to Plato's allegory of the cave, which Philo of Alexandria, the great Jewish theologian of the first century AD, used as a hermeneutical lens. Just as the Platonic philosopher must emerge from the darkened cave of physical illusion to view the spiritual/intellectual reality of the sun, so the biblical interpreter must go beyond the literal meaning of the text to its hidden, spiritual meaning. Thus the call of Abraham to leave his *land*, *kindred*, and *father's house* (Gen. 12:1) is taken by Philo to mean the purification of the soul from earthly matter, specifically, *the body*, *sense perception*, and *speech*. Then follows a fascinating sketch of the desire to ascend from Earth to heaven in Paul (a clear misreading), the Gnostic gospels, and the desert fathers. Part of the problem with this chapter is that Hendel takes the presence of Greek (the language) to imply a Platonic interpretation (p. 90), which is a non sequitur.

Chapter 5, "Between the Figure and the Real," then recounts the recovery of literal/realist interpretation of

Genesis, and the problems that came with this recovery. Hendel begins with Rashi, the twelfth-century Jewish rabbi, who often criticized previous Midrashic interpretations of the Bible and advocated a pesher approach, which corresponds in many ways with what we would call grammatical-historical interpretation. This approach was taken up by Luther, who confessed that in the past he used to allegorize "even a chamber pot," but then came to disdain anything but the plain sense of the text. Hendel quotes Luther on his perception of ludicrous or fictitious aspects of Genesis (such as Eve being created from Adam's rib) and on the genealogies of Genesis 10, as being "full of dead words." Hendel's point is that Luther began to see problems with taking the plain sense of the Bible as obvious truth, which was immediately relevant to the life of the faithful. After Luther, we find the learned Catholic Rabelais parodying the Genesis stories in the hilarious bestseller *Gargantua and Pantagruel*; then we have the Jewish Spinoza's literal/realist interpretation of the Bible that led to his questioning its divine origin and authority.

Chapter 6, "Genesis and Science: From the Beginning to Fundamentalism," traces the rise of the modern scientific picture of the cosmos, which initially seems to be congruent with the biblical "realist" picture. Indeed, a literal interpretation of Genesis contributed to the "disenchantment" of nature, which allowed it to be studied scientifically. Yet what science subsequently discovered about the cosmos, particularly the question of heliocentrism, seemed to contradict a plain-sense reading of Genesis; thus we have the famous conflict between Galileo and the church authorities. Here Hendel cites Augustine, who claimed that allegorical/figural interpretation was allowable only when a literal reading of the biblical text seemed false. The problem, as Hendel portrays it, is that in the modern era, with the decline of allegorical reading, interpreters were in a quandary when they discerned contradictions between the Bible and science. The long and short of this chapter is to suggest that there were three modern approaches to the seeming contradiction between science and scripture, particularly with respect to Genesis.

One approach was Galileo's limited acceptance of figural interpretation when the Bible seemed to contradict what he was discovering about the universe; this approach is encapsulated in the famous statement that "the intention of the Holy Spirit is to teach us how one goes to heaven and not how heaven goes." This distinction surfaces in the later position of Pope John Paul II, who reversed the Catholic Church's judgment against Galileo and affirmed that reason and revelation were two distinct, noncontradictory realms of knowledge.

But there were two other approaches to the seeming contradiction between science and scripture that arose from the decline of figural readings. One was the approach of Spinoza, who was upfront about the contradictions between science and Genesis, and who developed the rudiments of what later became higher biblical criticism, including Pentateuchal source theory (JEDP). Hendel's glee in sketching Spinoza's approach to the Bible is palpable, and one can see that he understands this approach to have led to the later formation of the SBL, and thus to his disappointment with that Society.

The only alternative to Spinoza and to biblical criticism, generally, is, according to Hendel, the doctrine of inerrancy, which became the favored approach of conservative Christians, including those who penned *The Fundamentals*. In the wake of New World exploration which led many to wonder about pre-Adamite races, the challenges of deep geological time, which did not fit the six days of creation, and the growing awareness of biological evolution which contradicted human uniqueness, more and more Christians who rejected figural readings of the Bible, and thus the separation of faith from science, attempted to harmonize a literal understanding of Genesis with a realist understanding of the world, which resulted, according to Hendel, in compromising the truth of both.

While there is much to ponder in this chapter, Hendel is confused about the meaning of inerrancy, treating it as equivalent to a focus on the "plain sense" of the text. Yet he goes on to claim that the idea of inerrant autographs means that evangelicals cannot establish any point of doctrine from the Bible unless they have access to these autographs, since the present Bible we have is "an incorrigibly corrupted text, unreliable in its details, unstable in its support of any interpretation of its meanings" (p. 191). Thus, for Hendel, inerrancy is a modern, historicized variant of the Bible's cryptic meaning (as delineated by Kugel).

Hendel's final chapter, "Modern Times," begins by tracing how Genesis was used in nineteenth-century debates about slavery and the status of women. But then the chapter shifts to an evocative portrayal of Emily Dickinson's "slant" telling of the Genesis stories and Franz Kafka's parabolic engagement with the text, concluding with Erich Auerbach's *Mimesis* and his profound analysis of the literary realism of Genesis, in contrast to Homer's epics. Not only does Hendel take Auerbach's analysis as returning us to the original meaning of Genesis, but he understands Auerbach's approach as presenting us with the choice of either submitting to this ancient text in its literal meaning or resisting its authority in the light of what we "know" as moderns. While Hendel chooses the second option, he does not intend to simply jettison Genesis (or the Bible as a whole), evident in his joyous lingering over the poetics of Dickinson and Kafka.

I have to be honest: I could not put this book down. I was hooked from the start and enthralled the whole way through, partially through Hendel's lucid writing, partially by wrestling with aspects of Hendel's portrayal that did not make sense to me. In the end, I came to realize that the primary focus of the book is on the modern recovery, not only of Genesis but also of the entire Bible, as a literal/realist text, which results in the reader necessarily discerning tensions between the text and the world. For Hendel, this leads to something like Stephen Jay Gould's "Non-Overlapping Magisteria" (NOMA), in which faith and science, including biblical studies, are viewed as entirely separate domains of knowledge, which should never interfere with each other. This, I discern, is what led him to critique, and then leave, the SBL in 2010.

Although I am sympathetic to NOMA, since it allows scientists who are Christians to get on with their scientific work without forcing the results of scientific inquiry to conform to our theological assumptions, I wonder if there is not more to be said on the intrinsic relationship of theology and scripture to science. Tom McLeish's amazing book *Faith and Wisdom in Science* (Oxford University Press, 2014) is perhaps a start at overcoming NOMA without reverting to the old program of harmonization.

All in all, however, Hendel's volume is a selective, nontechnical, thoughtful introduction to the history of interpretation of Genesis. Despite disagreements with aspects of Hendel's argument, I judge that *The Book of Genesis: A Biography* is worthwhile reading for anyone interested in this subject.

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Technology

RECODING GENDER: Women's Changing Participation in Computing by Janet Abbate. Cambridge, MA: MIT Press, 2012. 247 pages, notes, bibliography, index. Hardcover; $34.00. ISBN: 9780262018067.

Recoding Gender is a thoroughly researched book that uses interviews and primary documents to illustrate women's contributions to the history of computing. It is an engaging read that carefully provides context for facts and stories, without vilifying any of the players involved. Though there are certainly unfair practices, stereotypes, and biases mentioned, Abbate chooses to focus on the champions, with just enough background on the prevailing social constructs to make it clear why these were formidable successes. But this is also a weakness of the book. By choosing to only include the success stories, a rosier picture of the past is created than other sources would suggest is accurate. However, when read as an addition to existing male-dominated histories, this book provides a necessary understanding of how gender has impacted the relatively new field of computer science.

Abbate begins her book by explaining the role of women in two key computing projects of World War II: the British Colossus projects and the US ENIAC project. Though computer hardware was considered a male enterprise even during war times, programming, as a new and as yet undefined activity, was open to women. In fact, early in computing history, women were encouraged in software roles, since some saw programming as an extension of the role of women as "computers" who performed calculations by hand in clerical roles. Abbate uses interviews with women of each project to understand the appeal of the work (engaging, challenging, exciting) as well as the gender roles that were implicitly or explicitly associated with this new field. She also sheds light on the very limited understanding that society at large had of the new machines, and the skills that both men and women were able to use in programming.

Abbate moves forward from the war to consider the role of women in the developing computing industry of the early 1950s. At this time, hardware was still the primary selling point of a system, but custom software was often needed and so a programmer might be sent by the hardware company if required. Here, the opportunities for women were more varied, depending on how programming fit into the structure of the organization. In particular, in business application areas (as opposed to scientific areas), women often encountered a glass ceiling. To understand the context of these organizations, the author spends time exploring the ways in which programmers were recruited and assessed (e.g., college degrees of any kind showing an ability to learn, or specially formulated aptitude tests) and considers the implications of each from a gender perspective (e.g., far fewer women were able to pursue degrees than men at this time, but women were just as likely to do well on an aptitude test). She then looks at the various ways computing was put into context with other disciplines such as math, engineering, business, and considers the gendered implication of those associations.

As programming evolved in the 1960s, new terminology like "software engineering" and a greater understanding of the inherent complexity of programming also advanced. Abbate explores the factors that caused people to talk about the "software crisis" and the myriad approaches that were used in trying to overcome it, keeping each approach in the context of its gendered implications. For example, "automatic programming" and its related "structured programming" were highly influenced by women such as Grace Hopper who

sought to move programming away from mundane tasks and instead allow the programmer to work at a higher level. Women were allowed to be champions in these areas as they often had the requisite skills to develop language improvements and the experience to recognize which process improvements would be most beneficial. On the other hand, associating programming with the term "software engineering" had the unfortunate consequence of making programming seem like a masculine endeavor, given the disproportionate number of men in engineering fields.

The last two chapters of the book contrast the role of women in computing from first a business perspective and then an academic perspective. In the business-focused chapter, Abbate relays the experiences of two women who got around glass ceilings. They created work-family balance in their lives by building software companies that predominately hired mothers of young children who wished to work part time. In this way, Abbate shows that the field could be supportive of families, while at the same time showing the myriad challenges faced by these entrepreneurs. In the last chapter, Abbate highlights the impact of having very few role models for female academics, while giving several examples of nonlinear paths through academic ranks. She highlights the resourcefulness of women, but also points out that "women's narratives reveal the daunting level of hard work and persistence" required for advancement (p. 153).

Abbate ends her book by reviewing the ways in which women in computer science have created community for themselves, communities that are distinctly not masculine. While some women found that professional societies were a way to gain recognition in an otherwise male-dominated field, there were too few women at any one conference for there to be any sense of camaraderie. In this context, she explores the roles of the Systers and TechTalk mailing lists, and then the evolving role of the Grace Hopper Celebration of Women in Computing conference.

The lack of women in computing today is not a specifically Christian problem, but it is certainly a societal one. Women have different experiences with, preferences for, and insights into technology, and yet the vast majority of today's technology is written by men. God has created men and women to complement one another, and the Creator's endowed gifts to women in this field have gone vastly untapped for many years. With a better understanding of the role that gender has played in the history of computing, perhaps we can better imagine the ways in which all can contribute to the future of technology.

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