

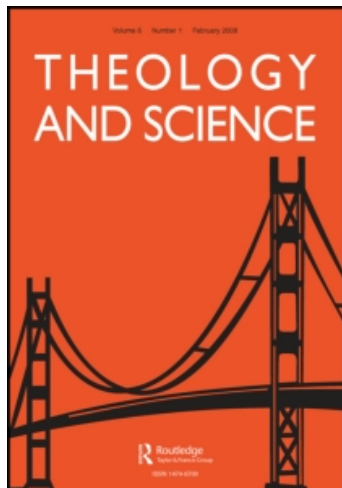
This article was downloaded by: [Van Slyke, James A.]

On: 13 May 2010

Access details: Access Details: [subscription number 921992992]

Publisher Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



## Theology and Science

Publication details, including instructions for authors and subscription information:

<http://www.informaworld.com/smpp/title~content=t713709314>

### Challenging the By-Product Theory of Religion in the Cognitive Science of Religion

James A. Van Slyke

Online publication date: 06 May 2010

**To cite this Article** Van Slyke, James A.(2010) 'Challenging the By-Product Theory of Religion in the Cognitive Science of Religion', *Theology and Science*, 8: 2, 163 – 180

**To link to this Article:** DOI: 10.1080/14746701003675546

**URL:** <http://dx.doi.org/10.1080/14746701003675546>

PLEASE SCROLL DOWN FOR ARTICLE

Full terms and conditions of use: <http://www.informaworld.com/terms-and-conditions-of-access.pdf>

This article may be used for research, teaching and private study purposes. Any substantial or systematic reproduction, re-distribution, re-selling, loan or sub-licensing, systematic supply or distribution in any form to anyone is expressly forbidden.

The publisher does not give any warranty express or implied or make any representation that the contents will be complete or accurate or up to date. The accuracy of any instructions, formulae and drug doses should be independently verified with primary sources. The publisher shall not be liable for any loss, actions, claims, proceedings, demand or costs or damages whatsoever or howsoever caused arising directly or indirectly in connection with or arising out of the use of this material.

## Challenging the By-Product Theory of Religion in the Cognitive Science of Religion

JAMES A. VAN SLYKE

**Abstract** *The by-product theory of religion in the cognitive science of religion is problematic on both scientific and philosophical grounds. The by-product theory of religion argues that the explanation for religious beliefs can be reduced to a by-product of the unconscious processes of evolutionary cognitive adaptations. At the scientific level, the concept of emergence describes processes related to religious beliefs that are not causally reducible to cognitive adaptations. At the philosophical level, the by-product theory is often associated with certain metaphysical assumptions about the non-existence of supernatural beings, which is not warranted based on the empirical evidence alone. In general, evidence from the cognitive science of religion does not necessitate the elimination of theological explanations of religious beliefs and theology can act as a competing interpretative framework for the empirical findings at the levels of cognitive and evolutionary science.*

**Key words:** Cognitive science of religion; New atheism; Reduction; Emergence; Theology; Top-down causation; Evolution and religion

The by-product theory of religion in the cognitive science of religion (CSR) claims that religious beliefs and behaviors are ultimately reducible to a by-product of evolutionary cognitive adaptations. This view of religion is problematic on two counts. First, evidence from a wide range of sources in the cognitive neurosciences demonstrates that the by-product theory is unable to account for a number of important causal processes in the formation and function of religious beliefs. The by-product theory characterizes religious phenomena from a causally reductive perspective which assumes that causation is primarily bottom-up from part to whole. However, an emergent view of cognition provides a better account of the multiple causal factors involved in religious beliefs.

Secondly, the by-product theory is often assumed to indicate that any theological explanation of religious belief is invalidated through the process of eliminative reduction. Thus, the real explanation for religious beliefs is at the level of cognitive and evolutionary science, not higher-level descriptions offered by religious studies or theology. However, the problem here lies in a lack of discrimination between scientific and metaphysical statements. Metaphysical

propositions about the existence or non-existence of gods are inherently multi-level, meaning that they rely on argumentation from multiple areas of knowledge, not just the empirical evidence offered by one level in the hierarchy of science. Thus, empirical evidence from the CSR is insufficient to simply eliminate a theological explanation of religion beliefs. Theology is one option that can offer a competing perspective on the interpretation of findings from the CSR.

### Causal reductionism

Scientific investigation has long assumed a hierarchy of scientific theories and levels corresponding to different levels of complexity.<sup>1</sup> Thus, lower levels in the hierarchy investigate phenomena at a smaller scale (i.e. physics, chemistry, microbiology, etc.) while higher levels investigate phenomena at a larger scale (i.e. sociology, psychology, ecology, etc.). Causal reductionism assumes that the primary explanation for any phenomena lies in the causal relationships among the parts of a whole. Thus, causation is mainly bottom-up from part to whole and the best explanation for any particular phenomena is one level below in the hierarchy of science.<sup>2</sup> This particular view of reduction has an interesting conceptual history beginning with the transition from the medieval to the modern worldview.

Prior to the rise of science during the modern period, most medieval scholars accepted a hylomorphic view of matter based on the work of Aristotle.<sup>3</sup> This view stipulated that things are composed of matter (physical constituents) and form (the particular function or telos of the object). Modern science rejected hylomorphism in favor of reviving the atomism of the ancient Greek philosopher Democritus. Thus, causal relations between atoms became the primary model for understanding causation at the higher level of composite wholes. Whole objects were epiphenomenal aggregates of micro-level processes or secondary effects of the primary causal interactions between the parts.<sup>4</sup> This led to the general practice of describing any particular whole phenomenon by simply referring to processes and functions of its parts one rung below in the hierarchy of sciences.

Causal reductionism is the one of the primary assumptions behind the by-product theory of religion, which has produced misleading statements about the nature of religious beliefs. Religious beliefs are classified as a “mere consequence or side effect of having the brains we have” and an “airy nothing.”<sup>5</sup> Or religion may simply be an accident caused by the misuse of adaptations:

[E]nthusiasm is building among scientists for the view that religion emerged not to serve a purpose—not as an opiate or a social glue—but by accident. It is a by-product of biological adaptations gone awry.<sup>6</sup>

Thus, the real cause for religious beliefs lies at the level of science studied by the cognitive and evolutionary sciences. “The explanation for religious beliefs and behaviors is to be found in the way all human minds work.”<sup>7</sup>

The by-product theory is closely aligned with the theories of evolutionary psychology and cultural epidemiology, which also demonstrate this same causally

reductive view of cognition and religion. Evolutionary psychology suggests that the human mind/brain is comprised of many different adaptive cognitive modules.<sup>8</sup> These modules contain cognitive programs specific to a particular evolutionary environment that required adaptive solutions to problems faced by our ancient Pleistocene ancestors. Thus, human cognition can be modeled after a Swiss army knife; cognitive problems in our contemporary environment approximate problems of our evolutionary ancestors, which triggers a particular module that processes the problem according to a pre-set series of computations (similar to an algorithm) that leads to a cognitive solution.<sup>9</sup>

Cultural epidemiology models the spread of religious beliefs as analogous to the spread of a pathogen in a particular population. Thus, certain types of religious beliefs are more contagious in cultural populations than others and will spread readily by exploiting certain default inferences afforded by cognitive adaptations. The architecture of the human mind/brain is predisposed to be drawn towards certain types of religious concepts because they are easily processed and remembered, whereas others are more cognitively costly (require more time and processing power) and do not spread as easily. For example, Boyer argues that religious concepts that are minimally counterintuitive will spread faster because they exploit certain default processing assumptions of intuitive categories of cognitive templates.<sup>10</sup> Religious concepts that are based on intuitive ontological categories (such as AGENT, ANIMAL, ARTIFACT) will spread faster because of the ease with which human cognition can process this information.

Both of these theories demonstrate a causally reductive view in their explanation of human cognition. According to Tooby and Cosmides, cognitive functions that are not the direct result of the processing of cognitive modules are simply “incidental by-products.”

Although our architectures may be capable of other kinds of functionality or activities (e.g. weaving, playing pianos), these are incidental by-products of selection for our Pleistocene competencies—just as a machine built to be a hair dryer can, incidentally, dehydrate fruit or electrocute.<sup>11</sup>

Humans may be capable of some interesting cognitive capabilities, but the true nature of cognition lies one level down from these by-products at the analysis of modular cognitive adaptations. Thus, an explanation of phenomena at one level (human cognition) can really be understood by looking one level lower (evolutionary adaptations). Cultural epidemiology makes a similar move by arguing that all macro-level processes can be understood as simply the cumulative effect of micro-level processes.

All epidemiological models, whatever their differences, have in common the fact that they explain population-scale macro-phenomena, such as epidemics, as the cumulative effect of micro-processes that bring about individual events, such as catching a disease.<sup>12</sup>

The pairing of these theories with causal reductionism in the CSR leads to distortions about the nature of human cognition and the causal explanation of religious beliefs.

## Emergence

To overcome the problems of causal reductionism and the by-product theory of religion, it is necessary to incorporate aspects of the theory of emergence as general principles that specify processes involved in the formation of religious beliefs. Most definitions of emergence presuppose some form of top-down causation or constraints, which is discussed in the following section; but I will begin by discussing the definition of emergence. Generally speaking, emergence is the *antithesis* to reductionism.<sup>13</sup> Emergence theories tend to agree that an exhaustive reductive explanation of natural phenomena is ultimately not possible and emergence is an important aspect of the process of evolution.<sup>14</sup> Harold Morowitz argues that emergence is a part of everything including the formation of stars and other planetary structures, multicellular organisms, as well as the formation of the numerous animal species and even the human cultural advancements of tool making, language, and agriculture.<sup>15</sup> Emergence has also been defined according to particular themes such as self-organization, which is illustrated in the formation and maintenance of ant colonies and feedback processes that characterize the flow of information in media and the Internet.<sup>16</sup>

Although most theories of emergence run counter to certain forms of reductionism, there are differences of opinion on the definition of emergence. Currently, the most distinctive divergence is between forms of weak and strong emergence or nonreductive and radical forms of emergence.<sup>17</sup> In general, weak or nonreductive forms of emergence specify that there are particular emergent properties of systemic wholes that are not reducible to the constituent parts, but different levels of complexity are not necessarily ontologically distinct. It is the formation, organization, or pattern of constituent parts that makes the crucial difference. Strong or radical emergence claims that certain systemic wholes not only have properties that are nonreducible, but that in certain cases there is an ontological distinction between certain levels of complexity. Thus, strong forms of emergence argue that in certain circumstances something novel, unique, or distinct emerges through the interaction of the components that produces a type of emergent entity.

The debate between weak and strong emergence is an important issue and involves several different perspectives in the dialogue between theology and science.<sup>18</sup> However, for the present discussion, weak emergence provides the necessary resources for contradicting causal reductionism in the CSR, yet this is obviously a debatable assumption. This type of emergence refutes certain assumptions about the nature of causation in the sphere of causal reductionism, especially the understanding of causation as primarily "bottom-up." Emergence provides a positive account of the causal role of systemic wholes in the various processes that involve whole part relations.

[W]hat the emergentist needs to show is that as we go up the hierarchy of complex systems we find entities that exhibit new causal powers (or, perhaps better, participate in new causal processes or fulfill new causal roles) that cannot be reduced to the combined effects of lower-level causal processes.<sup>19</sup>

According to William Bechtel, emergence “simply recognizes that whole systems exhibit behaviors that go beyond the behaviors of their parts.”<sup>20</sup> This does not mean that wholes contain some type of separate ontological substance to separate wholes from their parts, but simply shows that the operations of a phenomenon at the systemic level contain a wider range of possible functional states than the parts themselves. Thus, analysis of systemic properties requires a different level of analysis appropriate to the complexity of the phenomenon in question.

Bechtel argues that descriptions of the mind/brain in cognitive neuroscience and philosophy of mind require the use of mechanistic descriptions that include “component parts, component operations, and their organization.”<sup>21</sup> Thus, causally reductionistic explanations of any phenomena (in this case a religious belief), which describe the contributions of the components parts in a bottom-up fashion, are insufficient to address the complexity of causal processes at work in any mechanism.

[R]eductionistic research that focuses on the contributions of the of the parts and operation of a mechanism typically needs to be complemented by approaches geared to appreciating systemic properties such as how the parts and operations are organized and the difference that organization makes to the behavior of the components.<sup>22</sup>

Additionally, complex systems such as the human mind/brain are embedded in environments, which include shifting parameters that affect different properties and constrain some of the possibilities for cognition and behavior.

Murphy and Warren Brown argue that it is a fundamental fact of most forms of biological organisms that they are inherently active rather than passive.<sup>23</sup> Consequently, the environment in which an organism is embedded is highly important, in that the shifting demands of environmental feedback continually update and modify potential cognitive and behavioral outputs. Organisms and the environments in which they are situated form a feedback loop between internal processes and environmental constraints. Steven Quartz and Terrence Sejnowski identified several neuronal processes involved in the construction of basic aspects of representation based on feedback from the environment.<sup>24</sup> Referring to a large body of research, three aspects of neuronal complexity (synaptic number, dendritic arborization, and axonal arborization) have been directly linked to feedback from the environment. Proper organization and development of these different neuronal systems is dependent on information from the environment to specify certain parameters necessary for neuronal growth and the ultimate construction of particular representations.

Several areas of research in developmental neurobiology highlight the role of feedback as a complementary process to genetic factors in brain development. It seems highly unlikely that the human genome could ever encode all of the information necessary to specify the trillions of synaptic connections throughout the brain.<sup>25</sup> In the competition for survival among the myriad of synaptic connections, both internal processes and environmental feedback structure the primary contours of brain development.<sup>26</sup> Quartz argues that many human

behaviors and corresponding brain systems actually evolved according to “progressive externalization” where aspects of brain development became dependent upon external features of the environment.<sup>27</sup> Evolution exploited the stability of environmental factors to provide certain types of constraints on the formation of different types of neuronal structures necessary for representation and cognition. Especially in the case of humans, the development of several features of cognition is protracted such that proper development involves a prolonged period of neuronal and environmental interaction to construct neuronal patterns that become the basis for cognitive representations.<sup>28</sup>

Evolutionary psychology assumes that cognitive modules are informationally isolated and domain-specific; however, it is clear that many cognitive functions are dependent upon external environmental information, even at the most basic levels of representation. Environmental feedback does not just trigger the computational algorithms of cognitive modules, but is actively involved in structuring the computational programs of different cognitive functions. Cultural epidemiology makes a similar mistake in assuming that pathogenic effects are informationally isolated from the environmental feedback effects of particular languages and cultures. If basic forms of neuronal systems that represent different forms of information are highly dependent upon informational feedback from the environment, how can a more complex form of representation such as symbolic language simply be a function of internal cognitive constraints? In this sense, micro-level phenomena can only offer a partial explanation of macro-level phenomena.

### Top-down constraints

Aristotle classified four different types of causation: material, formal, efficient, and final.<sup>29</sup> During the modern era with the rise of Newtonian science, the only type of cause that survived from Aristotle’s original formulation in the Anglo-American context was efficient causation.<sup>30</sup> This view of causation describes substances as going through a linear series of cause-and-effect relations, such that A causes B causes C, etc. Roy Wood Sellars referred to this model as conceptualizing causal relations in terms of discrete “microscopic billiard balls” colliding with one another.<sup>31</sup> But it seems that we have lost something in neglecting Aristotle’s notion of a formal cause in terms of the pattern or structure of the whole (macrostructure) and its ability to constrain certain functions of its parts. The form or essence of something was correctly rejected on metaphysical grounds because forms as something that is a separate substance from matter makes little sense in the contemporary scientific worldview. Yet, is it possible to postulate the existence of a type of cause similar to a formal cause without the corresponding ontological baggage?

Alicia Juarrero argues that a new understanding of causation is necessary in light of recent developments in systems theory and non-equilibrium thermodynamics.<sup>32</sup> Causation is not fully explainable through descriptions proposed by efficient causation but requires an account of inter-level causality where the whole

is able to act as a constraint on its parts. This form of causation acts by limiting the degrees of freedom of potential actions of the parts.<sup>33</sup> Once a system has been organized into a particular configuration, the possibility of the parts operating in way that is inconsistent with that configuration becomes highly unlikely. The behavior of the parts of a system is limited by the overall configuration of the system. Robert Van Gulick referred to this process as “selective activation,” which is different than the alteration of component parts, but suggests that the macrostructure has a unique role to play in many systemic processes.<sup>34</sup>

However, the notion of top-down causation may be misleading. Top-down causation is not another form of efficient causation or in competition with other bottom-up accounts of causation. Thus, a better name for it may be top-down *constraints*, rather than causation, to show that we are talking about something different than efficient causation. Certain features of cognitive systems of representation contained within neuronal networks settle into attractor states similar to a topographical map with different valleys and grooves.<sup>35</sup> When the cognitive system is activated, the valleys and grooves act as attractor states that constrain the potential representational states of the cognitive system.

The psychological literature in cognitive science often refers to this effect as top-down processing, where larger conceptual schemas are employed to perceive different objects in the world in contrast to bottom-up processing.

Bottom-up processes are driven by sensory information from the physical world. Top-down processes actively seek and extract sensory information and are driven by our knowledge, beliefs, expectations, and goals. Almost every act of perception involves both bottom-up and top-down processing.<sup>36</sup>

Jouquin Fuster argues that as cognitive representational networks get farther from basic forms of representation in the primary sensory areas there is a higher level of reliance upon top-down processing.<sup>37</sup> Top-down cognitive constraints play an active role in processing incoming information, especially in terms of concepts and language processing. Cognitive science has shown several examples of top-down processing in perception, such as the word superiority effect, where identical symbols are perceived differently depending on the context, or phoneme restoration, where missing sounds are inserted depending on the context.<sup>38</sup>

Based on the evidence from emergence and top-down constraints, it seems highly unlikely that religious beliefs can simply be reduced to a by-product of cognitive adaptations. The formation of religious beliefs includes environmental feedback in terms of cultural and contextual variables that aid in the formation of specific religious beliefs. Additionally, religious beliefs can be conceptualized as a type of cognitive attractor state, which constraints how information it ultimately processed. Thus, religious beliefs may also function as a particular constraint in certain situations where top-down processing is activated in the processing of incoming information. Thus, religious beliefs are not causally reducible to an “airy nothing” or “biological adaptations gone awry,” in that several other causal processes at many different levels of complexity are involved in the formation and function of religious beliefs in individual persons and cultures. However, the question still remains as to whether the CSR is inherently hostile to a theological



explanation of religious beliefs. It is still possible that even if religious beliefs are not reducible to by-products, the beliefs themselves are still ultimately false or misleading. Thus, additional arguments need to be made to incorporate research from the CSR into a theological worldview. To accomplish this task, we must move on to the topic of eliminative reductionism.

### Philosophical issues for the by-product theory

The previous section demonstrated problems with causal reductionism and argued that the concept of emergence illustrates certain causal processes that are not reducible to by-products of cognitive adaptations. For this section, a further argument is made that certain aspects of the by-product theory may be shown to be philosophically objectionable. Certain uses of the by-product theory do not clearly differentiate between metaphysical and scientific statements. This mainly relates to the problem of eliminative reductionism and the relationship between different theories at different levels in the hierarchy of the sciences. The by-product theory and other theories about religion from the CSR do not necessitate the elimination of theological explanations of religious beliefs. A theological perspective can be used as a competing interpretative framework in contrast to the assumed connection between the CSR and philosophical naturalism.

Historically, the standard model for reduction is usually attributed to the work of Ernst Nagel, who defined reduction as the logical derivation of one theory from another lower-level theory via bridge principles that specify the epistemic links between the reducing theory and the reduced theory.<sup>39</sup> Later developments in the concept of reduction refer to this type of reduction as eliminative reduction. This is the thesis that the success of lower-level theories in explaining some phenomenon will ultimately lead to the elimination of higher-level theories in favor of the explanation offered at the lower level. The best example of this type of reduction is eliminative materialism, which claims that psychological folk concepts used in everyday language will ultimately be replaced with a comprehensive established neuroscience.<sup>40</sup>

In the case of theological explanations, the issue is whether a lower-level science (such as evolutionary or cognitive science) can provide a sufficient explanation of religious phenomena such that the principles and explanations presented by theology can be mapped onto a lower-level description, which offers a more penetrating account of religion. Thus, theology can be eliminated in favor of an explanation offered by the evolutionary or cognitive sciences; or, even if theology is not fully reduced, enough of the theories from that paradigm are reduced such that it serves merely as a placeholder for the aggregate effects that are studied by the lower-level sciences and does not offer any important contributions to the true causes of religious beliefs. If religion is an "airy nothing" or a "by-product of biological adaptations gone awry," it seems to be the case that theological explanations for the formation of religious beliefs are eliminated in favor of evolutionary and cognitive explanations because the evolution of these features of human society is accidental and without purpose.

### Inter- versus intra-level reduction

Robert McCauley offers some helpful insights that illustrate how the relationship between different levels in the hierarchy of the sciences is very complex and the outright elimination of higher-level descriptions is a rare occurrence.<sup>41</sup> Looking at the history of science, an important distinction can be made between *inter*-level and *intra*-level reduction in the hierarchy of sciences.<sup>42</sup> The most common type of reduction in science is intra-level reduction, which refers to theory replacement or change that occurs over time within a particular level of a science. As Thomas Kuhn demonstrated, more often than not, changes in theories within a scientific level often involve conceptual revolutions, where the previous theory was shown to be inadequate and replaced by a new one.<sup>43</sup> This does not involve a smooth reduction between the two theories, but the abandonment of the previous theory in favor of the new one without any strong correspondence between the two theories as indicated in the standard model of reduction.

Inter-level reduction is the reduction of theories or whole sciences between levels and is closer to the idea of reduction in the standard model. However, inter-level reduction of whole sciences is extremely rare and McCauley offers several reasons for the continuation of higher levels in the hierarchy of sciences. In many cases, lower-level sciences must appeal to findings from higher-level sciences to support their own conclusions.<sup>44</sup> In the case of the cognitive neurosciences, descriptions of brain activity provided by the neurosciences, which are intended to describe some facet of psychological phenomena, often require behavioral descriptions at the psychological level to define exactly what type of phenomenon the neurosciences are trying to describe. For example, the dopamine hypothesis,<sup>45</sup> as an account of the epidemiology of schizophrenic behavior, is dependent upon a higher-level description of what schizophrenia is in the first place. Understanding schizophrenia as a mental disorder depends on psychological research and reliance on definitions supplied by the Diagnostic and Statistical Manual (DSM-IV), which categorizes this disorder according to behavioral criteria, not neural criteria.<sup>46</sup> Further, the validity of several neuroscientific studies has been called into question recently because of their *lack* of behavioral and psychological criteria for describing the processes they claim to explain.<sup>47</sup>

Many scientists are not interested in reducing other levels of science; they are looking for whatever help they can find from the confirmation or disconfirmation of their own theories by other ones.<sup>48</sup> They want to find ways to expand and understand their own findings in other contexts and explore ways to refine their own theories so that they can be a more accurate representation of whatever phenomenon they are trying to study. Scientific progress would be greatly impoverished if, whenever there was a discrepancy between two different inter-level theories, one theory was simply eliminated in favor of another one. Paul Feyerabend makes a strong case that any scientific theory, regardless of its current state of destitution, may yet yield important results at some unspecified point in the future.<sup>49</sup>

Many cases of reduction that are assumed to be inter-level are simply cases of intra-level reduction co-occurring in separate sciences at the same time through

the process of cross-scientific pollination between two different explanatory paradigms.<sup>50</sup> A relevant example is already occurring between cognitive neuroscience, philosophy and theology. Research in the cognitive neurosciences has slowly accumulated a large body of evidence that demonstrates that different functions that used to be attributed to the properties of a nonphysical mind or soul can now be explained according to physiological processes of the brain and body.<sup>51</sup> Thus, the ontology of a human being can be defined as a physical organism, rather than a physical body plus a nonmaterial soul or mind. This did *not* lead to the elimination of theories about the functions of the mind in the philosophy of mind, but rather to different types of conceptual development and refinement that occurred as a result of what was occurring in the cognitive neurosciences.

In philosophy of mind, some form of physicalism or materialism has been a live option for many years.<sup>52</sup> For example, although Richard Rorty was surely influenced by neuroscience in his critique of Cartesian dualism in *Philosophy and the Mirror of Nature*, it is still a work of conceptual analysis in the area of philosophy.<sup>53</sup> In fact, most of the science is out of date and untenable in relation to current theories in the cognitive neurosciences, but the conceptual developments and philosophical critique are still highly valuable. Thus, physicalism, which is currently the dominant view in philosophy of mind, is an instance of intra-level change in philosophy that has been greatly influenced by intra-level changes in the cognitive neurosciences. Cognitive neuroscience has probably yielded an *increase* in philosophical theories about the mind that are committed to physicalism, yet are trying to understand how human cognition works at a more abstract level.

A similar trend has occurred in theological studies in the development of anthropologies that assume some form of physicalism.<sup>54</sup> However, this has *not* included the reduction or elimination of theological theories about the soul, but rather conceptual development about the nature of the soul. Investigation in biblical studies has shown that although dualism is often assumed as the default assumption of the scriptures, there is no real consensus in the bible about the nature of the person.<sup>55</sup> A physicalist account of the person is a better interpretation of the scriptures in several passages of both the Old and New Testaments.<sup>56</sup> Thus, theologians have not come to accept physicalism simply because the cognitive neurosciences allege it to be true, but because investigation in the cognitive neurosciences and philosophy of mind raised the issue in theological studies and many theologians came to the conclusion that there are good theological reasons for accepting a physicalist view of the person. This did not involve inter-level reduction, but intra-level conceptual change based on cross-scientific relations among different levels in the sciences.

Based on the distinction between intra- and inter-level changes in the hierarchy of science, it seems highly unlikely that the by-product theory or empirical evidence from the CSR in general will lead to the elimination of theology or other higher-level descriptions of religious phenomena. Explanations of different phenomena involve multiple levels in the hierarchy of science; no one level is able to give a complete account. Thus, the existence of supernatural beings is a

metaphysical proposition that cannot be answered by any one level in the hierarchy of science. The by-product theory alone, as an empirical scientific statement, is insufficient as an explanation to warrant the elimination of theology or the existence of supernatural agents. Rather, the by-product theory is sometimes used as empirical evidence as part of the larger tradition of philosophical naturalism.

### Differentiating science from metaphysics

Two of the popular texts in the CSR are Pascal Boyer's *Religion Explained* and Scott Atran's *In Gods We Trust*.<sup>57</sup> Now in one sense, these are works in science and anthropology; they are up-to-date collections of the latest research in religion from the perspective of the CSR. However, as philosophy of science has clearly shown us, science does not consist of collections of self-interpreting facts; empirical facts are theory-laden and interpreted according to certain types of metaphysical assumptions within a collection of like-minded scientists.<sup>58</sup> Thus, the difficulty is differentiating between the empirical statements within the CSR and the metaphysical statements, whether explicitly stated or implicitly held.

Many scientists would dispute the idea that they are doing any sort of metaphysics; metaphysical claims are abstract speculations, free from any form of determinative criteria for judging the accuracy of such statements. However, in today's culture, scientists are quickly becoming the new metaphysicians who provide a rational view of reality. Scientists and scientific facts are afforded a special place in many popular debates. However, the line between a scientific fact and a metaphysical proposition is not always clearly delineated. In fact, for the "new atheism" science is ultimately synonymous with metaphysics; the only way to gain a true picture of the world and how it functions is through scientific investigation into the nature of the universe.<sup>59</sup>

The problem of demarcation, differentiating between science and metaphysics, is a long-standing problem in the philosophy of science. The logical positivists in Britain during the early 1920s tried to rid science and philosophy of any type of speculative metaphysics.<sup>60</sup> However, later developments in the philosophy of science demonstrated that metaphysics could not simply be eliminated from scientific enquiry, but played an important role in the formation of principles and theories that provided a framework for the testing of hypotheses. Kuhn showed how scientific investigation occurred within a particular research paradigm.<sup>61</sup> Imre Lakatos argued that the "hard core" of any research program involved certain metaphysical assumptions about the nature of reality that allowed scientific research to get off the ground.<sup>62</sup>

The problem for a theologian who is committed to the existence of a nonmaterial being (i.e. God) is that the by-product theory of religion is an empirical statement that is sometimes interpreted according to certain metaphysical implications about the ontological existence of supernatural beings. In fact, Richard Dawkins uses the theory to promote his own version of atheism in order to expose *The God Delusion*.

[R]eligious behavior may be a misfiring, an unfortunate by-product of an underlying psychological propensity which in other circumstances is, or once was, useful. On this view, the propensity that was naturally selected in our ancestors was not religion per se; it had some other benefit, and it only incidentally manifests itself as religious behavior.<sup>63</sup>

The by-product theory of religion becomes a metaphysical statement when normative judgments are added to the theory in some way or another. For example, when Dawkins refers to religion as “unfortunate” or when Boyer refers to religion as an “airy nothing,” these are judgments about the ontological possibility and value of religion, not empirical statements. If religious beliefs were created solely by manipulation of natural evolutionary domains, this would obviously be problematic for a theologian who considers religious experiences to be informed by divine action. However, there is nothing objectionable about the realization that human minds and our cognitive evolutionary history play an important role in the formation of religious beliefs.

The extent to which different facets of cognition are the direct result of evolutionary adaptations or by-products of cognitive abilities intended for other purposes is an open scientific question. Stephen Gould refers to these by-products as “spandrels” and includes several different forms of human behavior and cognition such as religion, writing, art, science, commerce, war, and play.<sup>64</sup> However, when the by-product theory incorporates value statements or implies the impossibility of the actual existence of supernatural agents, it is being used as a metaphysical statement, not necessarily a scientific one. Metaphysical claims about the existence or non-existence of supernatural beings involve argumentation from multiple levels in the hierarchy of science. Thus, the by-product theory, as an empirical scientific statement, is insufficient on its own to eliminate the possibility of supernatural beings. It requires additional arguments that are typically related to a larger philosophical tradition. In this case, those arguments are part of the tradition of philological naturalism and atheism.

Philosophical naturalism can be understood as a particular tradition of rational inquiry that is often contrasted with theism.<sup>65</sup> MacIntyre defines a tradition as an extended argument through history with shared texts and evidence contained in a particular narrative.<sup>66</sup> Several contributors can be identified as part of this tradition including Baron d’Holbach, David Hume, Friedrich Nietzsche, and Sigmund Freud, with more recent contributions from the “new atheists.”<sup>67</sup> Thus, the philosophical problem with the by-product theory is the assumption that an empirical statement can simply eliminate contrary theological explanations without needing to rely on a larger body of argumentation. Philosophical naturalism is a viable metaphysical position, but scientific evidence from the cognitive and evolutionary sciences is insufficient to simply eliminate equivalent theological explanations of religious beliefs.

A helpful distinction is the difference between metaphysical (or philosophical) naturalism and methodological naturalism.<sup>68</sup> Methodological naturalism is the practice by which scientists study different types of phenomena by focusing on natural explanations based on physical causation. Methodological naturalism does not necessitate the further metaphysical claim that the only ontological substance

that exists in the universe is physical matter. Instead, it is an approach by which the focus of study is on the physical determinants of any particular event while leaving aside any metaphysical implications that may or may not be a consequence of that event.

Thus, scientific claims can be separated from metaphysical claims, each being part of a different domain with different forms of argumentation. In the CSR, there is an acceptance that the objects of study are different forms of natural explanations for religious phenomena. However, this does not necessitate that religious phenomena are exclusively the product of natural causes; just that for this particular type of study, the focus is on evolutionary and cognitive explanations rather than theological or religious ones. In the CSR, and especially among the new atheists, the distinction between scientific and metaphysical statements has at times become problematic. Thus, more clearly differentiating between metaphysical and methodological naturalism will be a great asset to the CSR and help delineate between scientific and metaphysical statements.

### Integrating a theological worldview

Not all participants in the CSR assume that their findings inherently undermine traditional religious belief. Theodore Brelsford argues that even if religious beliefs arise from unconscious cognitive adaptations, it may not be the case that these adaptations determine all aspects of religious belief.<sup>69</sup> Certain intuitions afforded by cognitive adaptations may be modifiable according to more explicit or conscious cognitive processes. Justin Barrett argues that certain aspects of cognitive adaptations may make certain theologies better equipped for transmission and comprehension than others.<sup>70</sup> Children very easily acquire concepts of God very similar to those from monotheistic traditions (Judaism, Christianity, and Muslim) based on mental tools such as theory of mind. It seems that the CSR merits a theological engagement that is both critical of certain propositions, but open to learning from its empirical findings like any other science.<sup>71</sup>

A theological outlook can offer a competing perspective for philosophical naturalism as a basis for metaphysical claims about the reality of supernatural entities based on evidence from the CSR. Arthur Peacocke argues that theology should be considered another level in the hierarchy of science using reasonableness as a criterion for judging the different types of truth claims in theology.

For theology, like science, also attempts to make inferences to the best explanation—or rather, it should be attempting to do so. In order to do this it should use the criteria of reasonableness already mentioned, for these are criteria, which at least have the potentiality of leading to an inter-subjective consensus.<sup>72</sup>

For Peacocke, theology should be considered the science at the top of the hierarchy of sciences because it integrates all of the other levels of explanation into a transcendent reality that is able to go beyond the history of the universe itself. It also attempts to describe the relationship between God and the universe, which

would arguably be the most complex type of interaction and a basis for the ultimate meaning and significance of the corresponding levels.<sup>73</sup>

Metaphysical assumptions contained within a particular theological worldview describe an overall picture of the purpose and goal of the universe. Ian Barbour argues that no one level in the hierarchy of science can give a complete description of any phenomenon; thus, any full explanation must appeal to multiple levels.<sup>74</sup> Robert McCauley and William Bechtel define this as explanatory pluralism.

Connections between sciences at different levels of analysis offer scientists working at each level resources (theoretical, practical, evidential) that would be unavailable otherwise.<sup>75</sup>

If these connections between sciences are important for scientific explanation, it would seem to follow that larger theological claims would also involve several different levels in the sciences. Metaphysical assumptions contained within broader conceptions of ultimate reality play a crucial role in more comprehensive explanations of phenomena. These types of explanations are not merely scientific, but also advocate for certain metaphysical pictures of the world.

Nancey Murphy and George Ellis argue that some type of metaphysical framework is necessary to answer questions that the individual levels cannot answer.

[S]ome metaphysical or theological account of the nature of ultimate reality is needed to top-off the hierarchy of the sciences. . . . [T]he sciences at the top of the hierarchy call for a concept of ultimate reality in order to answer questions that cannot be answered from within those sciences themselves.<sup>76</sup>

These questions are usually referred to as “boundary questions,” which are situations in which one level of explanation must rely on entities or theories from another level to explain particular phenomena.<sup>77</sup> Although another level of science can provide answers to some of these questions, it is often the case that appeals must be made to some sort of metaphysical understanding of ultimate reality to properly answer the question at hand.

The CSR can answer certain types of questions about the natural foundations of religious beliefs and concepts, but it cannot answer metaphysical or ultimate questions about the truth claims contained within those religious beliefs. Those questions can only be answered by appealing to other levels, specifically the metaphysical framework (i.e. theism, atheism, etc.) used to define ultimate meaning and purpose. Theologians, scholars of religion, and cognitive scientists can study the cognitive and evolutionary foundations of religion as a particular science while leaving the metaphysical debate for a different context. Scientific statements are often a component of larger metaphysical arguments, but the two are not inherently synonymous because of the larger role that the top-level metaphysical framework plays in defending metaphysical claims. Identical scientific claims may be a part of competing metaphysical arguments: agreement may be found on the accuracy of scientific statements while disagreement abounds in regard to their metaphysical implications.

## Conclusion

Two problems were identified in the by-product theory of religion in the cognitive science of religion. The first was related to the issue of causal reductionism, in that the theory argues that religious beliefs can be reduced to a by-product of evolutionary cognitive adaptations. The concept of emergence is able to explain certain causal processes at work in the formation and function of religious beliefs that are not reducible to cognitive adaptations. The second problem was related to the philosophical problem of differentiating between scientific and metaphysical statements. The by-product theory is often assumed to lead to some form of philosophical naturalism. However, the empirical evidence from the by-product theory (and the CSR in general) is insufficient to simply eliminate a theological explanation for religious belief. A theological perspective can offer a competing metaphysical framework for interpreting research from the CSR.

## Acknowledgements

The author would like to thank the Cognition, Religion and Theology Project at the University of Oxford, funded by the John Templeton Foundation, for its generous support of this research project. The views expressed are not necessarily those of the Cognition, Religion and Theology Project, the University of Oxford, or the John Templeton Foundation.

## Endnotes

- 1 Francisco J. Ayala, "Introduction," in *Studies in the Philosophy of Biology: Reduction and Related Problems*, ed. Francisco J. Ayala and Theodosius Dobzhansky (Berkeley and Los Angeles: University of California Press, 1974).
- 2 Nancey Murphy, "Reductionism: How Did We Fall into It and Can We Emerge from It?," in *Evolution and Emergence: Systems, Organisms, Persons*, ed. Nancey Murphy and William R. Stoeger, S.J. (Oxford: Oxford University Press, 2007), 21.
- 3 Nancey Murphy and Warren S. Brown, *Did My Neurons Make Me Do It? Philosophical and Neurobiological Perspectives on Moral Responsibility and Free Will* (Oxford: Oxford University Press, 2007), 44.
- 4 *Ibid.*
- 5 Pascal Boyer, *Religion Explained: The Evolutionary Origins of Religious Thought* (New York: Basic Books, 2001), 330.
- 6 Paul Bloom, "Is God an Accident?," *Atlantic Monthly* (December 2005): 2.
- 7 Boyer, *Religion Explained*, 2.
- 8 David Buss, ed., *The Handbook of Evolutionary Psychology* (Hoboken, NJ: John Wiley & Sons, Inc., 2005); John Tooby and Leda Cosmides, "Mapping the Evolved Functional Organization of the Mind and Brain," in *The Cognitive Neurosciences*, ed. Michael Gazzaniga (Cambridge, MA: MIT Press, 1995).
- 9 Leda Cosmides and John Tooby, "Evolutionary Psychology: A Primer," available from <http://www.psych.ucsb.edu/research/cep/primer.html>, accessed August 2004.
- 10 Pascal Boyer, "Religious Thought and Behavior as by-Products of Brain Function," *Trends in Cognitive Sciences* 7:3 (2003): 119–124.
- 11 Tooby and Cosmides, *Mapping the Evolved Functional Organization*, 1189.



- 12 Dan Sperber, *Explaining Culture: A Naturalistic Approach* (Oxford: Blackwell, 1996), 2.
- 13 Robert Van Gulick, "Reduction, Emergence and Other Recent Options on the Mind/Body Problem," *Journal of Consciousness Studies* 8:9–10 (2001): 1–34, here page 16.
- 14 Philip Clayton, *Mind and Emergence: From Quantum to Consciousness* (Oxford: Oxford University Press, 2004), 2.
- 15 Harold J. Morowitz, *The Emergence of Everything: How the World Became Complex* (Oxford: Oxford University Press, 2002).
- 16 Steven Johnson, *Emergence: The Connected Lives of Ants, Brains, Cities, and Software* (New York: Scribner, 2001).
- 17 Mark A. Bedau, "Downward Causation and Autonomy in Weak Emergence," in *Emergence: Contemporary Readings in Philosophy and Science*, ed. Mark A. Bedau and Paul Humphreys (Cambridge, MA: MIT Press, 2008); Gregory R. Peterson, "Species of Emergence," *Zygon* 41:3 (2006): 689–712.
- 18 Mark A. Bedau and Paul Humphreys, ed., *Emergence: Contemporary Readings in Philosophy and Science* (Cambridge, MA: MIT Press, 2008); Philip Clayton and Paul Davies, ed., *The Re-Emergence of Emergence: The Emergentist Hypothesis from Science to Religion* (Oxford: Oxford University Press, 2006); Nancey Murphy and William R. Stoeger S.J., ed., *Evolution and Emergence: Systems, Organisms, Persons* (Oxford: Oxford University Press, 2007).
- 19 Murphy, "Reductionism," 27.
- 20 William Bechtel, *Mental Mechanisms: Philosophical Perspectives on Cognitive Neuroscience* (New York: Routledge, 2008), 129.
- 21 William Bechtel and Adele Abrahamsen, "Explanation: A Mechanist Alternative," *Studies in History and Philosophy of Biological and Biomedical Sciences* 36 (2005): 421–441.
- 22 Bechtel, *Mental Mechanisms*, 17.
- 23 Murphy and Brown, *Did My Neurons?*, 106.
- 24 Steven R. Quartz and Terrence J. Sejnowski, "The Neural Basis of Cognitive Development: A Constructivist Manifesto," *Behavioral and Brain Sciences* 20 (1997): 537–596.
- 25 Steven R. Quartz and Terrence J. Sejnowski, *Liars, Lovers, and Heroes: What the New Brain Science Reveals About How We Become Who We Are* (New York: William Morrow & Co., 2002).
- 26 Gerald M. Edelman and Giulio Tononi, *A Universe of Consciousness: How Matter Becomes Imagination* (New York: Basic Books, 2000).
- 27 Steven R. Quartz, "Toward a Developmental Evolutionary Psychology: Genes, Development, and the Evolution of the Human Cognitive Architecture," in *Evolutionary Psychology: Alternative Approaches*, ed. Steven J. Scher and Frederick Rauscher (New York: Springer Publishing Co., 2002), 205.
- 28 *Ibid.*
- 29 Aristotle, *Metaphysics*, trans. John H. McMahon (Buffalo, NY: Prometheus Books, 1991).
- 30 Alicia Juarrero, *Dynamics in Action: Intentional Behavior as a Complex System* (Cambridge, MA: MIT Press, 1999), 21.
- 31 Roy Wood Sellars, *Philosophy of Physical Realism* (New York: Macmillan, 1932).
- 32 Juarrero, *Dynamics in Action*, 75.
- 33 *Ibid.*, 128.
- 34 Robert Van Gulick, "Who's in Charge Here? And Who's Doing All the Work?," in *Mental Causation*, ed. John Heil and Alfred Mele (Oxford: Clarendon, 1995), 252.
- 35 Juarrero, *Dynamics in Action*, 156.
- 36 Edward Smith and Stephen Kosslyn, *Cognitive Psychology: Mind and Brain* (Upper Saddle River, NJ: Pearson Prentice Hall, 2007), 55.
- 37 *Ibid.*, 51.
- 38 O. Selfridge, "Pattern Recognition and Modern Computers," in *Proceedings of the Western Joint Computer Conference* (Los Angeles, CA: Institute of Electrical and Electronics Engineers, 1955); R.M. Warren and R.P. Warren, "Auditory Illusions and Confusions," *Scientific American* 223:6 (1970): 30–36.

- 39 Robert N. McCauley, "Reduction: Models of Cross-Scientific Relations and Their Implications for the Psychology-Neuroscience Interface," in *Handbook of the Philosophy of Science: Philosophy of Psychology and Cognitive Science*, ed. Paul Thagard (Amsterdam: Elsevier, 2007), 105–158; Ernst Nagel, *The Structure of Science* (New York/Indianapolis: Harcourt, Brace and World/Hackett, 1961/1979).
- 40 Paul M. Churchland, *A Neurocomputational Perspective: The Nature of Mind and the Structure of Science* (Cambridge, MA: MIT Press, 1993), 1.
- 41 McCauley, "Reduction," 105.
- 42 William Wimsatt, "Reductionism, Levels of Organization, and the Mind–Body Problem," in *Consciousness and the Brain*, ed. A. Globus, G. Maxwell and I. Savodnik (New York: Plenum Press, 1976), 199–267.
- 43 Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: Chicago University Press, 1962).
- 44 McCauley, "Reduction," 32.
- 45 Neil R. Carlson, *Physiology of Behavior*, 6th ed. (Boston: Allyn and Bacon, 1998).
- 46 American Psychiatric Association, *Diagnostic and Statistical Manual of Mental Disorders DSM-IV-TR*, 4th ed. (Washington: American Psychiatric Association, 2000).
- 47 Greg Miller, "Growing Pains for Fmri," *Science* 320 (2008): 1412–1414.
- 48 McCauley, "Reduction," 54.
- 49 Paul Feyerabend, *Against Method* (London: Verso, 1988).
- 50 McCauley, "Reduction", 2007.
- 51 Patricia Churchland, *Brain-Wise: Studies in Neurophilosophy* (Cambridge, MA: MIT Press, 2002); Owen Flanagan, *The Science of the Mind*, 2nd ed. (Cambridge, MA: MIT Press, 1991).
- 52 Brian P. McLaughlin, "Philosophy of Mind," in *The Cambridge Dictionary of Philosophy*, ed. Robert Audi (Cambridge: Cambridge University Press, 1999), 684–694.
- 53 Richard Rorty, *Philosophy and the Mirror of Nature* (Princeton, NJ: Princeton University Press, 1979).
- 54 Warren S. Brown, Nancey Murphy and H. Newton Maloney, ed., *Whatever Happened to the Soul?: Scientific and Theological Portraits of Human Nature* (Minneapolis: Fortress Press, 1998); Joel Green, ed., *What About the Soul?: Neuroscience and Christian Anthropology* (Nashville: Abingdon Press, 2004); Malcolm Jeeves, ed., *From Cells to Souls—and Beyond: Changing Portraits of Human Nature* (Grand Rapids: Wm. B. Eerdmans, 2004 ); Nancey Murphy, *Bodies and Souls or Spirited Bodies?* (Cambridge: Cambridge University Press, 2006).
- 55 Nancey Murphy, "Human Nature: Historical, Scientific, and Religious Issues," in *Whatever Happened to the Soul? Scientific and Theological Portraits of Human Nature*, ed. Warren S. Brown, Nancey Murphy, and H. Newton Maloney (Minneapolis: Fortress Press, 1998), 1–30.
- 56 Joel Green, "Bodies—That Is, Human Lives: A Re-Examination of Human Nature in the Bible," in *Whatever Happened to the Soul? Scientific and Theological Portraits of Human Nature*, ed. Warren S. Brown, Nancey Murphy and H. Newton Maloney (Minneapolis: Fortress Press, 1998), 149–174; Joel Green, *Body, Soul, and Human Life: The Nature of Humanity in the Bible*, Studies in Theological Interpretation (Grand Rapids: Baker Academic, 2008).
- 57 Scott Atran, *In Gods We Trust: The Evolutionary Landscape of Religion* (New York: Oxford University Press, 2002); Boyer, *Religion Explained*, 2.
- 58 Feyerabend, *Against Method*; Kuhn, *Scientific Revolutions*.
- 59 Richard Dawkins, *The God Delusion* (Boston: Houghton Mifflin Harcourt, 2006); Daniel Dennett, *Breaking the Spell: Religion as a Natural Phenomenon* (New York: Viking, 2006).
- 60 Richard A. Fumerton, "Logical Positivism," in *The Cambridge Dictionary of Philosophy*, ed. Robert Audi (Cambridge: Cambridge University Press, 1999), 514–516.
- 61 Kuhn, *Scientific Revolutions*, 5.
- 62 Imre Lakatos, *The Methodology of Scientific Research Programmes*, ed. John Worral and Gregory Currie (Cambridge: Cambridge University Press, 1999).

- 63 Dawkins, *God Delusion*, 174.
- 64 Stephen. J. Gould, "Exaptation: A Crucial Tool for Evolutionary Psychology," *Journal of Social Issues* 47 (1991): 43–46.
- 65 Nancey Murphy, "Naturalism and Theism as Competing Traditions," in *29th International Wittgenstein Symposium* (Kirchber am Wechsel, Austria: Austrian Ludwig Wittgenstein Society, 2006).
- 66 Alasdair MacIntyre, *After Virtue: A Study in Moral Theory* (Notre Dame: University of Notre Dame Press, 1981); Alasdair MacIntyre, *Whose Justice? Which Rationality?* (Notre Dame, IN: University of Notre Dame Press, 1988).
- 67 Ronald Aronson, "The New Atheists," *The Nation*, June 25, 2007; Paul Henry Thiry Baron d'Holbach, *System of Nature, or, the Laws of the Moral and Physical World*, 2 vols. (London: 1797); Sigmund Freud, *The Future of an Illusion* (New York: Norton, 1961); Friedrich Nietzsche, *Genealogy of Morals*, trans. Walter Kaufmann (New York: Random House, 1966).
- 68 Michael Ruse, "Methodological Naturalism under Attack," in *Intelligent Design Creationism and Its Critics: Philosophical, Theological, and Scientific Perspectives*, ed. Robert T. Pennock (Cambridge, MA: MIT Press, 2001), 363–386.
- 69 Theodore Brelsford, "Lessons for Religious Education from Cognitive Science of Religion," *Religious Education* 100:2 (2005): 174–191.
- 70 Justin L. Barrett, *Why Would Anyone Believe in God?* (Walnut Creek: AltaMira Press, 2004).
- 71 Lluís Oviedo, "Is a Complete Biocognitive Account of Religion Feasible?," *Zygon* 43:1 (2008): 103–126.
- 72 Arthur Peacocke, *Theology for a Scientific Age: Being and Becoming—Natural and Divine* (Oxford: Basil Blackwell, 1990; reprint, Minneapolis: Fortress Press, 1993), 17.
- 73 *Ibid.*, 23.
- 74 Ian Barbour, *Religion and Science: Historical and Contemporary Issues* (San Francisco: Harper, 1997).
- 75 Robert N. McCauley and William Bechtel, "Explanatory Pluralism and the Heuristic Identity Theory," *Theory and Psychology* 11 (2001): 738–761, here 742.
- 76 Nancey Murphy and George F. R. Ellis, *On the Moral Nature of the Universe: Theology, Cosmology, and Ethics* (Minneapolis: Fortress Press, 1996), 21.
- 77 Bernd-Olaf Küppers, "Understanding Complexity," in *Chaos and Complexity: Scientific Perspectives on Divine Action*, ed. Robert John Russell, Nancey Murphy and Arthur Peacocke (Berkeley and Vatican City State: The Center for Theology and the Natural Sciences and Vatican Observatory Publications, 1995), 93–106.

## Biographical Notes

**James A. Van Slyke** is Assistant Research Professor at the Travis Research Institute, Fuller Theological Seminary, Pasadena, California.